Gas turbine life extension

TOPIC: Crack damages in Exhaust Collector and Exhaust Ducting.

Symptoms:

- Visual cracks
- Cracks detected by NDT
- Burn marks and discolored Collector insulation and duct cladding
- Burn marks and discolored Expansion Bellow soft part
- High turbine enclosure temperature

Concequences:

- Non-compliance with HES regulations
- Non-compliance with Zone Requirements, with risk of fire or explosion if surface hot spots are exposed to hydrocarbons
- Exhaust leakages to surroundings may cause personnel injuries
- Heat damages to surrounding equipment
- Heat damage to Expansion Bellow soft part
- Heat damage to surface protection
- Exhaust leak inside turbine enclosure may cause turbine alarm and trip

How to inspect:

- Visual inspection of internals and externals
- NDT
- Thermography
- Inspect for heat damages to surrounding cables, surface protection, etc.
- Inspect for heat damages on instrument and cables inside turbine enclosure

Non-confirmance reasons:

- Temperature gradients during Start & Stop Cycle
- Structural vibrations induced by exhaust swirls and pulsations
- Unfortunate combinations of material thicknesses
- Unfortunate welding practice
- Design with sharp corners and crack indicators
- Design with insufficient Low Cycle Fatigue life.
- Manufacturing defects
- Mechanical operational loads and environmental loads

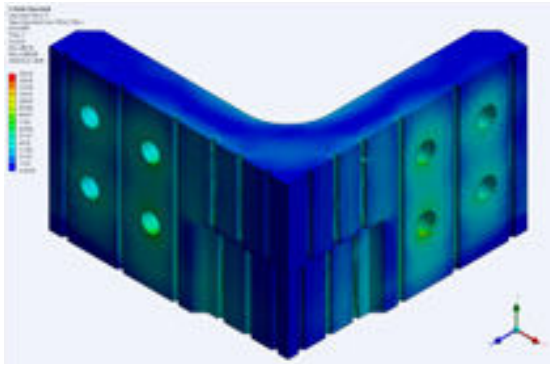
Corrective actions:

- Field scanning of damaged areas
- Install CCRM™ Reinforcement elements
- CCRM™ fasteners type self-aligning HotBolt™, material Inconel 625
- Pre-tension HotBolt™ in steps to avoid embedment relaxation
- Protect HotBolt™ Extension Sleeve from heat radiation
- Bolts to be locked with HotBolt™ Locking Plates.
- Note: Repair welded cracks or welded on patches will re-crack after a limited number of Start/Stop Cycles.

CCRM™ – Crack Cold Repair Method.

- Patented and proven method for cold repair of crack damages.
- Designed for 20-year life with 500 Start/Stop Cycles, with safety factor 2,6

Processed scan of a crack damaged duct corner. The damage has been tried repaired by drilling crack end holes, grinding and welding the crack, and by welding on patches. The repair failed as both the repair welded crack and welded on patches cracked after a limited number of Start/Stop Cycles.



FEM-analyses of CCRM corner reinforcement. 20-year life with 500 Start/Stop Cycles, with a safety factor of 2,6.

Crack damaged corner reinforced with CCRM™.