INSITITUTE OF POWER ENGINEERS

Spring Newsletter 2017

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Upcoming Events

2017 Annual Golf Tournament
The NS Branch of the Institute of Power Engineers will be hosting its annual golf tournament on August 16th at the Greenwood Golf Club. More information will be posted as event planning continues.

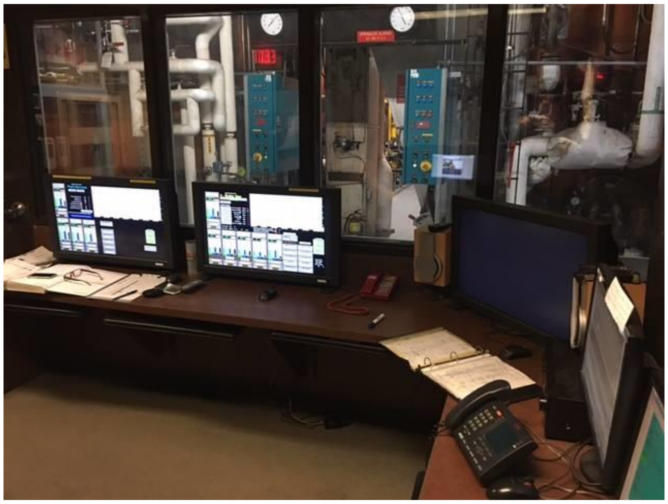
2017 Nova Scotia Chief Power Engineer and Chief Operator Conference This years' conference will be held November 8th and 9th at the newly renovated Double Tree by Hilton Dartmouth - Halifax (formerly the Holiday Inn Harbourview). Planning for this years' conference and we will update the information as it becomes available.

Please add these dates to your calendar.

"Places the IPE have toured"

TOURS AND MORE TOURS ….

THE VG BOILER PLANT



The VG Boiler Plant is a high pressure steam plant rated at 88,146 kw. The plant operates three 100 KPPH packaged water tube boilers at 120 psig drum pressure and 110 psig header pressure. Plant steam load will fluctuate between 20 KPPH during nights in the summer to 100 KPPH on the coldest days of winter.

The tour also included a visit to our three central chiller plants. The Centennial building chiller plant has three 300 ton chillers (840 M.H.P.) operating on R-22 refrigerant, the Mackenzie chiller plant has three 450 ton units (1282 M.H.P.) operating on R-22 refrigerant and the Rehab building plant has a MultiStack chiller consisting of four 80 ton units operating on R-134A refrigerant.

Attendees were also introduced to some of the mechanical heating and ventilation systems as an awareness of what the 3rd Class Assistant Shift Engineers at the VG are responsible for during their mechanical room rounds.

Thank you to David Horne, Chief Power Engineer at the VG, for taking the time to conduct the tour.

HEFLER BIOMASS PLANT

HISTORY

1866	Started Hefler Lumber Company by Erastus Hefler with an Up-down mill
1934	Royce Hefler joined his father Harry Hefler at age 12 The family moved to a rotary mill powered by water wheel The mills main business was the manufacturing of barrel hoops and staves
1945	Royce Hefler took over the business from his father Harry
1950	Royce started to work on producing long lumber for construction The mill moved to its present location, which was the site of the Thomas mill Royce Hefler operated both mills for a time then built an electrically powered oxford mill
1952	Installed the first Yates matcher planner in Nova Scotia
1965	Installed a de-barker and chipper to extend their business
1978	Mill was rebuild after extensive fire damage and updated to produce 5 million board feet of lumber per year
1981	After a second fire, the mill was rebuilt this time capable of producing 8 million board feet per year
1989	Hefler Lumber joins with Mobile Concrete to form Sackville Concrete
1990	A new kiln was installed allowing the mill to dry up to 50,000/bf a day
2014	Hefler Forest Products has been rebranded as Hefler Quality Lumber
2015	Biomass Energy Plant construction completed

The process uses thermal gasification, which produces heat, electricity and water vapor. The only by-product is ash (mineral). The thermal gasification of solid fuels can be characterized by the following significant phases:

The furnace burns uses biomass in the form of unmarketable wood to create heat. The furnace operates under a slight negative pressure created by the induced draft (ID) fan. The fan is located before the gas stack and draws the hot flue gasses from the gasification zone into the final combustion zone then through the boiler and gas handling and cleaning equipment.

As the hot gasses pass through the boiler, the energy recovery phase of the gasification system converts the thermal energy in the hot gasses into steam. The result of these individual processes is a controlled and efficient conversion of biomass into thermal heat that is transformed in the boiler to steam. This minimizes emissions as the emissions are double burned to achieve a clean stack.

The only thing left to vent to the atmosphere is low pressure steam and heat.

The steam is directed to a two sage turbine which is connected to a 3.1 MW generator directly connected to Nova Scotia's electrical grid.

The waste heat and steam will run the kiln, displacing the use of diesel fuel. It can also be used for other activities such as a thermal wood oven.

We would like to thank Clayton White, Hefler's Lead Shift Power Engineer, for conducting the tour of the plant.

A BOILER: THE EXPLOSIVE POTENTIAL OF A BOMB

William Axtman

Category : Incidents

Summary: This article was originally published in the Winter 1996 National Board *BULLETIN*.

This classic BULLETIN *article is a sobering reminder of the explosive force of boilers and pressure vessels. From home hot water heaters to industrial-size boilers used in public buildings, the explosive potential of pressure equipment is present and real. Public awareness of the importance of proper maintenance and inspection is vital for personal and civic safety.*

Some code requirements may have changed because of advances in material technology and/or actual experience. The reader is cautioned to refer to the latest edition and addenda of the National Board Inspection Code

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Over the years, various estimates of the potential energy of a boiler or pressure-vessel explosion have been presented, with the intent of demonstrating the danger of this equipment if not properly maintained. Fire and rescue squads have entirely too much familiarity with the explosive potential of even the small pressure vessel in everyone's home or apartment, the hot-water heater – a device that sometimes is under the regulatory jurisdiction of no organization whatsoever.

It is because hot-water heaters are usually so reliable that many consider them benign. But consider this: If you could capture all the energy released when a 30-gallon home hot-water tank flashes into explosive failure at 332°F, you would have enough force to send the average car (weighing 2,500 pounds) to a height of nearly 125 feet – or more than the height of a 14-story apartment building – starting with a lift-off velocity of 85 miles per hour!

When this amount of explosive force is unleashed in a basement or utility closet, the shock wave created by the explosion carries dirt, debris, ceiling, pipe, darkness, and burning temperatures in all directions with tremendous force. The result is devastating damage to anything in the vicinity. Whole houses can be leveled. Nearby cars can be tossed around like playthings. Furniture, even several rooms from the point of the explosion, will become airborne. People in the same building or on a nearby sidewalk or parking lot can be injured or killed. All of this is due to the power unleashed in a shock wave of energy as the pressure vessel explodes. In a fraction of a second, as hot water flashes to steam, everything turns to darkness and destruction.

Fortunately, such disasters are rare, considering the huge number of boilers and pressure vessels in use worldwide. So the general public only hears about the occasional explosive disaster associated with a pressure-vessel failure. However, the explosive potential is ever present and very real, especially if regular maintenance and repair are ignored.

Standard physics laws of temperature and pressure are used to measure the explosive potential of boilers and pressure vessels. New calculations show, for instance, that if liberated in a rupture, a 30-gallon hot-water tank at 90 psig (or 104.7 psia) has approximately 314,095 foot-pounds of energy to flash its water into steam at 332°F. Translate that force potential into real-world terms and you have the example of the car being rocketed into the air as noted above. Another way to look at this 300,000 foot-pound figure is that it equals the explosive force of 0.16 pounds of nitroglycerin.

Yet another approach to examine the potential explosive force is the flashpoint conversion factor for water to steam. Here the increase in volume is a factor of approximately 1,600 to 1. So when water or a similar dense liquid that normally needs one cubic foot for containment suddenly needs 1,600 cubic feet, explosion occurs. That's like taking the volume of an 5-gallon bathroom trash can and causing it to fill a 12- by 11-foot living room with an 8-foot ceiling in a split second. Such a dose of explosive power propagates the shock wave that inevitably does most of the damage to property and humans.

Several operational situations can bring on the violent, deafening blasts that result when a buildup of pressure is suddenly released. A common cause of explosion is the runaway firing condition that takes place when the boiler's burner does not shut off. In this case, when the hot-water heater is connected to the city water supply on one side and the building hot-water service on the other, the check valve will shut off and no back pressure will go into the city side. Instead, the tank will take the pressure. As a result, the temperature in the tank will rise. And this temperature rise will compromise the tank structure, weakening the metal around the bottom of the tank and causing a sudden failure.

Of course, a properly functioning pressure and temperature relief valve would prevent such a failure. But a properly installed and maintained safety valve is not a universal feature of pressurized vessels.

Another type of explosion is caused by superheated liquid. Here the resulting vapor explosion occurs when a liquid transforms quickly into a gas, causing a rapid pressure increase. Actually, a typical malfunction can result when normally benign, saturated steam is forced out of its temperature/pressure equilibrium by a combination of valves shutting and extra energy being introduced into the system. These conditions disrupt the temperature/pressure balance, causing the fluid (steam) system to seek out a new equilibrium.

When this occurs in a closed vessel, as the liquid accidentally heats above its boiling point, the frantic and almost instantaneous physics of the system trying to re-establish equilibrium can result in explosion. Often, part of the vessel breaks away because the liquid is vaporizing to gas so rapidly. The rarefaction wave moves within the vessel and the resulting compression wave violently forces the liquid particles out through the vessel breach. This sequence of events spells split-second disaster.

Firefighters and other well-trained emergency personnel follow important protocols for identifying flows of superheated material. They are trained to assume a mine-field-type situation exists if they hear a leak. Everyone stops moving immediately. Someone at a safe peripheral location at the incident scene cautiously holds up a broom handle or 2- by 4-inch board and waves it across the breach where the invisible but searing steam might be. If present, the steam will literally cut the wood. If a human hand were to reach up unsuspectingly, trying to detect the steam, it too, could be cut by superheated steam! Instead, the length of wood indicates the area of the leak – or, preferably, the clear path around the leak – and the personnel can be shown a path to safety.

Preventing catastrophic failure of any boiler or pressure vessel has always been a concern of the National Board. Boilers in dry cleaning operations, pressurized steam cleaners in jewelry shops, air compressors used by painters, pressurized air systems used with power hydraulic lifts in auto repair shops, even instrument sterilizers in dentists' offices – all are capable of causing injury due to explosion. On one hand, they rarely are inspected for proper mechanical performance and structural integrity. On the other hand, their operators are occasionally guilty of rigging the wiring or controls intended to prevent potentially explosive operational problems. And as a complicating factor, each state or province has its own inspection rules, and most apply only to commercial operations of a certain size or to water heaters or steam heat systems in dwellings that hold four or more housing units.

The National Board is conspicuously aware of the explosion hazard of boilers and pressure vessels. For most of this century, the public, law enforcement agencies, emergency response teams, and industry standards groups have looked to the National Board for assistance in setting guidelines for boiler safety. One of those areas of concern is the actual force generated by explosive failure – and how best to increase public awareness and safety practices to control this explosive potential.

Because the dangerous potential of boilers is a situation that can be controlled, the National Board has an opportunity to extend its leadership role in the arena of safety. Explosion depends on how the vessel fails, when it fails, and how close people or properties are when the rupture occurs. Better quality safety standards and information allow the National Board to better serve the industry and the public. And that is exactly what the National Board views as a primary goal.