The Jockey Pump, an Important Part of a Fire Pump System.

August 1, 2009 Rev. No. 2

A Jockey Pump is an important component of a fire pump system. The Jockey Pump is not as mundane as many engineers, contractors, and installers would have you believe. Why are they so misunderstood?

The Jockey Pump (JP) or Pressure Maintenance Pumps (PMP) as they are known today actually serve a very important role in the fire pump system as well as the complete fire protection system. Many engineers and installers ask (What is a Jockey Pump and what is the function of this pump within the fire protection system?) As we progress through this paper, many of the benefits the JP provides within a fire sprinkler or standpipe system will be revealed for your consideration.

The requirement for a PMP is in question quite often. **The *NFPA-20 2007 Standard for Installation of Stationary Pumps for Fire Protection*** gives guidance to the question in several ways. In the body of the standard, Chapter 5: General Requirements, Paragraph 5.24 Pressure Maintenance (Jockey or Make-up) Pumps, the standard provides complete guidance for planning, installation, and setup of a Pressure Maintenance Pump. (PMP) There is not a direct statement about the requirements for a PMP. This is the same statement you can make about a fire pump. There are specific installations that are manual rather than automatic. However they are rare. With the amount of information provided for the PMP throughout the standard I personnally believe that eliminating a PMP will result in damage to the fire protection system.

There are several very good examples given why a PMP should be used. In the appendix Section A-5.24: Pressure maintenance (jockey or make-up) pumps should be used where it is desirable to maintain uniform or relatively high pressure on the fire protection system. A jockey pump should be sized to make-up the allowable leakage rate within 10 minutes or 3.8.L/min (Minimum of 1gpm whichever is larger.)

Section A-5.24.5 (1) states that a jockey pump is usually required with automatically controlled pumps.

These two sections give you the information to make the right choice. The reason you need a uniform or relatively high system pressure is to protect the fire sprinkler system from in-rush of pressure or water hammer when the fire pump starts up automatically. Should you have a system without the PMP and the pressure was somewhere around 50 PSI from a city supply or elevated tank, you will receive a tremendous water in-rush (water hammer) into the system when a fire pump rated at 125 PSI starts. The kinetic energy developed can seriously

damage the fire protection system. You will be raising the pressure rapidly to several hundred pounds per square inch.
I believe you should be required to prove the system with calculations and safe guards before you can eliminate the PMP on an automatically controlled pumping system.

When you enter into a project that includes the installation of a fire pump, you must perform an analysis of the complete system requirements to insure that you provide an approved functional installation. The main goal is to provide a well-engineered, adequately sized, and reliable water supply necessary for fire sprinkler protection for years to come. As you progress through the analysis, you must look at every part of the system and include all features of the pump system as outlined in the applicable edition of the NFPA-20.

One of the most important items in a Fire Pump System that is installed per the NFPA-20 Standard is the lowly Jockey Pump. First, I believe we must understand what the term Jockey Pump (JP) means and how important this small pump is to an automatic fire protection system. JP's are pressure maintenance or makeup pumps used to provide a prescribed level of pressure needed to prevent the main fire pump from starting intermittently and to provide sufficient flow to replenish the system within a set time frame. The NFPA-20 Standard specifically prohibits the main fire pump or secondary fire pump from being used as a PMP. The JP provides makeup water for incidental leakage within the system such as, packing on valves, seepage at compression joints, leaks at fire hydrants, and inadvertent use of water from the interior or underground piping system.

Let us look at the NFPA-20 2007 Standard for the Installation of Stationary Pumps for Fire Protection, and determine the requirement for JP's. The 2007 Standard does not offer a specific definition of a JP or pressure maintenance pump. The Pressure Maintenance Pump (PMP), JP, or makeup pump is referenced in Paragraph 5.24* Pressure Maintenance (Jockey or Makeup) Pumps. Section 5.24.1- The PMP shall have rated capacities not less than normal leakage. Section 5.24.2- The pumps shall have discharge pressure sufficient to maintain the desired fire system pressure.

These two sections cover a lot of ground without really defining the importance of the PMP, unless you really study the wording. "Shall have rated capacities not less than normal leakage." These words tell you that you must do some calculation to determine the sizing of the pump. Things get a bit gray at this point. First if the PMP is connected to an underground distribution system, there is a good chance that a sizable PMP will be required. If the PMP is connected to an interior piping system only, then the PMP will be much smaller. How do we determine the sizing?

We first must look at the type of system we are dealing with and calculate what the "normal leakage" really is.

Calculating the Size of Jockey Pump for an Underground Distribution System:

An underground fire water supply distribution system falls under the guidelines set forth in the ***NFPA-24 Standard for the "Installation of Private Fire Service Mains and Their Appurtenances".*** Refer to ***Chapter 10: Underground Piping, Paragraph 10.10.2.2: Hydrostatic Testing,*** and study this complete paragraph to determine the permitted leakage allowed in underground piping systems.

This chapter will guide you through an exercise that will give you a good idea of the amount of leakage that is allowed. You must consider other factors, such as soil conditions, rocky soil, and traffic conditions.

The guidelines are not intended to give you the license to leave a leaking system. Your original test should be a dry joint test at the required test pressures. These allowances give an indication of the loss of water that will take place over time due to earth movement, traffic, or soil settling.

Using the NFPA-24 2002 Edition, the selection of a PMP for the pumping system would be as follows: You have an underground system with 8,000 ft of 12" ductile iron underground piping, supplying 40 sprinkler systems with 40'-0" run-ins of 8" pipe with PIV's, 30 fire hydrants with AWWA type valves, 14 division valves, 75 MJ tees, and 100 miscellaneous fittings such as ells, sleeves; etc.

You must estimate the number of pipe joints in the system. Based on the project above, the list of materials will give you approximately 2700 joints (connections) or intersections. The NFPA-24 standard states that the maximum leakage per 100 joints is 2 quarts per hour which translates into an estimated loss of approximately 14 gallons per hour. You also must allow for incidental leaking or use within the thousands of feet of pipe inside the facility. The standard requires the water and the pressure to be replenished within ten minutes. Taking the system pressure into account, your choice of pumps will be sized much larger than the water usage. High-pressure requirements in some sprinkler systems may require the pressure to be at 165-PSI static pressure. That means the PMP will be required to deliver 20GPM or more at 165 PSI to meet the requirements. Looking at the characteristic curves of most popular pumps you will find your choice to be a 7.5 -10 HP PMP rated at 25/30 GPM @ 382 Feet of head (165 PSI) depending on the type pump you choose. You must also take into consideration the net positive suction pressure available and calculate the effect

of rise to shutoff of the system to prevent any overpressure of the total fire system. You also must install a pressure relief valve in the PMP discharge to protect the system from over pressure. Turbine pumps and some multistage pumps are a real concern due to their high shutoff pressure potential.

The NFPA Standard requires a maximum of 10 minutes to repressurize the total system. In your calculations, you must also consider the thousands of feet of steel pipe in the facility that also must be pressurized.

The latest Edition of NFPA-24 2007 has changed the method for calculating the "normal leakage" for an underground distribution system. I personnally prefer the older method since the new method does not take into account the number of piping joints in a system. The multiplier for 100'-0" of pipe may only have four joints in the run. If you are in an area of the loop where you have several run-ins and a hydrant you may have 10 or 12 joints in a 100'-0" section of the loop. The leakage on an underground system would normally occur at a joint or intersection. The total number of pipe joints must be calculated to insure the proper sizing for the JP.

Another area of concern is the rating of underground piping materials. Underground distribution systems are often times installed by utility contractors that may not be aware of the total pressure a fire pump system generates. Many times the wrong pressure rating for piping materials is chosen and the rating for the fire loop will be Class 150 or 150 psi. In the early planning of a project, the contractor supplying and installing a pumping system, should insure that the Project Engineer/Manager provides the correct data sheets showing the total discharge pressures that will be generated by the fire pump unit(s) to all jobsite contractors or subcontractors performing any work on the distribution system.

Calculating the Pump Size for an Interior Piping System Example:

Choosing a PMP for an interior piping system, supplied by a fire pump system taking suction directly from a water supply without any underground, is a very different selection process. Interior piping systems do not have the potential for seepage or leakage, as does the underground system. Therefore the pump will be much smaller in comparison. If you have the same head pressure requirement as mentioned before, and this pressure requirement is due to the height of the building your choice will be based on the horsepower required to provide the high pressure. A pump rated 5 GPM or less at 381 feet of total discharge head (TDH) will *normally* be sufficient. The horsepower will then be from 3-5 HP depending on the manufacturer. The installation of a Pressure Maintenance Pump is simply the best choice for an automatically controlled fire pump system.

Refer to NFPA-20 2007, Chapter 14.2.7 * Field Acceptance Test Procedures and A-14.2.7 Sub-Section (4)-(a, b, c, d, e, f, and g,) and use this information in the selection of a pump and the proper setup of the system after installation is

complete. This information alone details the need for a PMP if you understand hydraulics at all.

A properly installed Pressure Maintenance Pump will normalize the high and low pressure found in many systems. Property damage from a poorly installed system will be prevented by choosing the correct pumping unit for the system.

Oversizing a PMP can be more problematic than an undersized pump selection. The old method of choosing a JP pump based on sizing of 1% of the size of the fire pump may work ok on some systems such as small underground distribution systems.

There is still a concern that using the 1% method on an underground piping system, you may size the PMP too small. I have personally witnessed this problem many times over the last 50 years.

When using the 1% method on an interior system, you must be very careful not to oversize the PMP. I have witnessed many applications based on the 1% selection process that required down sizing of the PMP before the customer could accept the system. Don't try to short cut the process, simply do the research and math and you will sleep better and provide a much more reliable fire protection system to your client.

Bill M Harvey, S.E.T.

Harvey & Associates, Inc.
P.O. Box 818
Fountain Inn, SC 29644

bill@harveyandassociates.com
harveyassociates@msn.com

Important Notice: As a member of the NFPA Technical committee for NFPA-20, the following disclaimer applies. The information included in this article is not a Formal Interpretation issued pursuant to NFPA Regulations. Any opinion expressed is the personal opinion of the author and does not necessarily represent the official position of the NFPA Technical Committees.

Revision 2 Clarifies the Pump Selection Process.