An Analysis of The Joint Commission's Fire Protection Standards and Practices at Hospital XYZ

by

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Abstract

Do The Joint Commission regulations regarding testing of fire protection equipment create safer medical facilities, or do they create unnecessary maintenance costs that aren't warranted due to recent technological advancements in fire protection equipment? This study examines if the efforts expended to meet The Joint Commission regulations on fire pumps are necessary and if following these regulations are at odds with the manufacturer's recommendations. This study uses printed material from a fire pump manufacturer, applicable regulations, and current industry standards to answer this question.

This study determines that inadequate information exists to conclusively say if The Joint Commission regulations increase maintenance costs unnecessarily; however this study does reveal ways to potentially lower maintenance costs for fire protection equipment. One method to lower maintenance costs includes the utilization of an appropriate management system within the

medical facility. This system can be used to ensure the employees of the facility are qualified to conduct the fire pump testing, the lack of which has been identified as a weakness in the fire protection standards. This study also identifies a mechanical modification that can make maintenance costs for fire pumps lower. This mechanical modification is the installation of a pressure relief valve, which would allow excessive pressure to be released, instead of being allowed to build up. With the current lack of available information on this issue in general, further research is necessary to determine if The Joint Commission regulations increase maintenance costs unnecessarily for fire protection equipment.

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Chapter I: Introduction

Medical facility care is at a premium these days as a large portion of the population, specifically baby boomers, grow older and require more medical attention. Most medical facilities in the United States of America receive Medicare and Medicaid financial support for services they provide to patients. Medicare and Medicaid programs and payments are controlled by a division of the federal government named the Centers for Medicare & Medicaid Services (CMS). With thousands of medical facilities across the country, many of which receive payments from CMS, it is important that these facilities uphold strict standards in regards to life safety (Centers for Medicare & Medicaid Services, 2010, n.p.). In 1965, Congress passed an amendment stating that hospitals accredited by The Joint Commission are deemed to be in compliance of the health care standards and eligible to receive payments from CMS (The Joint Commission, 2009, n.p.).

The Joint Commission, formerly the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), is the organization that CMS uses to ensure medical facilities are meeting all of the accreditation requirements. The Joint Commission is a privately owned non-profit organization (The Joint Commission, 2009, n.p.). In many respects The Joint Commission act as life safety experts similar to the Department of Labor's Occupational Safety and Health Administration (OSHA). Both are concerned for human life and practices; OSHA looks at employee work practices and employee safety, where The Joint Commission focuses on the welfare of patients. In January 2009, The Joint Commission released 165 new regulations to which medical facilities must conform (The Joint Commission, 2009, n.p.). In March 2009, those 165 regulations were reduced to just 87 (The Joint Commission, 2009, n.p.).

For example, one of the regulations stats, "At least quarterly, the [organization] tests supervisory signal devices (except valve tamper switches)" (Joint Commission Resources, 2009, p. 41). For a small hospital this might not be a problem but for large complexes this could be a daunting task. It might take a day or more to manually check all of the signal devices; this time might be better suited elsewhere, if it could be shown that the devices did not fail.

This study examines the maintenance concerns from The Joint Commission standards, which were derived from the National Fire Protection Association (NFPA). Currently, one of The Joint Commission requirements is, "For automatic sprinkler system: Every week, the [organization] tests fire pumps under no-flow conditions. The completion date of the tests is documented" (Joint Commission Resources, 2009, p. 42). Another regulation is, "For automatic sprinkler system: Every 12 months, the [organization] tests fire pumps under flow. The completion date of the tests is documented" (Joint Commission Resources, 2009, p. 42). The Joint Commission wrote these standards from NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 1998 edition.

Significance

The fire pump is one of the main functioning parts of a fire suppression system. With more technological breakthroughs in the production of parts and their reliability rates, it might not be necessary to spend the time and fiscal effort to continually check the fire pumps' operation. Employee time is at a premium and every hospital across the United States of America that has an automatic sprinkler system is required to comply with these standards, if they wish to continue to receive financial benefits from CMS. Extrapolated, this amounts to a significant portion of time and fiscal effort put forth by hospitals across America every year.

Statement of the Problem

The Joint Commission regulations may provide safer medical facilities, but may also increase maintenance costs that are unnecessary with recent technological advancements in fire protection equipment.

Purpose of the Study

The purpose of this study is to investigate if The Joint Commission's standards on fire safety pumps are out of date, given recent technological advancements. This study will examine if the effort taken to meet The Joint Commission regulations are necessary and if following these regulations are at odds with the fire pump manufacturers' recommendations.

Assumptions of the Study

The assumption for this study is accuracy in the operational manuals, and printing of the current standards.

Limitations of the Study

One limitation of this study includes The Joint Commission regulations. The Joint Commission has regulations regarding the way medical staff deals with patient care, but this study focuses primarily on the facility itself and the applicable regulations. Another limitation includes the regulations and standards from NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems and NFPA 101 Life Safety Code. NFPA has standards and regulations which govern every aspect of fire safety and this study will only be examining NFPA 25 standards on fire pumps and NPFA 101 regulations. Another limitation includes the possibility for the printed materials to have misprinted information. Clear, concise, and honest representation of the components from the manufacturer is assumed.

Methodology

This study will examine the 1998 edition of NFPA 25 standards, which The Joint Commission currently uses, and compare them to the most current NFPA standards. Once this is complete, manufacturer's operation manuals will be examined to determine the manufacturer's best practices. The study will then compare the manufacturer's operational recommendations with the standards that the pumps are being scrutinized against. Lastly, this study will review the management practices and procedures used to ensure the medical facility will be compliant with regulations and best practices, outlining the best plan of action for management regarding the topic of fire pump usage, testing, and reliability.

Chapter II: Literature Review

This literature review will present background information on the history and advantages of The Joint Commission, regulations The Joint Commission uses, fire pump reliability and rating information, and management systems for compliance to risk control principles. It is important to understand the relationship organizations have with one another; background information is needed for an appreciation of where these standards and regulations stem from.

History of The Joint Commission

This section will cover some of the major moments in history for The Joint Commission. The Joint Commission has had a significant impact on the Medicare and Medicaid systems. While constantly improving itself, with new standards and regulations, The Joint Commission has helped to shape the health and safety of medical facilities today.

In 1910 The Joint Commission's goal was to have health care facilities across the United States of America adopt consistent safety standards and regulations (The Joint Commission, 2009, n.p.). The Joint Commission was involved in helping hospitals and health care personnel provide safer care for their patients. Congress approved the Social Security Amendment in 1965, with a provision that hospitals need to be accredited to receive Medicare and Medicaid payments (The Joint Commission, 2009, n.p.). The Joint Commission was the organization put in charge of the accreditation process for medical facilities, which they need to meet The Joint Commission and CMS standards, to receive Medicare and Medicaid payments (The Joint Commission, 2009, n.p.).

Advantages of The Joint Commission

Over the years, The Joint Commission has played a role in shaping the health and safety in medical facilities. Aside from shaping health care facilities, this section will discuss the

benefits of The Joint Commission which include patient safety, increased peer respect, and financial value.

Improvement of patient safety has been one of the main benefits of The Joint Commission; this is done through the accreditation process when a medical facility first opens and continues with unannounced follow-up inspections (Chassin, 2008 p. S7). While these inspections used to be announced in advance, the decision was made to switch to unannounced inspections many years ago; this decision was implemented due to the importance of patient safety with the theory that health care facilities need to make safety a daily practice.

Chassin (2008) mentioned another advantage to receiving The Joint Commission's accreditation, is the increased reputation a medical facility receives from the health care community (p. S6). When health care facilities examine and measure themselves against other facilities, The Joint Commission inspection can be a valuable tool to critically scrutinize the industry and provide a nonbiased perspective of where improvements could be made.

Finally, there is a financial benefit as well. There are four major insurance groups that have reduced premiums for healthcare facilities upon passing inspection (Chassin, 2008, p. S8). These four companies are Darwin National Assurance Company, General Star Indemnity Company, American International Group (AIG), and MAG Mutual Insurance Company. The Joint Commission is gaining widespread attention for the inspections and assistance provided to health care facilities, making them safer for patients (Chassin, 2008, p. 8).

Regulations The Joint Commission Uses

This section will cover the standards The Joint Commission uses and where these standards originate from. To understand these standards and regulations, it is important to know who wrote them, why they were written, and how they apply to the situation at hand.

The Joint Commission is charged with ensuring all hospitals and medical facilities abide by the same safety regulations. To regulate fire protection standards, The Joint Commission needs a set of regulations to evaluate against medical facilities. These regulations, which are a form of law, come from the federal government stating, "Center for Medicare and Medicaid Service (CMS) has adopted the 2000 edition of NFPA 101, Life Safety Code, as its updated fire and life safety requirement for facilities receiving Medicare and Medicaid reimbursements" (CMS adopts NFPA life safety code, 2003, p. 48). The Joint Commission standards come from the 2000 edition of NFPA 101, Life Safety Code.

Within the Life Safety Code, there are sections that regulate fire pumps including testing, inspection, and procedures. These sections stem from NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 1998 edition (National Fire Protection Association, 2000, p. 101-79). National Fire Protection Association (1998) states:

> The first edition of NFPA 25 was a collection of inspection, testing, and maintenance provisions that helped ensure the successful operation of water-based fire protection systems. NFPA 25 was developed as an extension of existing documents such as NFPA 13A, *Recommended Practice for the Inspection, Testing, and Maintenance of Sprinkler Systems*, and NFPA 14A, *Recommended Practice for the Inspection, Testing, and Maintenance of Standpipe and Hose Systems*, which have successfully assisted authorities having jurisdiction and building owners with routine inspections of sprinkler systems and standpipes. These documents have since been withdrawn from the NFPA standards system. NFPA 25 became the main document governing sprinkler systems as well as

related systems, including underground piping, fire pumps, storage tanks, water spray systems, and foam-water sprinkler systems. (p. 25-1)

Fire Pump Reliability and Rating Information

An examination of fire pumps' reliability and ratings will help to determine how fire pumps are best utilized. This information is also used for the design and application in medical facilities.

Many times it is necessary to identify how long a system or part will last in an operation. This is important to understand because, "Proper operation of fire protection systems has far-reaching ramifications. Failure of these systems to operate can lead to significant losses that would not otherwise occur" (Beattie, 2008, p.61). Usually testing is conducted to evaluate the useful life of these parts and although this takes a large capital investment of time and money, industries which utilize this equipment continue to experience monetary losses and injuries (O'Brien, 2007, p. 83). There is a way to reduce the likelihood of monetary losses and injuries; which is to follow the accepted engineering practices to help calculate the failure modes. This is done with three different methods including: analysis of field return data, cyclical life testing (fatigue analysis), and failure modes effects and diagnostic analysis (FMEDA) (O'Brien, 2007, p. 83).

When a fire pump is first manufactured it goes through an extensive process to become certified to be used (Wahl & O'Neill, 1997, p. 54). The testing agencies that can certify the different components of a fire pump to be used in a fire suppression system include, but are not limited to: Underwriters Laboratory (UL) and Factory Mutual (FM). This certification also helps with determining the rated capacity of the fire pump. The first step is to determine the flow requirements from the fire hose system, standpipe system, and the automatic sprinkler heads

(Wahl & O'Neill, 1997, p. 55). Rating of fire pumps, as mentioned by Wahl and O'Neill (1997) also come from the fire pump's operation; the fire pump operates "On a curve, providing 100 percent rated capacity at the 100 percent rated pressure; 150 percent rated capacity at the 65 percent rated pressure; and up to 140 percent rated pressure at no-flow (churn) conditions" (p. 56).

Management Systems for Compliance in the Risk Control Field

This chapter will conclude with an overview of management systems for risk control on an organizational level. These management practices are good for the implementation of new policies and procedures to insure a company follows the required regulations. This section will also cover where the fire pump topic fits into the management system.

There are many forms of management systems for regulatory compliance. One of these systems is the Occupational Health and Safety Assessment Series (OHSAS) 18001: designing and implementing an effective health and safety management system (Kausek, 2007, n.p.). The scope of this system, written by British Standards Institution (2007), states "This Occupational Health and Safety Assessment Series (OHSAS) Standard specifies requirements for an occupational health and safety (OH&S) management system, to enable an organization to control its OH&S risks and improve its OH&S performance" (p. 1).

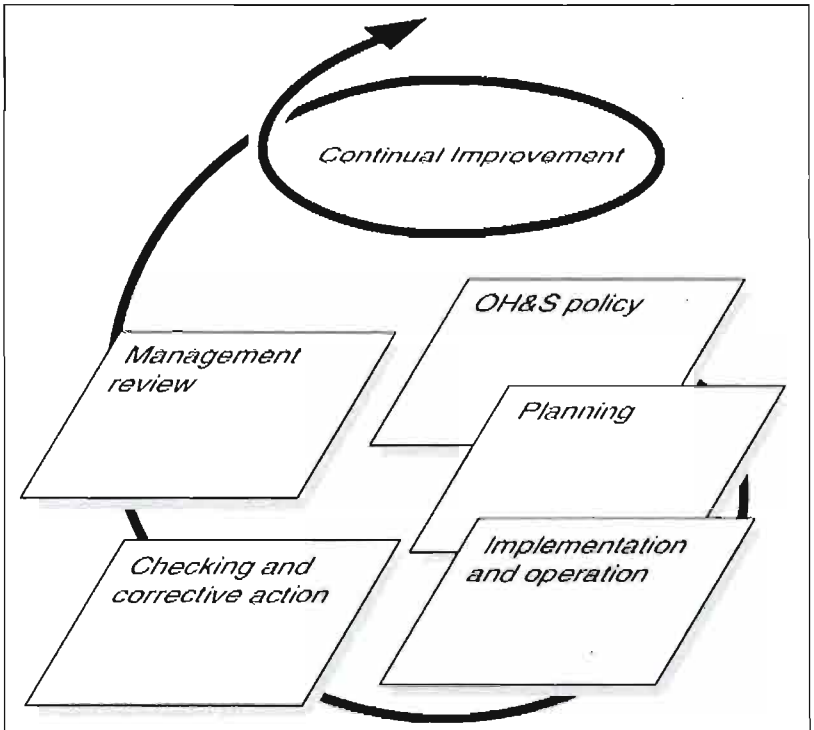

Figure 1. OH&S management system model for OHSAS 18001 which is based on methodology called Plan-Do-Check-Act (PDCA) (British Standards Institution, 2007, p. vi).

According to OHSAS 18001 & 18002 (2008) the execution and integration of OHSAS 18001 system into a management system includes the following steps:

1) Leadership commitment. This is the key to occupational health and safety management system (OHSMS) success.
2) Establishing roles and responsibilities for OHSMS throughout the organization.
3) Planning, which includes risk assessment.
4) Developing procedures to communicate OHS information to employees and to other stakeholders and interested parties.
5) Develop documentation and data control systems.

6) Establish a system of operational control and plans/procedures for emergencies.
7) Leadership's formal review of OHSMS to ensure that the goals and objectives set out in the planning and implementation phases are met. (p. 22)

Within the OHSAS 18001:2007 document, these steps are used for guidance in the development and integration of OHSMS into a company's management structure. This is important for the fact that the OHSMS program is designed to push companies into becoming proactive instead of purely reactive (OHSAS 18001 & 18002, 2008, p. 23). If properly implemented, when a risk is identified, the necessary steps can be executed because top management, having already made a commitment to safety, realizes the potential benefits of a new policy or procedure which ensures employee health and safety.

This topic fits into Section 4, OH&S management system requirements, under a subheading called Evaluation of Compliance. In this area, OHSAS 18001 talks about how to insure that an organization is actively complying with the applicable regulations.

Summary

The Joint Commission has grown since its inception in 1910. From 1910 to 2010, CMS has been created and joined forces with The Joint Commission. Together, they provide healthcare facilities with resources and assistance to improve patient safety. The Joint Commission, which reports to CMS, uses the 2000 edition of NFPA 101, Life Safety Code. Now, more than a decade old, these standards on fire pumps warrant a further understanding and closer inspection. While looking into these standards, a variety of methodologies will be used to determine if the regulations are out-dated. The OHSAS 18001 management procedures, if

implemented correctly, can assist in the implementation of new policies and procedures, while staying current with The Joint Commission regulations and standards.

Chapter III: Methodology

This section will detail the methodology used to answer questions regarding whether The Joint Commission regulations provide safer medical facilities, or if they increase maintenance costs unnecessarily due to recent advancements in fire protection equipment technology? This study will compare the different manufacturer's recommendations to the regulations medical facilities are required to follow in order to remain compliant. Subject areas to be addressed are: instrumentation, data collection procedures, data comparison, data recommendations, and limitations.

Instrumentation

The Joint Commission standards on fire protection will be laid out in a table along with the manufacturer's recommendations and current NFPA recommendations. This table is located in Appendix A. The table which will include The Joint Commission standards, manufacturer's recommendations, and current NFPA recommendations will be distinguishing the differences amongst the following categorical information:

- Regulation, Standard, or Specification – This piece will explain if the material is a regulation, standard, or specification and what this means for compliance
- Types of testing – This section will cover what types of test need to be conducted on fire pumps
- Frequency of testing – This piece will explain how often testing needs to occur in medical facilities
- Length of testing – In this area, the length of the different testing methods will be inspected

- Requirements for personnel – This section will explain the requirements for the personnel that are conducting the testing
- Preventative maintenance required – This area will cover if there are any required maintenance activities
- Mechanical modifications – This segment will include any mechanical modifications that are allowed by the standards or regulation
- Useful life – This part will assess what most medical facilities can expect to see in terms of longevity

Data Collection Procedures

The data will be collected from all of the organizations' and manufacturer's published specifications. The printed materials will be from the 2000 and 2009 editions of NFPA 101: Life Safety Code, the 1998 and 2008 editions of NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, the 2009 edition of The Joint Commission regulations, and the Aurora 481 model fire pump manufacturer's specifications.

The 2000 edition of NFPA 101 will be used to see what CMS uses when enforcing their regulations with the help of The Joint Commission. The 2009 edition of NFPA 101 will be used to see what changes have been made over nine years of fire protection advancements when compared to the 2000 edition (National Fire Protection Association, 2000, 2009). As a reference for NFPA 101, the 1998 and 2008 editions of NFPA 25, chapters 5 and 8 will be used to answer the questions in the categories outlined above; these are the respective chapters for fire pump standards (National Fire Protection Association, 1998, 2008). The 2009 edition of The Joint Commission regulations will be used as this is the most recent edition specifying the requirements medical facilities must be compliant with (Joint Commission Resources, 2009,

Chapter 4). The Aurora 481 model fire pump specifications were chosen to determine what an average medical facilities' fire pump would consist of, when adhering to The Joint Commission regulations. All of these resources will be used to help answer the questions, organized into the following categories, to try to understand the differences between the standards and regulations. The categories, and their related questions, are as follows:

Regulation, Standard, or Specification

- Is this material a regulation, standard, or specification?
- What does the regulation, standard, or specification say for compliance?

Types of Testing

- What are the different types of testing for fire pumps?

Frequency of Testing

- How often should the pump be tested?

Length of Testing

- How long should the pump run for a churn test? (Weekly)
- How long should the pump run for a churn test? (Annual)
- How long should the pump run for a flow test? (Weekly)
- How long should the pump run for a flow test? (Annual)

Requirements for Personnel

- Who needs to conduct the testing?

Preventative Maintenance Required

- Is preventative maintenance required?

Mechanical Modifications

- Are any mechanical modifications allowed?

Useful Life

- What is the useful life expected from the fire pump, under normal circumstances?

The questions will help to identify the differences between the standards and regulations in the different areas related to fire pump testing and reliability.

Data Comparison

When the answers from the printed texts are recorded in the table they may then be examined for differences. A comparison may be made between the different texts to determine if regulations have changed over the past ten years and to ascertain if there is any conflicting information. The failure rates published by the manufacturer' will be compared to a failure rate formula, which will be calculated on a current setup of a fire pump.

Data Recommendations

Recommendations will be made based off the results indicated in the table; when the table has been filled out, it will show the differences between the resources and possible points of interest for the recommendations. The manufacturer's failure rates and useful life data will also be used to make recommendations when compared against the reliability formula and the calculations based on the field application. After the recommendations are presented, the use of OHSAS 18001 management systems may be used to help top management implement the recommendations and insure the company is staying current with new regulations.

Limitations

The limitations of this study include the possibility for the printed materials to have misprinted information. Clear, concise, and honest representation of the components from the manufacturer is assumed. Another limitation is the assumption that each manufacturer's published failure rates have been completed correctly, without any mathematical error.

Chapter IV: Results

This section will provide an overview of the results from the investigation, as well as the resulting calculations from the reliability test. The following data has been collected from the 2009 edition of The Joint Commission regulations, 2000 and 2009 editions of NFPA 101 Life Safety Code, the 1998 and 2008 editions of NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, and the Aurora 481 model fire pump manufacturer's specifications. This full data has been tabulated in Appendix A. Subject areas to be addressed are: table analysis; regulation, standard, or specification; types of testing; frequency of testing; length of testing; requirements of personnel; preventative maintenance required; mechanical modifications; useful life; calculated failure rate, consequences of non-compliance, and discussion of the results.

Table Analysis

The data gathered from the printed texts have been recorded in the table, located in Appendix A, and have been examined for differences. A comparison between the different texts is used to determine if regulations have changed over the past ten years and to ascertain the existence of any conflicting data.

Regulation, Standard, or Specification

In this section the goal was to determine which materials were regulations, standards, or specifications. The printed materials provided by the manufacturer for the Aurora 481 model pump are suggested guidelines and are considered specifications. The Joint Commission regulations are considered regulations as they are approved by CMS and can be used to assess fines or penalties against a medical facility. CMS has adopted the 2000 edition of NFPA 101. This means that every medical facility, that provides care under Medicare or Medicaid, must

meet or exceed these regulations. As of yet, CMS has not adopted the 2009 edition of NFPA 101 thereby making this document a standard. Both, the 1998 edition and 2008 edition of NFPA 25 are standards because they act as reference documents for the regulations. This information comes from Table 1 which in an excerpt from Appendix A.

Table 1

Regulation, Standard, or Specification Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
Is this material a regulation, standard, or specification?	Specification These are suggested guidelines by the manufacture	Regulation Approved by CMS	Regulation Adopted by CMS	Standard	Standard	Standard

Types of Testing

In this part, the question was designed to determine what types of testing needed to be conducted on a fire pump. The outcomes for this question were derived from the 1998 and 2008 editions of NFPA 25 and the manufacturer's specifications. Both editions of NFPA 25 agree there are two types of tests for fire pumps. The two types of tests include a no-flow condition test and flow condition test. A no-flow condition test is commonly referred to as a churn test. The regulations and standards agree upon this. The manufacturer's specifications only discuss flow testing. This information has been derived from Table 2.

Table 2

Types of Testing Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
What are the different types of testing for fire pumps?	Flow condition	No-flow condition (Churn) and flow condition	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 & 5-3.3.1 No-flow condition (Churn) and flow condition	8.3.1 & 8.3.3.1 No-flow condition (Churn) and flow condition

Frequency of Testing

In this section, the goal was to evaluate when the different types of testing must be conducted. All of the printed materials agree that a fire pump should be tested weekly as well as annually. This information is shown in Table 3.

Table 3

Frequency of Testing Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
How often should the pump be tested?	Weekly and Annually	Weekly and Annually	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 & 5-3.3.1 Weekly and Annually	8.3.1 & 8.3.3.1 Weekly and Annually

Length of Testing

This segment addressed the length of time over which the different testing methods would need to be conducted. Table 4 has been derived from Appendix A which contains the information from the printed texts.

Table 4

Length of Testing Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
How long should the pump run for a churn test? (Weekly)	N/A	Tests fire pumps under no-flow conditions.	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 Minimum of 10 minutes.	8.3.1.2 Minimum of 10 minutes.
How long should the pump run for a churn test? (Annual)	N/A	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.3.2.1 Minimum of ½ hour	8.3.3.2 Minimum of ½ hour
How long should the pump run for a flow test? (Weekly)	A few minutes	N/A	N/A	N/A	N/A	N/A
How long should the pump run for a flow test? (Annual)	No length of time given	No length of time given	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.3.2.2 No length of time given	8.3.3.2 No length of time given

For the question of how long should the pump run during the weekly churn test, Joint Commission Resources (2009) stated that, "Every week, the [organization] tests fire pumps

under no-flow conditions. The completion date of the tests is documented. Note: For additional guidance on performing tests, see NFPA 25, 1998 edition" (p. 42). Both NFPA editions agree that the pump should be churn tested every week for a minimum of 10 minutes. The manufacturer's specifications did not address a weekly churn test.

For the question of how long should the pump run during an annual churn test, the 1998 edition and 2008 edition of NFPA 25 list a series of steps to complete every year, and during these steps the pump is churn tested for at least 30 minutes. The manufacturer's specifications do not address this form of testing.

For the question of how long should the pump run for a weekly flow test, The Joint Commission and NFPA do not mention any requirements or standards which must be adhered to. Management should test the fire pump weekly and Aurora (2003) states the pump, "should be operated a few minutes at rated speed with water discharging through some convenient opening" (p. 78).

For the question of how long should the pump run during an annual flow test, all of the organizations agree that there should be an annual flow test, but none of them specified a length of time to run the test. They do, however, list a series of steps to follow to ensure the pump is thoroughly checked and is operating correctly.

Requirements for Personnel

This section is used to determine who may conduct the weekly and annual testing and any requirements for those individuals. The 1998 edition and 2008 edition of NFPA 25 state qualified personnel shall conduct the tests. The manufacturer's specifications mention an employee may conduct the tests. This is the extent of the requirements of personnel who conduct pump testing. Table 5 has summarized this information.

Table 5

Requirements for Personnel Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
Who needs to conduct the testing?	Employees should conduct tests	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2 Qualified operating personnel shall be in attendance during the weekly pump operation.	8.3.2.1 Qualified operating personnel shall be in attendance during the weekly pump operation.

Preventative Maintenance Required

This section reviews if any preventative maintenance is required by the standards or regulations. The regulations state testers shall refer to the NFPA standards concerning preventative maintenance. The 1998 and 2008 edition of NFPA 25 state that manufacturer's recommendations should be followed concerning preventative maintenance. Aurora (2007) states, "Your Aurora pump requires no maintenance other than periodic inspection, lubrication, and occasional cleaning" (p. 1). This information is shown in Table 6.

Table 6

Preventative Maintenance Required Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
Is preventative maintenance required?	Pump requires no maintenance	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-5.1 Follow manufacturer's maintenance schedule	8.5.1 Follow manufacturer's maintenance schedule

Mechanical Modifications

This segment includes any mechanical modifications which are allowed by the standards, regulations, or specifications. The manufacturer's specifications allow for a pressure relief valve to be installed but its installation is not required. Both editions of NFPA 25 also allow a pressure relief valve to be installed, as a safety feature to discharge water, but again, it is not required. This information has been derived from Table 7.

Table 7

Mechanical Modifications Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
Are any mechanical modifications allowed?	Relief valve	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 Relief valve	8.3.1.4 Relief valve

Useful Life

This area was included to evaluate the regulations, standards, and manufacturer's specifications about the useful life of the pump. Throughout the extensive research, no data could

be found concerning the lifespan of a fire pump. There was no published data from the manufacturer on the subject either. This data has been summarized in Table 8.

Table 8

Useful Life Data collected about Fire Pumps

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101	2009 Edition NFPA 101	1998 Edition NFPA 25	2008 Edition NFPA 25
What is the useful life expected from the fire pump, under normal circumstances?	N/A	N/A	N/A	N/A	N/A	N/A

Calculated Failure Rate

The manufacturer did not publish any data on this subject. There is no published data on longevity, expected years of service, life cycle data, or failure rate data. Likewise, no formula for failure rates of a centrifugal pump could be ascertained from any of the printed materials or texts.

Consequences of Non-compliance

In each of the regulations The Joint Commission enforces, it is typically mentioned how to comply with the regulation and what may happen if a medical facility does not comply. If the medical facility does not comply with the regulations, several things may occur depending on the severity of the offense. The Joint Commission's fine structure operates on a sliding scale. As the severity of the offense increases, the severity of the penalty also increases. The penalty may be a written warning, monetary fines, or the loss of all Medicare and Medicaid payments from CMS (The Joint Commission, 2009, n.p.). Before Medicare and Medicaid funding is withdrawn, the

medical facility typically has an opportunity to address the areas in question and make the necessary improvements.

In this situation, the testing of the fire pump also requires that these weekly and annual tests be appropriately documented. The Joint Commission's sliding scale fine structure, when enforcing fire pump regulations, may be as follows: If the medical facility misses no requirements or only one of the documentation requirements, this is considered acceptable and a warning may be given for the single missing record. If the medical facility staff misses two records, a fine may be given; if three or more records are missing there is a possibility that Medicare and Medicaid funding may be withdrawn.

Discussion of the Results

The regulations used for the study are the 2009 edition of The Joint Commission regulations and the 2000 edition of NFPA 101. Both of these documents were used to understand which regulations a medical facility is required to be in compliance with. The 2009 edition of NFPA 101 and both editions of NFPA 25 were used to gain insight in determining how the standards may have changed over a span of ten years. It was found that although ten years of advancements in technology had occurred, the wording of the standards were almost identical. This means that very little has changed between the 1998 and 2008 editions of NFPA 25 when discussing fire pumps.

When it came time to attempt to answer the problem statement, some particular sources stood out. The manufacturer's specifications were very useful in determining proper pump setup and performance expectations. The regulations, however, did not assist in answering the problem statement. The regulations simply state what rules a medical facility must adhere to, but gave no interpretation or justification for the regulations. The standards gave no reasoning either, but they

did however, help to answer the question of how to comply with the regulations. Overall, the manufacturer's specifications and the NFPA 25 standards were used most often, while conducting this study.

Chapter V: Discussion

So far in this study the history and advantages of The Joint Commission have been examined to determine the relationship they have with medical facilities. This study has also examined the regulations that apply to fire pumps and a management system for risk control on an organizational level. The data was collected from a variety of printed sources and organized into categories, which were documented into the table located in Appendix A. This section will discuss the limitations, provide conclusions, and propose recommendations.

Limitations

One limitation includes the regulations and standards from NFPA 25 and NFPA 101. This study will only be examining NFPA 25 standards on fire pumps and NPFA 101 regulations. The limitations of this study also include The Joint Commission's applicable regulations on fire pumps. Another limitation includes the possibility for the printed materials used in the research to have misprinted information. The last limitation includes the limited amount of printed material covering the topic of fire pumps.

Conclusions

The data collected from the manufacturer's specification, regulations, and standards, stated that there should be weekly and annual testing of a medical facility's fire pump. This protocol is widely used across the United States of America if a medical facility receives Medicare and Medicaid payments from CMS. Within this weekly and annual testing, the regulations favor churn testing, while the manufacturer never addresses this form of testing. The only form of testing the manufacturer recommends is flow testing. It is interesting that the manufacturer only recommends flow testing because as previously pointed out, when a fire pump is first manufactured, it is subjected to an extensive evaluation process in order to be certified to

be used as a fire pump (Wahl & O'Neill, 1997, p. 54). The evaluation process conducted, upon completion of manufacturing a fire pump includes, tests to ensure the pump can withstand the rigors of being a fire pump through adverse conditions. As mentioned by Wahl and O'Neill (1997), a fire pump is tested and expected to operate, "On a curve, providing 100 percent rated capacity at the 100 percent rated pressure; 150 percent rated capacity at the 65 percent rated pressure; and up to 140 percent rated pressure at no-flow (churn) conditions" (p. 56). This would indicate that in highly adverse conditions that a fire pump, in good operating condition, can operate over its rated capacity. The pump is designed to perform when it is needed the most. The manufacturer, however, does not address performing a weekly churn test, per the standards and regulation, but instead recommends a weekly flow test.

For annual testing, the standards and regulations, as well as pump manufacturers, recommend checking the fire pump thoroughly. During this inspection, the fire pump is evaluated on a curve, in which the capacity and pressure are graphed against voltage and amperage needed to produce 150 percent of the pump's rated capacity. From the data collected, this is the accepted method used to demonstrate the fire pump is in proper working condition.

Management System

Within the literature published by the manufacturer, no specific lengths of time are mentioned concerning the weekly or annual testing; unlike the NFPA 25 standards, which require very specific lengths of time when conducting fire pump testing. This is important for the regulation aspect, as it shows if the medical facility has been conducting the tests and conducted for the proper length of time. A good management system is needed to ensure these requirements are being met.

The OHSAS 18001 management procedures, if implemented correctly, can assist in the implementation of new policies and procedures, while allowing the medical facility to stay current with The Joint Commission regulations. It is imperative that some form of management system be used to ensure these regulations are being followed correctly. If the regulations are not appropriately followed, the medical facility may incur a reprimand from The Joint Commission for being non-compliant.

Allowable Mechanical Device

The manufacturer and NFPA 25 allow the installation of a pressure relief valve; this is to allow water to discharge, on the discharge side of the pump, after a pre-set pressure has been reached. The installation of a pressure relief valve is not required by the regulations or standards, but doing so would be a good idea. If the pump has increased the water pressure in excess of what the system could ever demand, a pressure relief valve would discharge water in an effort to lower the pressure on the discharge side of the fire pump, instead of continuing to build pressure which could possibly overload the system's components. The pressure relief valve would only open at a pressure above the highest pressure required for extinguishing a fire; this ensures that water would not be flowing through the pressure relief valve when the system is suppressing a fire.

Recommendations

The standards and manufacturer's specifications mention that the testing of a fire pump shall be conducted by qualified personnel. Unfortunately, no requirements are ever delineated concerning the qualifications of these personnel. The standards do not state what constitutes a qualified personnel member. The manufacturer's specifications state an employee shall be allowed to conduct the tests. An employee with no training or understanding of fire pumps would

be ill-equipped to perform the necessary tests appropriately, and therefore, should not be conducting these tests. One recommendation is to have this policy examined and have information added to the standard concerning the minimum qualifications an employee must meet before being allowed to conduct the testing. Should a qualified employee be certified in pumps, plumbing systems, sprinkler systems, or have some formal training before conducting these tests? These concerns should be addressed in the standard.

Compliance within a Management System

Another recommendation is to implement and utilize a management system to ensure compliance with the standards and regulations. OHSAS 18001 management procedures could be utilized by a larger company very effectively, but the organization's structure and culture will dictate which management system to use. At a minimum, management system elements should include organization planning and support, standards and practices, training, and accountability with performance feedback.

Lack of Information

Another area to be addressed is the lack of information available concerning the useful life of a fire pump. The standards, regulations, and the manufacturer's specifications did not address what the useful life of a fire pump might be. Medical facilities should require the installation of a fire pump, which can last at least a prescribed minimum amount of time. Pumps such as these are designed and built to withstand highly adverse operating conditions, and it would not be unreasonable for a medical facility to expect the pump to perform for a certain length of time. This expectation could be used to help medical facilities determine which pump manufacturer has the best product for their specific needs. The recommendation is to have this useful life data published by the pump manufacturer. If a manufacturer does not have this data,

there should be regulations in place which require manufacturer's to conduct this testing and publish the data.

Mechanical Modification Recommendation

All fire suppression systems should have a pressure relief valve installed. This recommendation would allow the system to discharge water when creating significant pressure. From the data collected, the use of a pressure relief valve does not harm the operation of the system, and it could possibly increase the life of the components used in the suppression system.

Further Investigation

Upon completing this study, it cannot be concluded if the regulations enforced by The Joint Commission increase the maintenance cost for fire pumps in a medical facility. The final recommendation from this investigation is to have further research performed on this topic. All of these recommendations have been summarized in Table 9.

Table 9

Fire Pump Recommendations Summary

- Determine employee qualifications needed to test a facilities fire pump
- Utilize a management system to ensure compliance with the standards and regulations
- Encourage the publication of the useful life data from the manufacturer
- Fire suppression systems should utilize a pressure relief valve
- Perform further fire pump research

Fire pumps are one of the major hidden system components, which make up the modern medical facility and with the current lack of available information on the longevity of fire pumps, additional research is desperately needed.

References

Aurora. (2003). Engineering Specifications: Centrifugal Fire Pumps Models 481-483-485. Retrieved from http://www.aurorapump.com/pdf/900/Engineering%20Specs.pdf

Aurora. (2007). Instruction and Repair Manual. Retrieved from http://www.aurorapump.com/pdf/410/InstructionMan_410.pdf

Beattie, W. (2008). Handling Impairments to Fire Protection Systems. *Professional Safety, 53*(10), 60-63. Retrieved March 6, 2010, from ABI/INFORM Global. (Document ID: 1600836031).

British Standards Institution. (2007). *Occupational health and safety management systems--requirements*. Occupational health and safety assessment series. London: British Standards Institution.

Centers for Medicare & Medicaid Services. (2010). *Hospitals*. Retrieved from http://www.cms.hhs.gov/CertificationandComplianc/08_Hospitals.asp

Chassin, M. (2008, June 2). The Joint Commission: A new look at what it can do. *Journal of Family Practice*, *57*, 6-8. July 6, 2009, Retrieved from Academic Search Premier database.

CMS adopts NFPA life safety code. (2003). *Professional Safety, 48*(5), 48. Retrieved March 6, 2010, from ABI/INFORM Global. (Document ID: 336024691).

Joint Commission Resources. (2009). *Environment of Care Essentials for Health Care.* Oakbrook Terrace, Illinois: Joint Commission Resources.

Kausek, J. (2007). *OHSAS 18001: Designing and implementing an effective health and safety management system*. Lanham, Md: Government Institutes.

National Fire Protection Association. (1998). *Standard for the inspection, testing, and maintenance of water-based fire protection systems*. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. (2000). *Life Safety Code*. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. (2008). *Standard for the inspection, testing, and maintenance of water-based fire protection systems*. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. (2009). *Life Safety Code*. Quincy, MA: National Fire Protection Association.

O'Brien, C. (2007). Mechanical Failure-Rate Data for Low-Demand Applications. *Chemical Engineering, 114*(10), 83-87. Retrieved March 7, 2010, from ABI/INFORM Global. (Document ID: 1403806631).

OHSAS 18001 & 18002. (2008). *Professional Safety, 53*(10), 22-24. Retrieved March 7, 2010, from ABI/INFORM Global. (Document ID: 1600835951).

The Joint Commission. (2009). Retrieved July 6, 2009, from The Joint Commission Web site: www.jointcommission.org/

Wahl, A., & O'Neill, J. (1997, May). Pumping power. *Consulting - Specifying Engineer, 21*(5), 54-60. Retrieved March 7, 2010, from ABI/INFORM Global. (Document ID: 11792538).

Appendix A: ***Manufacturers' Recommendations Verses Standards and Regulations.***

Categories and Questions	Aurora 481 Model Pump	2009 Edition Joint Commission Regulations	2000 Edition NFPA 101 Life Safety Code	2009 Edition NFPA 101 Life Safety Code	1998 Edition NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems	2008 Edition NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
Regulation, Standard, or Specification						
Is this material a regulation, standard, or specification?	Specification These are suggested guidelines by the manufacture	Regulation Approved by CMS	Regulation Adopted by CMS	Standard These are suggested guidelines unless a governing body makes them regulations	Standard These are suggested guidelines unless a governing body makes them regulations	Standard These are suggested guidelines unless a governing body makes them regulations
What does the regulation, standard, or specification say for compliance?	N/A	EC.02.03.05 The hospital maintains fire safety equipment and fire safety building features.	9.7.5 All automatic sprinkler and standpipe systems required by this *code* shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*	9.7.5 All automatic sprinkler and standpipe systems required by this *code* shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*	N/A	N/A

Types of Testing						
What are the different types of testing for fire pumps?	Flow condition	No-flow condition (churn) and flow condition	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 & 5-3.3.1 No-flow condition (churn) and flow condition	8.3.1 & 8.3.3.1 No-flow condition (churn) and flow condition
Frequency of Testing						
How often should the pump be tested?	Weekly and Annually	Weekly and Annually	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 & 5-3.3.1 Weekly and Annually	8.3.1 & 8.3.3.1 Weekly and Annually
Length of Testing						
How long should the pump run for a churn test? (Weekly)	N/A	Every week, the [organization] tests fire pumps under no-flow conditions. The completion date of the tests is documented. Note: For additional guidance on performing tests, see NFPA 25, 1998 edition.	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 A weekly test of electric motor-driven pump assemblies shall be conducted without flowing water. This test shall be conducted by starting the pump automatically. The pump shall run a minimum of 10 minutes.	8.3.1.2 The electric pump shall run a minimum of 10 minutes.

How long should the pump run for a churn test? (Annual)	N/A	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.3.2.1 (a) Check the circulation relief valve for operation to discharge water. (b) Check the pressure relief valve (if installed) for proper operation. (c) Continue the test for ½ hour.	8.3.3.2 (a) Check the circulation relief valve for operation to discharge water. (b) Check the pressure relief valve (if installed) for proper operation. (c) Continue the test for ½ hour.
How long should the pump run for a flow test? (Weekly)	Pumps should be operated a few minutes at rated speed with water discharging through some convenient opening. The management of a property with a fire pump should make similar running tests weekly.	N/A	N/A	N/A	N/A	N/A

How long should the pump run for a flow test? (Annual)	The annual tests are set up to provide a complete check on the performance of the whole assembly: suction connections, pump, prime mover, steam and electric supplies.	Every 12 months, the hospital test fire pumps under flow. Refer to NPFA 25 1998 Edition	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.3.2.2 (a) Record the electric motor voltage and current (all lines). (b) Record the pump speed in rpm. (c) Record the simultaneous (approximately) readings of pump suction and discharge pressures and pump discharge flow. (d) Observe the operation of any alarm indicators or any visible abnormalities.	8.3.3.2 (a) Record the electric motor voltage and current (all lines). (b) Record the pump speed in rpm. (c) Record the simultaneous (approximately) readings of pump suction and discharge pressures and pump discharge flow.
Requirements for Personnel						
Who needs to conduct the testing?	Employees should conduct tests	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2 Qualified operating personnel shall be in attendance during the weekly pump operation.	8.3.2.1 Qualified operating personnel shall be in attendance during the weekly pump operation.

Preventative Maintenance Required						
Is preventative maintenance required?	Your Aurora pump requires no maintenance other than periodic inspection, lubrication and occasional cleaning.	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-5.1 A preventive maintenance program shall be established on all components of pump assembly in accordance with the manufacturer's recommendations.	8.5.1 A preventive maintenance program shall be established on all components of pump assembly in accordance with the manufacturer's recommendations.
Mechanical Modifications						
Are any mechanical modifications allowed?	Relief valve	N/A	Refer to NPFA 25 1998 Edition	Refer to NPFA 25 2008 Edition	5-3.2.1 A valve installed to open as a safety feature shall be permitted to discharge water.	8.3.1.4 A valve installed to open as a safety feature shall be permitted to discharge water.
Useful Life						
What is the useful life expected from the fire pump, under normal circumstances?	N/A	N/A	N/A	N/A	N/A	N/A