POWERHOUSE HEAT RECOVERY SYSTEMS

Diesel plants can be equipped with a system that captures jacket water heat from the diesel engines so that it can be used for heating other buildings referred to as the "end user buildings". Pre-insulated arctic pipe either cross-linked polyethylene (pex) or steel is typically routed below grade from the power plant to end user building. Heat exchangers separate the engine coolant from the fluid that circulates through the arctic pipes and allows heat to transfer between the two fluids. Pressure gauges and thermometers are installed in key locations to allow the system operation to be monitored.

HEAT EXCHANGER – A brazed plate heat exchanger (HX-1) is installed between the engines and the radiators. The heat exchanger is used to recover heat from the engines and transfer it to the heat recovery system and the intermediate tank heat coil. The heat exchanger provides a separation between the engine coolant and the heat recovery system. A pump circulates hot engine coolant from the discharge pipe through the "hot" side of the heat exchanger. Another electric pump (P-HR3) circulates fluid through the "cold" side of the heat exchanger to the heat recovery arctic pipe which runs outside of the plant. The heat exchanger is equipped with isolation valves, drain valves, and thermometers on all 4 ports and pressure gauges and pressure relief valves on both sides.

NORMAL OPERATION - The heat recovery system is designed to reduce the amount of fuel consumed at the end user building and is not intended to serve as the primary heat source. The heating system in the end user building must be fully operational, maintained and set to operate at appropriate temperatures to allow the heat recovery system to function. The amount of heat available for recovery varies with the electrical load on the

generators. One pump circulates hot engine coolant through the “hot” side of the heat exchanger and another pump circulates heat recovery fluid through the “cold” side of the heat exchanger and arctic pipe. Both pumps should run continuously during the heating season. When the pumps run the pressure gauge on the downstream side will be higher than on the upstream side. Proper operation can be verified by turning the pumps off momentarily and then back on and watching the pressure gauges. The hot fluid leaving the heat exchanger should be 170F-190F and the returning fluid should be 10F-20F colder, depending upon the heat load. The pressure in the arctic piping loop should be 30 PSI – 40 PSI when the system is at normal operating temperature.

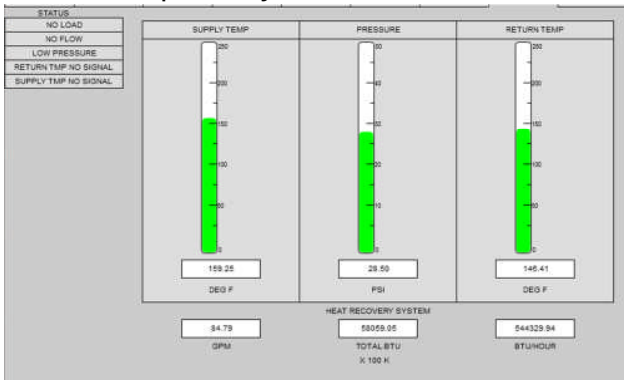
EXPANSION TANK & GLYCOL MAKE-UP – The heat recovery system has a separate expansion tank that provides room for expansion and contraction of the fluid as the temperature varies. The expansion tank is a sealed tank that contains a bladder with an air pre-charge. There is no site level gauge on the sealed tank so proper operation must be monitored by observing the system pressure. The heat recovery system is typically charged with a 50% mix of Safe-T-Therm propylene glycol and treated water. Note that this is different than the engine coolant. When the system pressure drops add only pre-mixed solution identical to the original fluid, ***do not add water or other types of anti-freeze***. A piping connection is mounted near the expansion tank for adding fluid. Because of the relatively high pressure of the system, an electric pump such as a “little giant” is required to add fluid. Place the pump suction hose in the drum or pail of pre-mixed glycol solution. Open the valve labeled “NORMALLY CLOSED, OPEN ONLY FOR ADDING FLUID, PROPYLENE GLYCOL ONLY”. Operate the pump until the system pressure is 40 PSIG if the system is hot or 20 PSIG if the system is cold. Close the valve, remove the pump and hoses, and seal the drum or pail.

AIR VENTS – Automatic air vents are installed in the heat recovery piping system. They are located near the heat exchangers and any other high points in the system. The isolation valves are normally left closed to prevent leaking. Air must be vented from the system at least two times per year and whenever new fluid is added. See Section 2.3 - Six Month Inspection and Maintenance for procedure.

END USER BUILDING – Another heat exchanger (HX-2) is installed in the end users building typically in or near the boiler room. If the end user is using the recovered heat to for potable water tempering such as a community water treatment facility then the heat exchangers should be double wall to help prevent contamination of the drinking water in case of heat exchanger failure. The heat recovery arctic piping loop from the power plant is connected to the “hot” side of the heat exchanger. The building heating system return pipe is connected to the “cold” side of the heat exchanger. Under normal operation

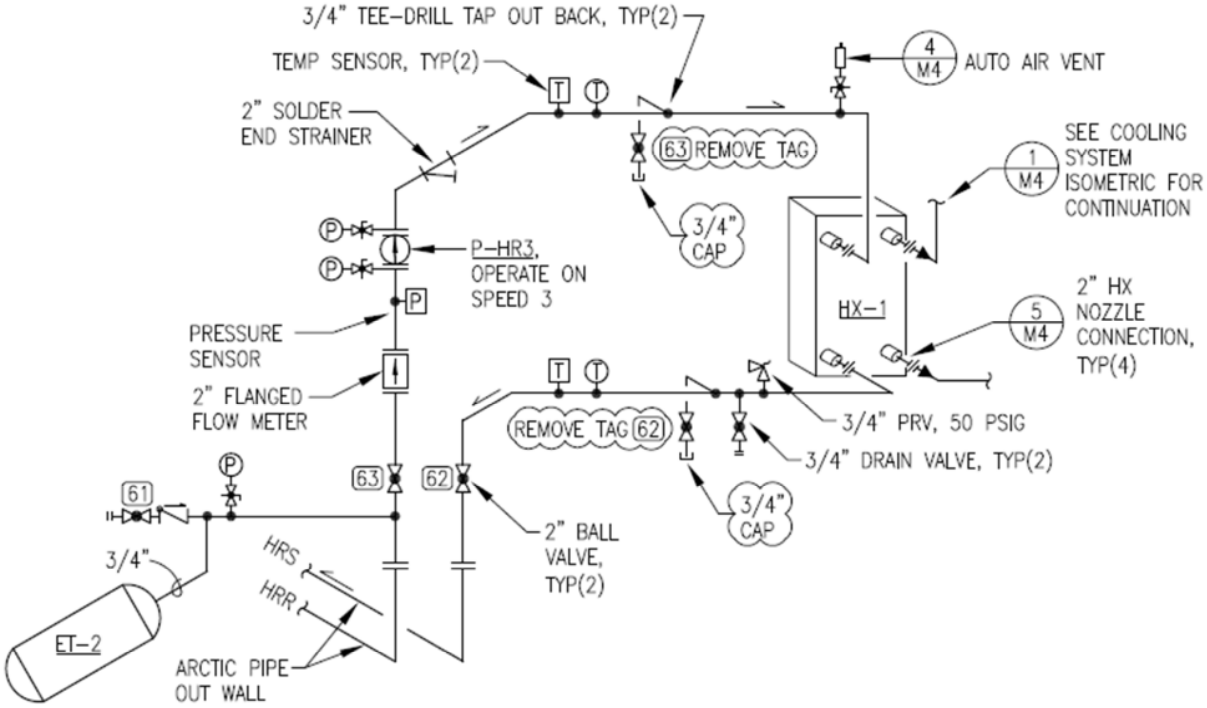
the heat exchanger pre-heats the fluid before returning to the boiler. When the amount of recovered heat available is equal to or greater than the heat demand in the building, the heat recovery system will maintain the building temperature and the boiler will not fire. When the heat demand exceeds the amount of recovered heat available, the building heating piping temperature will gradually drop until the boiler fires. To ensure proper system operation the boiler should be set to fire at no lower than 160F and to shut off at no higher than 180F.

ALARMS – The master section of the switchgear and SCADA has indicators that show problems with the heat recovery system. If the flow rate in the heat recovery piping drops below a pre-set level, a red “LOSS OF FLOW” will illuminate. The most likely causes are a closed valve or a failed pump. The alarm will automatically clear once flow is started. If the pressure in the heat recovery piping drops below a pre-set level, a red “LOSS OF PRESSURE” will illuminate. The most likely cause is a leak in the piping. The alarm will automatically clear once the system is returned to normal pressure. If the temperature in the heat recovery return pipe exceeds the temperature in the heat recovery supply pipe for a preset time interval (usually 1 hour) the amber “NO LOAD ON HEAT RECOVERY” will illuminate. This can occur for brief intervals when the boiler at the end user building fires but it should clear under normal operation. If this alarm stays on for an extended period of time it indicates that the recovered heat is not being used and possibly that heat from the end user building is being wasted through the power plant radiators. The most likely causes are that the boiler at the end user building is set too high or the engine cooling system is operating below the normal range. Check the thermometers in the piping to determine the cause of the problem and make adjustments to the system as required.

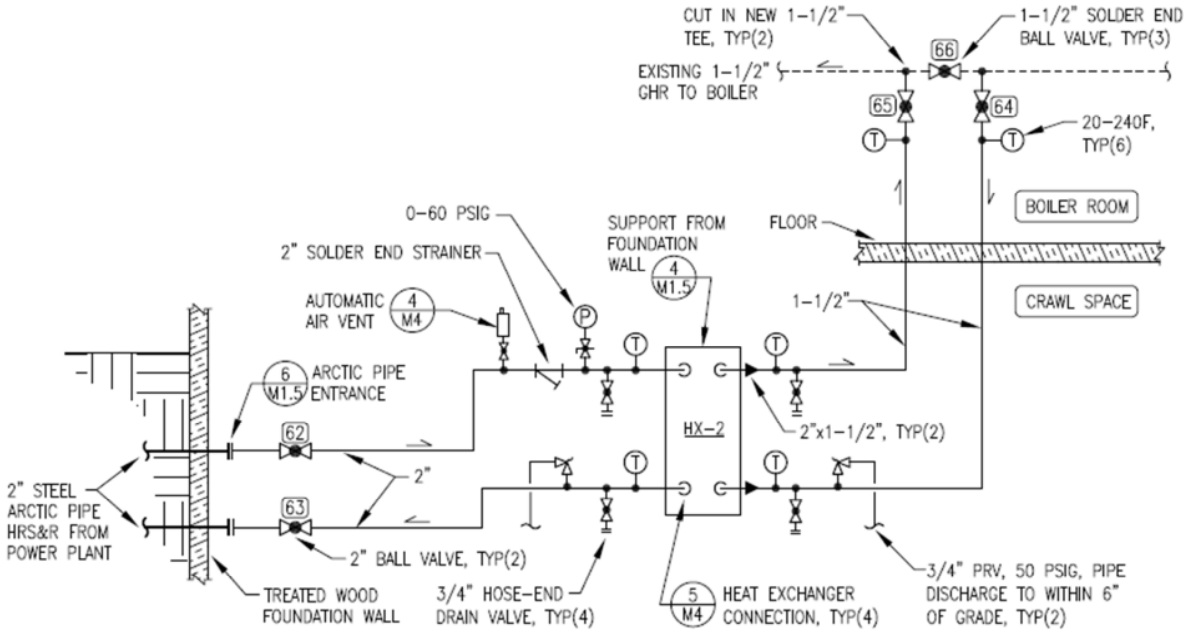


ENERGY METER – The heat recovery system is equipped with an energy meter to record the amount of recovered heat that is used. The energy meter consists of a flow meter and temperature sensors for the supply and return pipes. The flow meter and temperature sensors are typically located in the power plant near the heat exchanger and measure the amount of heat leaving the power plant. The PLC calculates rate of heat transfer

and records the total heat delivered. A display screen on the operator interface unit shows the flow rate in gallons per minute (GPM), the pressure in PSI, the supply and return temperatures in degrees F, the heat transfer rate in BTU/hour, and the total heat transferred in BTU. Note that the units of the total heat transfer display are actually 100,000 BTU which is roughly equivalent to the heat in one gallon of diesel fuel.



Powerhouse



End User Building