PROFESSIONAL LOSS CONTROL, INC.

EVALUATION
OF
HOSE LENGTH - STANDPIPE SYSTEM
AT
CRYSTAL RIVER UNIT 3
FLORIDA POWER CORPORATION

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1.0 INTRODUCTION

The manual hose stations for the standpipe system at Crystal River Unit 3 are distributed throughout the plant in both safety related areas and the balance of the plant. The hose standpipe system's design and installation are based upon the guidelines established by Appendix "A" to the Branch Technical Position APCSB 9.5-1 and NFPA 14 entitled "Standpipe and Hose Systems." The primary intent of the standpipe and hose system in safety related areas is to provide manual fire fighting capability for the protection of safety related equipment and systems. The fire fighting capability is maintained for safe shutdown functions and minimizing radioactive releases to the environment.

2.0 PROBLEM STATEMENT

Appendix "A" to the BTP 9.5-1 states that interior manual hose installation should be able to reach any location with at least one effective hose stream. To accomplish this, standpipes with hose connections, equipped with a maximum of 75 feet of 1-1/2 inch woven jacket-lined fire hose and suitable nozzles should be provided in all buildings, including containment, on all floors and should be spaced at not more than 100-foot intervals.

NFPA 14 states that each hose connection provided for use by building occupants (Class II service) shall be equipped with not more than 100 ft. of listed 1-1/2 inch lined, collapsible or noncollapsible fire hose attached and ready for use.

The present manual hose installation can not reach all safety related areas with an effective hose stream. Examples of this include el. 145' of the Control Complex and el. 164' of the Control Complex.

3.0 SYSTEM DESCRIPTION

The three (3) fire pumps take suction from two ground storage tanks, each having 360,000 gallon capacity. These storage tanks are dedicated to fire protection. The one electric driven and two diesel driven fire pumps are each rated at 2000 gpm and 125 psig. System pressure is maintained by a 30 gpm pressure maintenance pump at 110 psig. If system pressure in the Fire Service Pump House drops below 95 psig, the electric driven pump starts; if the pressure falls below 85 psig, one diesel driven pump starts; and, if the pressure drops below 75 psig, the second diesel driven fire pump starts. Shut off pressure (churn pressure) is approximately 150 psig. The pressure relief valves on the diesel driven fire pumps are set at 150 psig. The fire pumps are each capable of supplying 50% of the maximum plant water demand. The maximum plant demand is based upon 4000 gpm for a main power transformer fire (water spray system and Turbine Building wall water curtain) plus 1000 gpm for manual hoses (outside water streams). Each fire pump is capable of supplying 100% of the water demand in safety related areas.

The yard loop water distribution system is constructed of 12 inch nominal diameter cement lined cast iron pipe.

The standpipe risers and horizontal cross mains are either four (4) inch in diameter or six (6) inch in diameter. Refer to Flow Diagram FD-302-231, Sheets 1-2, Rev. 27. Most of the hose stations that are connected to risers contain 75 feet of 1-1/2 inch hard rubber hose with variable fog pattern nozzles. Operation of any fire hose will cause at least one fire pump to start and alarm in the Control Room.

4.0 CALCULATIONS

One solution to not having the capability to reach all safety related areas of the plant with an effective hose stream is to provide each hose station with 150 feet of rubber lined fire hose.

Worst case scenarios include the following:

4.1 Use of Hose Station FSV-162-Heater Bay Platform hose station will be used to manually fight fire on the 164' elevation in the Control Complex.

Assumptions:

- At least one fire pump operates.
- Pressure loss in the underground yard loop and risers
- is negligible.
- 150 ft. of hose (1-1/2 in.) rubber lined is installed on the hose reel.
- 100 gpm flow in hose.

Hose Line Fire Stream Calculations

$$*FL = 24\ Q^2 L$$

$$= 24 \left(\frac{100}{100}\right)^2 \times \frac{150}{100}$$

$$= 36 \text{ PSI}$$

FL = Pressure Loss

$Q = \frac{\text{(GPM) Flow}}{100}$

$L = \frac{\text{Length (ft.)}}{100}$

El. Pressure = (164' - 119') x 0.433 $\frac{\text{PSI}}{\text{Ft.}}$ = 19.5 psi

Total Pressure Loss = 36 psi - 19.5 psi = 55.5 psi

Pressure Available at Nozzle = 150 psi - 55.5 psi = 94.5 psi

This nozzle pressure, 94.5 psi, is adequate to produce an effective hose stream.

*NFPA Fire Protection Handbook, 15th Edition, Table 16-7I

4.2 Use of Hose Station FSV-169-El. 119' Intermediate Building.

This hose station will be used to manually fight fire on the 119' elevation of the Intermediate Building along with the wet pipe sprinkler system.

Assumption:

- At least one fire pump operates.
- 150 ft. of hose (1-1/2 in.) rubber lined is installed on the hose reel.
- 1000 gpm is used by the wet pipe sprinkler system (per NFPA 13, 1985 Edition, Table 2-2.1 (A) Ordinary Hazard NOTE: This is a very conservative assumption: At an average of 25 gpm per sprinkler - 40 would operate.
- 100 gpm flow for the hose.

The pressure drop with 1000 gpm flow in the 12 inch yard piping system is negligible. This is based on a C-140 with 1000 gpm flow in 1000 feet of 12 inch pipe, the pressure loss is less than 1 psi. With the yard piping system having multiple flow paths (loops), the pressure loss would be less than the above. The connects to the yard piping system are not located adjacent to one another.

Hose Line Fire Stream Calculations:

$$*FL = 24\ Q^2 L$$

$$= 24 \left(\frac{100}{100}\right)^2 \times \frac{150}{100}$$

$$= 36 \text{ PSI}$$

FL = Pressure Loss

$$Q = \frac{\text{Flow (GPM)}}{100}$$

$$L = \frac{\text{Length (Ft.)}}{100}$$

$$\text{El. Pressure} = (119' - 119') \times 0.433 \frac{\text{PSI}}{\text{Ft.}} = 0$$

Total Pressure Loss = 36 PSI

Pressure Available at Nozzle = 150 PSI - 36 PSI = 114 PSI

This nozzle pressure, 114 PSI, is adequate to produce an effective hose stream.

*NFPA Fire Protection Handbook, 15th Edition, Table 16 - 7I

5.0 CONCLUSION

The hose stations on the standpipe system could be provided with 150 feet of 1-1/2 inch rubber lined fire hose so that fire hose can reach all safety related areas with an effective hose stream.

This is based upon the pressure/flow characteristics of the fire pumps, yard loop water distribution system, and standpipe risers.

The hydraulic calculation for two scenarios, high elevation and simultaneous flow of a hose stream and sprinkler system, indicate that adequate flow and pressure are available with 150 ft. of 1-1/2 inch rubber lined hose.

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