



# HRSG TUBE RESTRAINTS UPGRADE

**For Robust Design and Improved Reliability**

## **Improve reliability, reduce O&M costs and prevent consequential damage and tube failure.**

Horizontal gas flow HRSG tubes are exposed to flow induced vibration (FIV) caused by the GT exhaust gas flow profile, gas ducting arrangement and tube arrangement. Tube restraint systems are installed in the harp at vertical intervals to prevent excessive tube movement caused by vibration and thermal expansion.

Tube restraint systems are constructed in different ways depending on HRSG manufacturer, however the exposure to high temperature and continual gas flow, leads to inevitable breakage of the restraint components including clips and supports. Furthermore, flexible plant operation exposes the restraints to high temperature transients increasing the risk of failure. This results in the restraints falling vertically, allowing tubes to move and bend. Eventually, the restraints will become ineffective and lead to tube fin wear and, in extreme cases, tube damage.

## **Improved Reliability**

Plant owners are typically faced with ongoing maintenance costs associated with routine repair of damaged tube restraints. Furthermore, damage to fins and tubes can lead to material loss sufficient to cause tube leakage and forced outages.

GE Vernova has developed a range of tube restraint upgrades, intended to replace (in whole or part) existing restraint systems, so improving reliability.

GE Vernova's upgrade solutions are based on current GE Vernova best practice for new HRSGs but also consider the requirement for an effective retrofit solution. The solutions also build on GE Vernova's own experience in overcoming tube restraint system failures caused by challenging GT exhaust gas flow profiles.

Restraint system upgrades can be completed during scheduled GT Hot Gas Path Inspection (C Inspection).



Figure 1: Fin wear from friction with damaged restraint



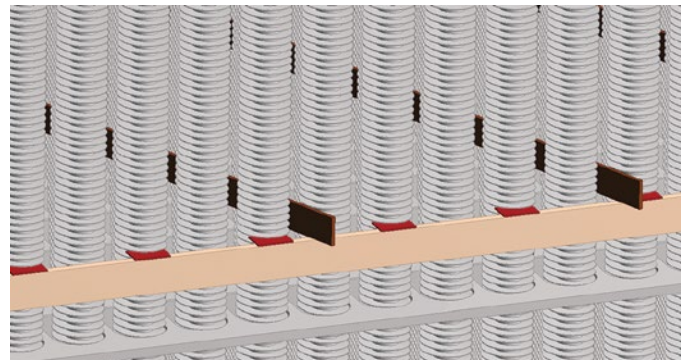
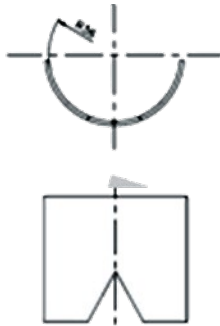
Figure 2: Leaking tubes from damaged restraints

## Tube Restraint Upgrade Solution

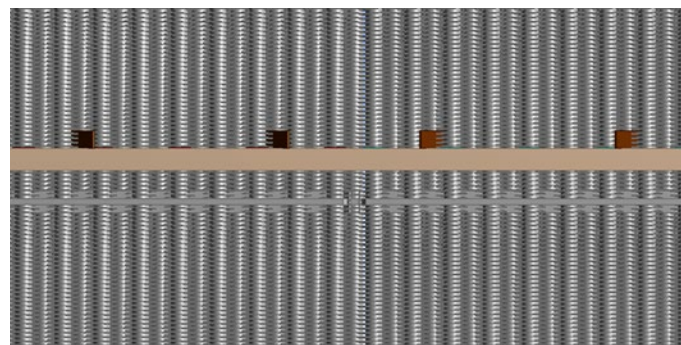
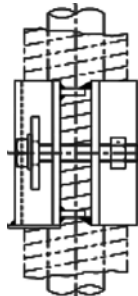
This tube restraint replacement solution is applicable for restraint systems failures in the first two rows of a harp assembly.

The upgrade consists of the following;

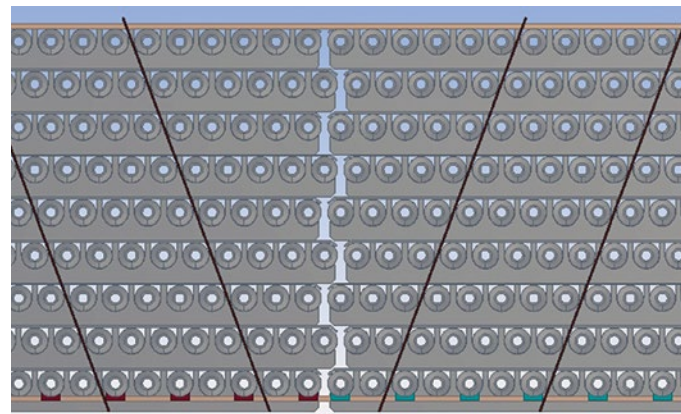
### 1. Tube Sleeves



### 2. Wavy Bar



### 3. Sliding Bolt Type Tie Bar



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