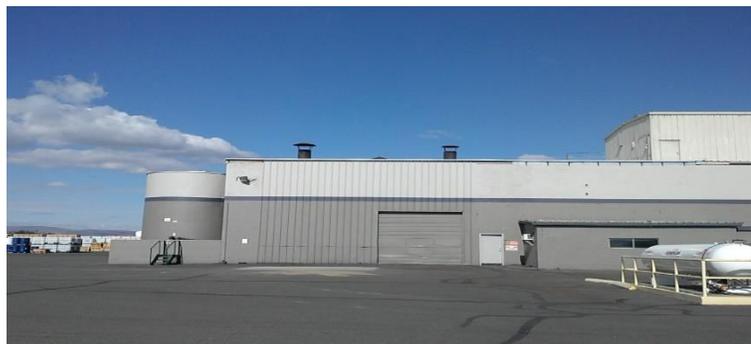




## Case Study - 600 and 700 HP Steam Boilers - Scale

(Case study updated on June 10, 2013)

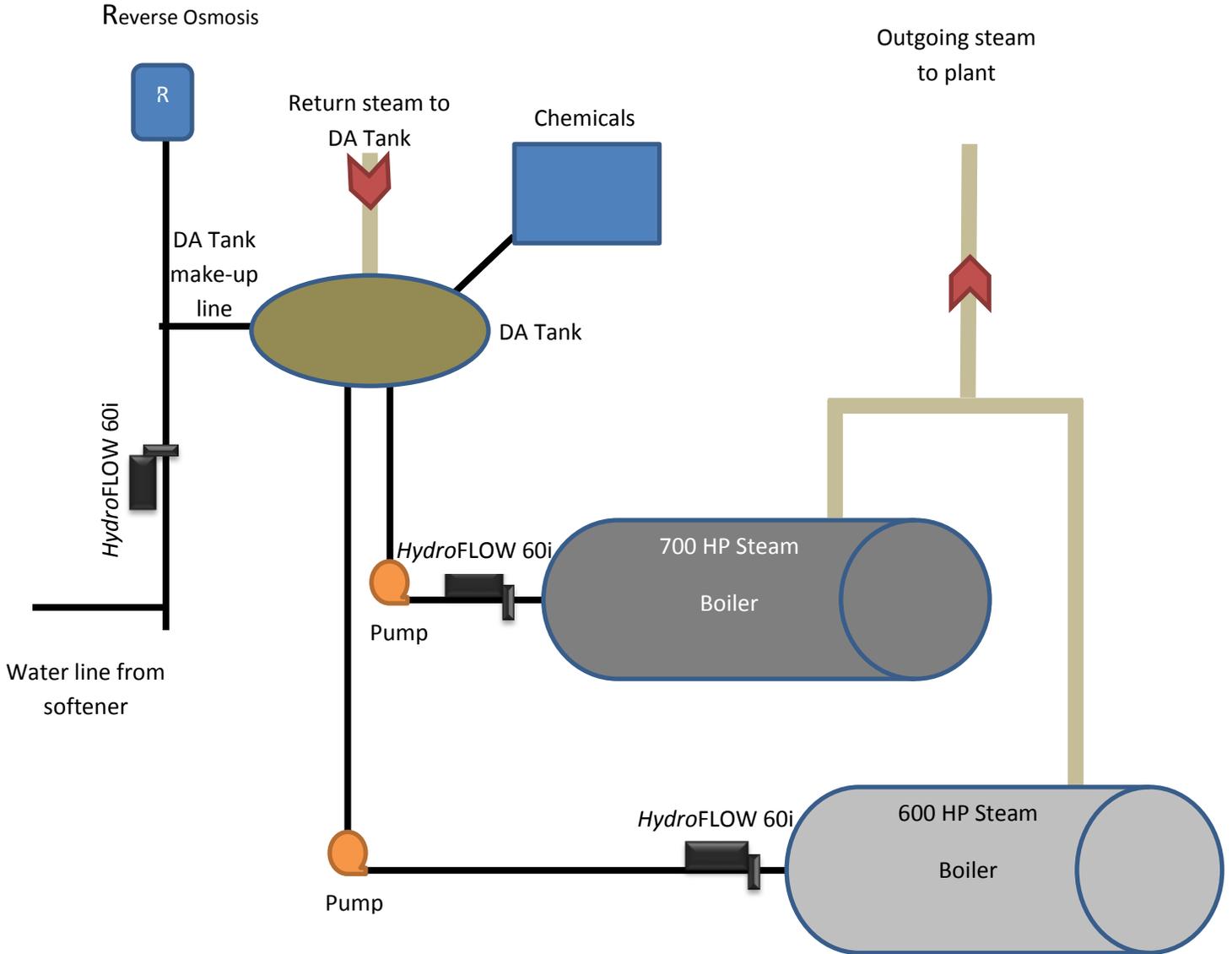
- Installer:** MBI Water Solutions - *HydroFLOW* Master Distributor in the US Pacific Northwest.
- Customer:** Chemical Plant in Wapato, Washington, USA. Please contact Rudy Nicacio, Manager of MBI Water Solutions, in order to receive the customer's contact information. Phone: (509) 453-3326 Email: rudy@mbiyakima.com
- Application:** 600 and 700 horse power low pressure diesel steam boilers.
- Installed units:** One *HydroFLOW* 60i unit was installed on the water line, after the softener, which provides make-up water to the DA tank. Two *HydroFLOW* 60i units were installed on the incoming water line feeding each steam boiler.
- Water source:** Well water with a hardness of roughly 200PPM of calcium carbonate. Note: The water softener reduces the hardness to around 80PPM.
- Chemicals:** Anti-scalant, anti-corrosive and iron inhibitor chemicals.
- Installation date:** January 30, 2013
- Background:** Due to excessive lime scale accumulation, the diesel steam boilers were on the verge of being decommissioned for a week in order to be acid cleaned; a process which typically costs over \$15,000. In addition, there was a strong possibility the steam boilers required replacement (\$350K each). The head of maintenance decided to evaluate *HydroFLOW's* ability to clean the steam boilers and possibly avoid acid cleaning.
- Success factors:** Remove scale deposits from the steam boilers, DA tank and pipes without the need to acid clean and lose a week's worth of production time.



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### System Configuration





**DA Tank**



**HydroFLOW 60i on water line from softener**





## 600 HP Steam Boiler



## HydroFLOW 60i on pipe feeding the steam boiler





## 700 HP Steam Boiler



## HydroFLOW 60i on pipe feeding the steam boiler





## Results

4 months before HydroFLOW install



8 months after HydroFLOW install (No Salt)



*\*Note Elimination of White hard Scale. Upon next inspection there will be a black magnetite formation on the Pipes.*

## Lime scale from blow-down



- Within a few days, soft chunks of grayish and reddish scale and “putty” (wet calcite crystals) began washing out via blow-down.



- Immediately following installation and after consulting with the manufacturer of the steam boilers; the maintenance supervisor increased blow-down frequency to every two hours for the initial 2.5 months. Increasing the blow-down frequency accelerated the removal of scale deposits from the system. Currently, the steam boilers are being blown-down 3 times a day.
- The water softener was bypassed less than a month after installation, which led to acceleration in the removal of scale from the system.
- Chemicals are yet to be reduced. Note: Following a water analysis by a *HydroFLOW* representative, some chemical reduction can be achieved. See below Steam Boiler Questions & Answers and Water Test Requirements for additional information.
- Within 2.5 months, the stack temperature of each steam boiler reduced from roughly 650 degrees F (at Low Fire) to roughly 400 degrees F (at High Fire), indicating increased efficiency.
- Within 2.5 months, fuel consumption went down from 400 to 275 gallon per day; which translates to roughly \$150K savings annually.
- Due to the great results, the customer decided to delay the possible replacement of the steam boilers (\$350K each).
- Quote from the maintenance supervisor: "I'm very pleased with *HydroFLOW*'s results. Instead of dreading it, I'm actually looking forward to the next state inspection!"

## Low Pressure Steam Boiler Questions & Answers

### What are the basic guidelines for steam boiler applications?

- Customer to provide *HydroFLOW* USA with DA/condensate tank feed water analysis, current chemical usage data and picture documentation of the steam boiler's tubes and internal cavity.
- Install a *HydroFLOW* water conditioner before each boiler and condensate tank.
- Continue with the regular chemical regimen. An ROI of roughly 6 months will be achieved thanks to heat transfer efficiency gain, which is attributed to lessened fuel consumption due to scale removal.
- Water softener should be bypassed and chemicals should be reduced ONLY after the initial 3 month inspection proves the *HydroFLOW* device is operating properly. *HydroFLOW* USA will work with customer to determine which chemicals can be reduced.
- Periodic inspections should be conducted in order to locate a problem, and correct it, before it becomes severe.

### How is it possible to know if the water conditioner is having a positive effect?

- A visual inspection of the steam boiler's tubes and internal cavity should be performed in 3 month intervals. The purpose of the inspections is to verify that the water conditioner is removing and/or preventing lime scale accumulation.



- As lime scale deposits will begin to remove; stack temperature is expected to gradually drop due to lessened fuel consumption. In new or recently cleaned boilers; stack temperature is expected not to significantly increase.
- If applicable, a gas/fuel meter feeding the steam boiler can be monitored in order to verify lessened fuel consumption.

**Note: It is very important to obtain photo documentation of the steam boiler's baseline conditions prior to the installation and during each inspection. The purging of lime scale can last up to one year if the existing lime scale deposits inside the steam boiler are extreme.**

#### Possible negative effects?

Negative effects are not expected but the following side effects may occur:

- Removal of lime scale flakes could accumulate in the bottom of the steam boiler's cavity and should be discarded if they impede the steam boiler's operation.
- During the initial months of operation, lime scale debris may begin to clog the pump screen of the condensate tank or accumulate inside the condensate tank itself. The accumulation of debris will gradually decrease and eventually stop over time.
- Blown-down water may be reddish with rust and include lime scale particles that are being removed. Over time, the water will become clearer.

#### After installation, should the standard blow-down schedule be maintained?

The blow-down schedule should be increased by 50% during the initial purging stage of 3 ~ 6 months in order to assist in the removal of lime scale. Customer should consider implementing automatic blow-down in all steam boilers and introduce standardized boiler blow-down and maintenance procedures.

#### Is periodic water testing necessary?

Yes, refer to the "HydroFLOW Water Test Requirements for Steam Boilers" document.

#### What routine maintenance does the water conditioner require?

The water conditioner has no moving parts and typically lasts well over 10 years if maintained properly and installed with an adequate surge protection device. Weekly preventative maintenance inspections should include a visual check to ensure the mounting hardware is fastened securely, the red and green lights are glowing brightly, the ferrite ring is intact, the polymer screws are tight and the unit is clean.



## Water Test Requirements

**Make-up water test requirements (from city or well) - water sample to be taken before the water softener and chemical injector.**

- **Total Hardness in PPM (parts per million)<sup>[1]</sup>**
- **Hardness as Calcium Carbonate (CaCO<sub>3</sub>) in PPM**
- **Magnesium (Mg) in PPM**
- **Silica or Silicon Dioxide (SiO<sub>2</sub>) in PPM**
- **Iron (Fe) in PPM<sup>[2]</sup>**
- **Chloride (Cl) in PPM**
- **Dissolved Oxygen<sup>[3]</sup>**
- **pH<sup>[4]</sup>**
- **Alkalinity**
- **Conductivity**
- **Ferrous metal corrosion rate in MPY (mils per year)**

[1] Following proper installation of the *HydroFLOW* water conditioner on the steam boiler's incoming water line; the water softener should be bypassed and the use of scale inhibiting and anticorrosive chemicals can be discontinued.

[2] *HydroFLOW* water conditioners have no effect on iron. Consult with your chemical provider if iron levels are over 0.1 PPM (for low pressure steam boilers) or 0.05 - 0.02 PPM (for medium to high pressure steam boiler).

[3] *HydroFLOW* water conditioners have no effect on dissolved oxygen. A deaerator and/or oxygen scavenger chemicals may be required if the oxygen level is over 0.04 PPM (for low pressure steam boilers) or 0.007 PPM (for medium to high pressure steam boilers).

[4] Low pH (acidic water) may be harmful for steam boilers. Consult with your chemical provider if the pH is below 7.5.

**Blow-down water test requirements.**

- **pH<sup>[1]</sup>**
- **Conductivity<sup>[2]</sup>**
- **Ferrous metal corrosion rate in MPY (mils per year)<sup>[3]</sup>**

[1] It is recommended to contain a pH level of over 9. Chemicals may be required and blow-down may need to be reduced in order to increase the level of pH.

[2] *HydroFLOW* water conditioners are designed to work at high conductivity levels. It is recommended to follow the steam boiler's manufacturer instructions (typically 3,000  $\mu\text{S}/\text{cm}$ ). It is recommended to increase blow-down by 50% during the initial purging stage of 3 ~ 6 months in order to assist in the removal of limescale. As conductivity levels stabilize, the blow-down schedule can be reduced according to water testing parameters.



[3] Typically, although the actual corrosion rate is reducing, the measured corrosion rates (i.e. the amount of iron in the water) will increase following the installation of a *HydroFLOW* water conditioner due to the system being purged of existing limescale and corrosion deposits. Gradually, the measured corrosion rate will decrease and stabilize at roughly 30% less than what is was prior to the installation of the water conditioner.