

Frequently Asked Questions about Once-Through Steam Generators

As Manufactured by **Innovative Steam Technologies**

What is an Innovative Steam Technologies (IST) Once Through Steam Generator (OTSG)?

IST designs and manufactures heat recovery steam generators that recover the heat available in a gas turbine exhaust stream. The steam generator has a once through flow path on the water/steam side; therefore all water that enters the OTSG leaves as superheated steam without any recirculation. Steam drums are therefore not required and are eliminated in this design.

If there are no steam drums, how is steam purity maintained?

Since all water that enters the unit leaves as superheated steam, the cleanup of the water must be done upstream in the feedwater treatment plant. Good quality water entering the OTSG results in good quality steam going to the steam turbine.

Isn't the requirement for ultra pure-water very expensive for the OTSG?

The water purity required is **not** "ultra-pure". The water purity required can easily be accomplished with existing and proven water polisher technology. This type of equipment is very common in the power generation industry and is available at a reasonable cost from many suppliers.

Since there are no drums, isn't it difficult to control the OTSG?

The OTSG control is based on controlling steam temperature through a feedback signal that adjusts the feedwater control valve. There is also a feed forward control that senses a change in gas turbine load and pre-adjusts the feedwater control valve to the new expected flow. This control system has proven to provide excellent control in the OTSGs installed to date.

In a process steam application, the OTSG can also be configured to maintain a header pressure by adjusting feedwater flow. In this case, an outlet attemperator is required to maintain steam temperature at desired levels.

What does the term dry-running mean?

Depending on the alloy used in the OTSG tubing and the maximum expected gas turbine exhaust temperatures, it is possible to run the gas turbine at full load while shutting off all water to the boiler. This eliminates the need for a bypass

damper and associated stack and silencer, thus eliminating a large capital cost item and also the efficiency lost due to the leakage through the bypass damper. The OTSG is also capable of starting up when running in this condition. When dry-running is not required, less expensive alloy tubes can be used in the design of the OTSG.

Can steam flow be reduced in an OTSG while maintaining gas turbine load?

It is possible to reduce steam flow while maintaining gas turbine load. In this mode of operation, the steam temperature leaving the boiler will increase and an outlet desuperheater is required to maintain steam temperature at levels desired for the steam turbine or process.

How long will the tubes and fins tolerate dry operation?

The tubing, due to their alloy nature, can handle dry operation for indefinite time periods. The fins however, are usually manufactured from carbon steel and oxidize at a slow rate during dry operation. This still allows tens of thousands of hours of dry operation with negligible effect on fin thickness and boiler performance. If extended dry operation is expected, stainless steel fins can be used.

Are there any capacity limitations for the OTSG?

IST's product line currently extends up to 50MW gas turbine sizes for combined cycle and cogeneration applications. Steam injection boilers can be built for any size gas turbine. Development work is underway for full-size once through steam generators for large gas turbines and products will be available commercially in 2002.

How does the OTSG efficiency compare with drum type boiler efficiency?

The OTSG can be designed with the same performance and efficiency as a drum type unit. A drum unit does have efficiency loss in boiler blowdown and exhaust gas leakage through the diverter valve in the bypass stack, therefore when these factors are considered the OTSG becomes more efficient.

Can the OTSG be designed with multiple pressure levels?

The OTSG is very suitable for multiple pressure levels, especially since extra steam drums are not required for extra pressure levels. Different pressure levels can be arranged to maximize performance of the boiler. One OTSG installation was designed with three pressure levels for steam plus one for preheating feedwater.

On a dual pressure boiler can either pressure level be operated dry while the other is still operating?

IST's practice is to allow dry operation of the LP level while the HP is in operation, but not vice-versa. This is necessary since the LP system is designed to operate in a lower gas temperature zone. If the HP were run dry, the LP would make much more steam than the level was designed for.

How do you prevent scale and/or deposits in the boiler and steam turbine?

Scale and deposits do not form in the boiler and steam turbine, provided that the water treatment guidelines are followed. Since all the water that enters an OTSG leaves as superheated steam, it is important to maintain the proper quality of feedwater.

What is the normal life of an OTSG?

IST designs the OTSG based on a 25 year life, however during normal operation and field measurements to date, we expect that the actual life will be much longer.

How sensitive is the OTSG with regards to oxygen content in the feedwater?

The alloy tubing used in the OTSG design is **not sensitive** to oxygen attack.

How do you prevent water carryover to the steam turbine?

To prevent carryover to the steam turbine, all pressure levels in the OTSG are operated in a superheated condition. If saturated steam is required, an outlet attenuator is used to control steam temperature.

What are the major advantages of an OTSG over a drum type unit?

There are numerous advantages of an OTSG which are detailed in other literature, however the main advantages are stated below:

- a) Dry running capability without the need for a bypass stack and damper. Eliminating this capital cost item and the associated loss of efficiency due to leakage up the bypass stack are major advantages of the OTSG.
 - b) The small footprint allows for an installation in cramped areas.
 - c) The simplicity of the OTSG results in less expensive subsystems and quicker and less expensive site installation. This most often makes the OTSG the most economical choice for waste heat recovery applications.
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How do you prevent excessive thermal stress during startup and shutdown?

The OTSG is inherently very good from a thermal cycling point of view. Since the OTSG has no steam drum, the pressure parts consist of relatively thin small diameter tubes and headers. This reduces the thermal stresses associated with thick wall pressure parts during startup and shutdown operating scenarios.

How is an integral deaerator handled with an OTSG?

If a deaerator is required for the application, a stand alone deaerator and storage tank can be supplied with the OTSG. A low pressure steam section may be added or high pressure steam may be pegged to provide steam to the deaerator.