STEAM PRESURE REDUCTION ENERGY AND WATER SAVINGS OPPORTUNITY

1.1 BACKGROUND

A. This paper is meant to give a background into the potential energy, water and chemical savings methods associated with steam pressure reducing retrofits. While we give a broad overview of legacy and new methods of implementing such methods, the desired outcome would be for Steam Management, Inc. to work with you in a collaborative relationship to find the solutions that best fit your needs.

1.2 INTRODUCTION

A. Steam distribution systems utilizing saturated steam are potential candidates for reducing the steam system operating pressure. Steam systems can have large excess capacity in boilers, valves, pumps, and piping. This can also be true for systems designed for peak winter conditions. Steam pressure reduction is the lowering of the steam pressure at the point of use for distribution to better match the required heating or process load at the time of need. Within practical limits, pressure-reducing valves (PRVs) will adjust the pressure at the lower levels to controlled set points to better match the specific heating or process load at these times. This means that most of the benefits from pressure re- duction occurs due to the differential pressures between the peak system demand and the minimum demand.

1.3 SUMMARY

A. Steam pressure reduction has the potential to save fuel and water by a steam system. The amount of capital investment may be minimal for the appropriate application of this efficiency measure. The amount of savings varies with the design and maintenance of the existing system.

B. The potential to effectively reduce steam pressure most commonly applies to oversized steam systems or systems with large variable demands.

C. Steam pressure reduction should be tested to establish the critical pressure at a steam load that is above average but below peak. This will also provide an estimate of savings.

D. A detailed system evaluation is necessary due to potential problems and limits to steam

pressure reduction. For example, reducing the pressure increases the steam velocity and therefore may cause problems including erosion of piping and other components and noise in piping. The pressure drop through pipes, valves and bends increases as the pressure is reduced. Steam trap capacities are based on a pressure differential that may not be possible with a reduced steam system pressure.

1.4 DIGITAL PILOT OPERATED PRESSURE REDUCING VALVE

A. The control system includes Proportional, Integral and Derivative functions to improve the accuracy under varying load conditions. For space heating loads, the normal control strategy is to provide steam pressure re-set based on outdoor temperature to match the required demand. For process loads, the normal control strategy is to provide steam pressure re-set based on the process production schedule. Set point(s) for space heating may be remotely adjusted through the Building Management System such as the use of BACnet. Set point(s) for process heating may be remotely adjusted through the manufacturing Programmable Logic Controllers. See Figure 1 for general arrangement.

B. Advantages:

1. Both controller and valve actuator can communicate with a PLC or BMS.

2. No compressed air supply is required.

C. Disadvantages:

1. If a spring return actuator is required, the available shut-off pressure may be limited.

2. Relatively slow actuator speed, so only suitable for applications where the load changes slowly.

D. Points to Note:

1. Safety, if electrical power is lost the valve position cannot change unless a spring return actuator is used.

2. Spring return actuators have limited shut-off capacity.

E. Application:

1. Slow opening/warm-up systems with a ramp and dwell controller.

2. Pressure reduction supplying large steam distribution systems.

1.5 ENERGY AND WATER SAVINGS

A. Steam leaks:

1. External steam leaks occur in piping, joints, valves, and other components for various reasons. In large steam systems there are always some leaks. The degree of leakage depends how well the system is maintained. Leaks in pipes may be caused by corrosion, erosion, water hammer, faulty design, or poor installation. Joints of any type-welded, threaded, or flanged can leak because the original connection was flawed. Valves leak externally through their connections to piping or through the valve-stem packing or other paths. Pressure relief valves are notorious for leaking. Valves may also leak internally due to poor seats causing losses or pressure increases in downstream equipment.

2. Steam trap maintenance is a major cause of losses in steam systems. Lowering the main steam pressure is not a substitute for regular trap maintenance. How- ever, based on the condition of the average steam distribution system, a reduction in average pressure can result in savings. Steam system companies specializing in steam system energy conservation perform these estimates in different ways, employing considerable experience and judgement after reviewing the specific steam system.

3. Lowering the average pressure reduces the leakage rate in the system. Therefore, steam leakage as a loss factor may be estimated from system surveys and engineering equations for leakage.

B. Large steam systems have multiple local condensate receivers which collect hot condensate and pump it back to the boiler plant. It is not uncommon to have multiple receivers located in various process departments or buildings. Steam flashes as the condensate is lowered in pressure from the load pressure to the condensate system pressure. Flash steam losses will be directly reduced by lowering the steam pressure. When a steam trap passes condensate from the working pressure to the condensate system pressure, the condensate contains excess energy above the liquid saturation level at the lower pressure. This excess energy causes some of the liquid to flash into steam. There- fore, the amount of flash steam savings can be calculated due to lowering of the steam

distribution pressure.

C. The quantity of steam supplied to the boiler plant deaerator is determined by the amount of energy required to heat a mixture of hot condensate and cold makeup water to the saturation temperature at the operating pressure of the deaerator. There will be a small reduction in steam supplied to the deaerator when the main pressure is reduced. Reductions in steam leaks, steam trap leaks, and flash vent losses all contribute to a reduction in the boiler makeup water rate and to a reduction in the amount of steam supplied to the deaerator. The reduction in deaerator steam and makeup water can be calculated by doing a system mass and energy balance analysis.

D. The reduction in leaks and vent losses are directly proportional the amount of makeup water required and therefore result in water savings. The reduction in makeup water also results in less makeup water treatment chemicals required to treat the makeup water and thus water and chemical cost savings. The reduction in water and chemicals can be calculated by doing a mass and energy balance analysis.

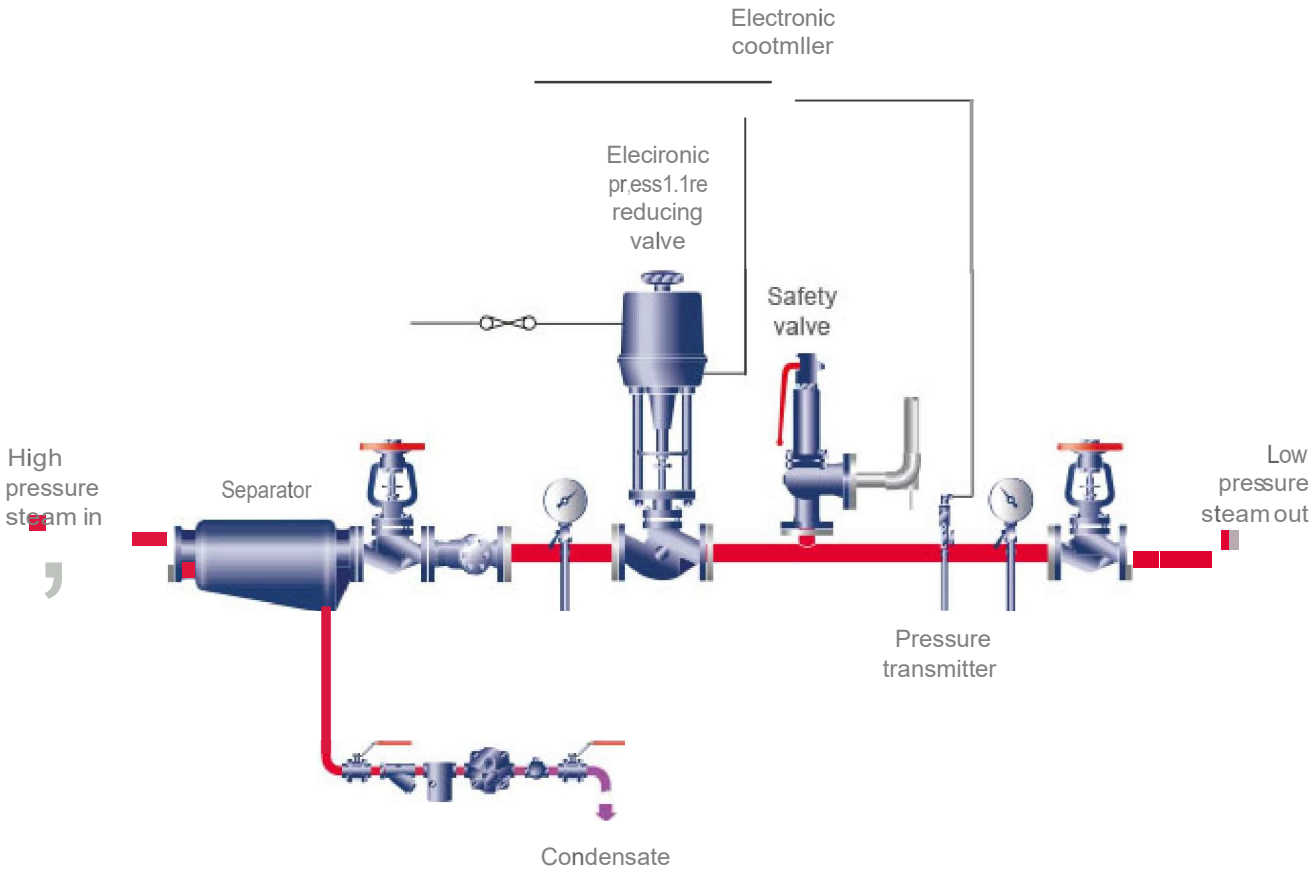

FIGURE 1 GENERAL ARRANGEMENT OF AN ELECTRIC PRESSURE REDUCING STATION

References:

(1) SPIRAX-SARCO, INC; 4647 Saucon Creek Road, Center Valley, PA 18034; Pressure Reducing Valves

(2) US Department of Energy; Washington, DC 20585-0121; DOE/G0-102005-2193, Steam Pressure Reduction Opportunities and Issues