Remanufacture > Recycle > Re-use

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# ReManufacture+ and failure modes of power generation control valves and ancillary equipment

SpiralWeld Webinar Series

# This webinar will cover...

1. SpiralWeld™ ReManufacture
2. High performance power generation materials
3. Valve criticality in power plant operation
4. Typical wear & failure mechanisms and remanufacture solutions
5. The SpiralWeld™ process
6. Conclusion
7. Q&A session

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# SpiralWeld™ ReManufacture and ReManufacture+

**ReManufacture ("Recycle")**

- We remake the OEM solution
- Recycling the core value
- Incorporating advantages of:
  1. Technological progress
  2. Improvements from operational experience
  3. Elimination of known operational weaknesses
- Part returned to full working condition with a service life at least equal to a new part.

**ReManufacture+ ("Upcycle")**

- We remake the OEM solution **better-than-new!**
- Applying our problem evaluation, redesign and re-engineering process.
- Reduced component failure rates leading to more reliable operations.
- All the benefits of ReManufacture, **PLUS**
  1. Improved MTBF
  2. Reduced cost of maintenance
  3. Reduced lost production costs
- Using upgraded materials with superior properties to suit the service conditions.
- Special surface finishing processes available to further enhance component life.
- ReManufacture+ applied to new parts

# Power generation plant material evolution

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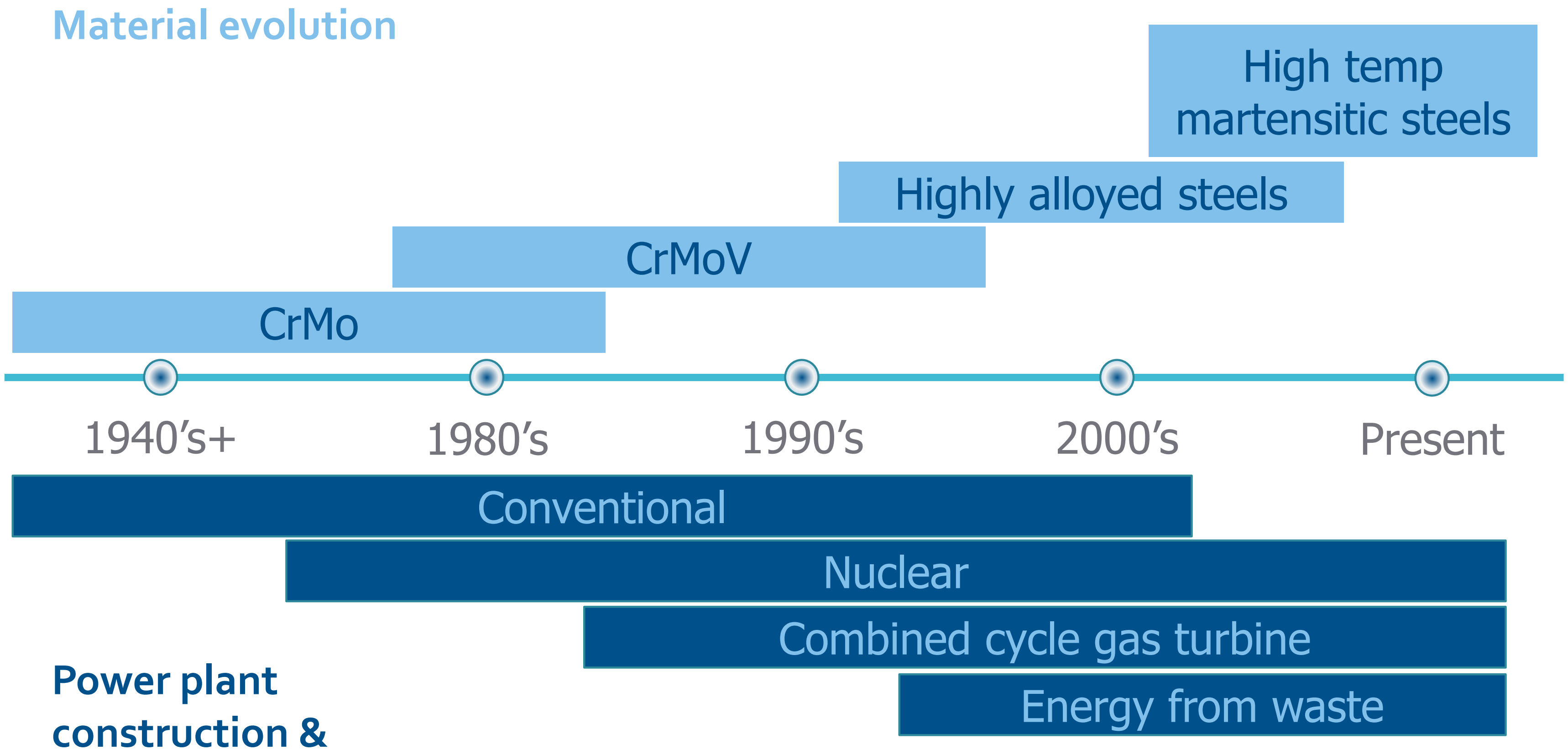
# High performance power generation materials




**Power plant construction & operation**

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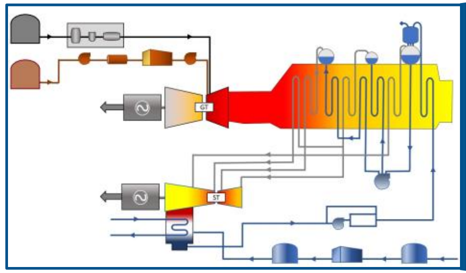
# Valve criticality in power plant operation



Hundreds of valve operations

Feed water
Pollution control
Cooling water
Chemical treatment
Turbine control

Harsh environments
Chemicals
Abrasives
High temperatures
High mass flow rate
Wet steam
**Increased cycles**

**REDUCED**
**Mean Time Between Failure**

- **Widespread in modern thermal plant**
- **Loss of process energy**

# Examples of failure modes and subsequent remanufacture solutions

# Erosion & corrosion

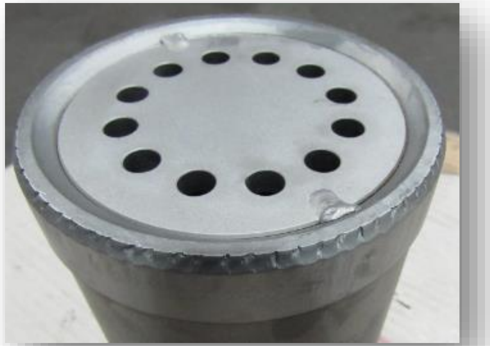
**Erosion –** Wear caused by continuous flow of a fluid (steam/water) gradually damaging and removing material.

**Corrosion** - When a refined metal is naturally converted to a more stable form (e.g. oxide) leading to deterioration of the material.

**Typical components we see:**

Turbine control valves, high, intermediate & low pressure bypass valves, feed water regulators, min flow & condensate valves.

- Main & pilot control surfaces
- High flow control features e.g. flutes, channels



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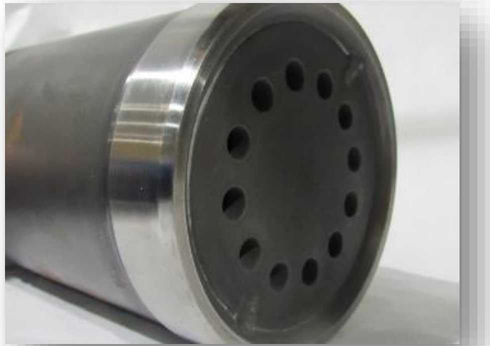
# Erosion & corrosion

**ReManufacture+ Solution**

- Replace critical control surfaces with an advanced hard facing to increase durability
- Return parts to standard dimension
- Extend MTBF to beyond standard inspection cycles
- Improve repairability
- Traceability of part life
- Reduced energy & raw material usage



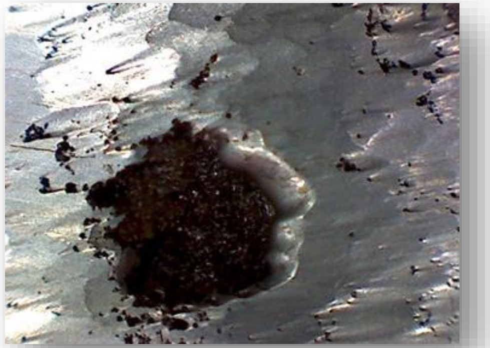
# Microbial infestation corrosion

**Microbial Infestation Corrosion (MIC)** - metal deterioration caused by metabolic activity of micro-organisms

**Typical components we see:**

Water submerged components, particularly with extended period of inactivity.

- Water pump shafts, backwash components, impellers
- Shaft seal locations, impeller surfaces & eyes



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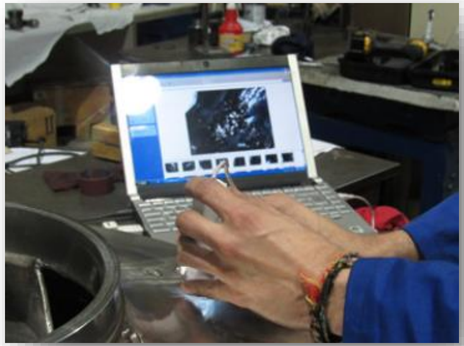
# Microbial infestation corrosion

**ReManufacture+ Solution**

- Map the infestation under microscope
- Excavate & re-inspect until MIC has been removed
- Pre-machine, if required
- Recover with suitable weld overlay to qualified procedures
- Machine to drawing dimensions
- Full non-destructive test at final inspection



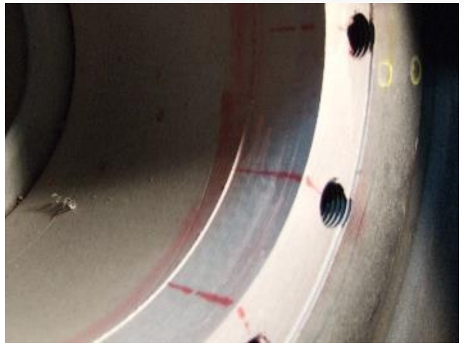
# Crack propagation

**Crack initiation** can be due to many mechanisms

**Crack propagation** addressed by excavation and recovery

**Typical components we see:**

- Pump casings
- Shafts
- Valve bodies and control surfaces

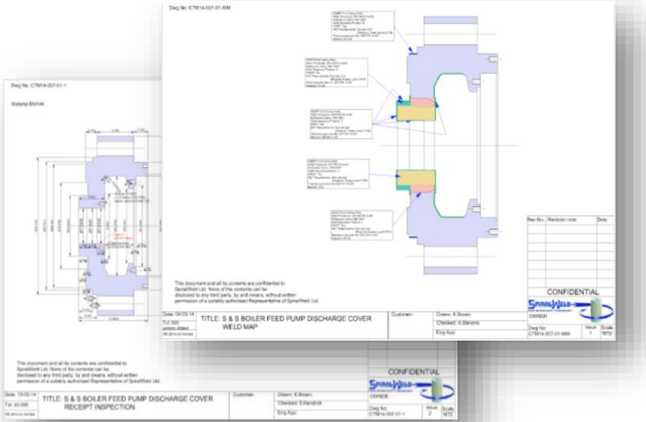


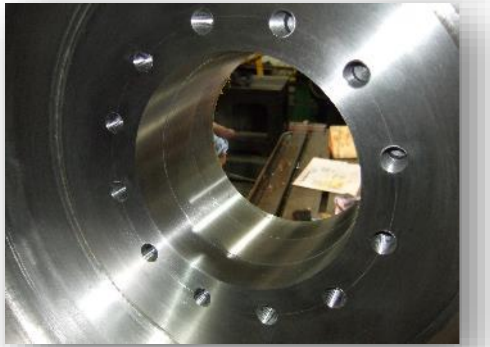
# Crack propagation

**ReManufacture+ Solution**

- Detailed inspection & reverse engineering
- Pre-machine to understand crack depth
- Root cause analysis and solution engineering
- SpiralWeld™ recovery of parent material
- Reinstate all casing features
- Re-clad with improved material

**Completed significantly faster and at lower cost than replacement, resulting in avoidance of significant production losses**



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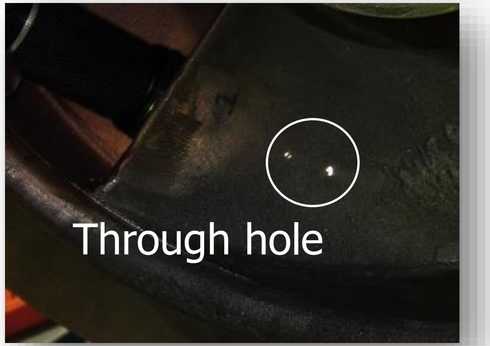
# Cavitation

**Cavitation –** Rapid formation and collapse of voids within a liquid. Resulting implosion releases energy which damages component surfaces.

**Typical components we see:**

- Pump impellers
- Ship propellers

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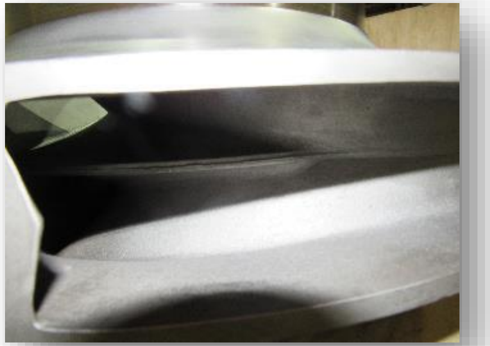
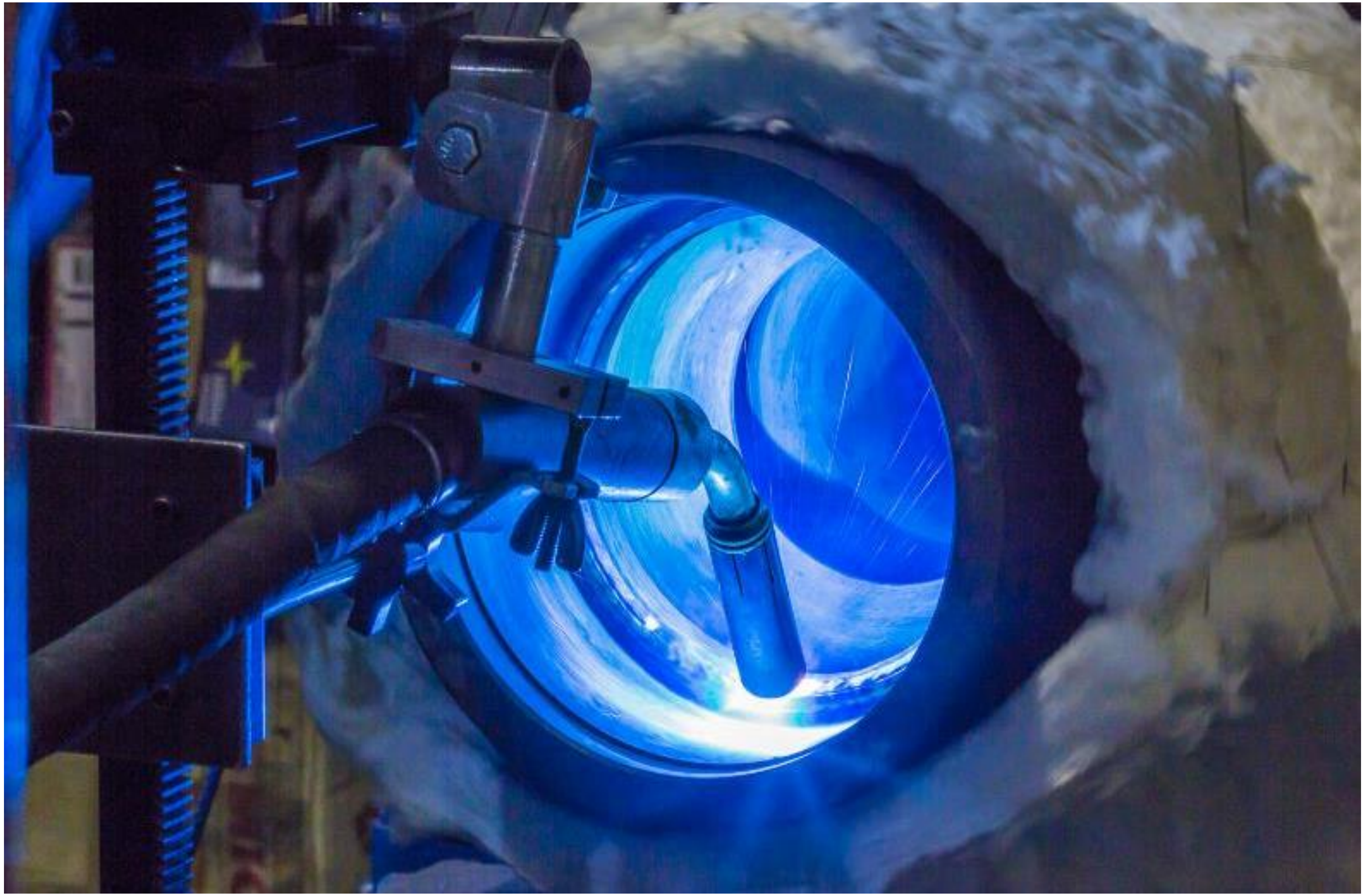
# Cavitation

**ReManufacture+ Solution**

- Full inspection & reverse engineering
- Removal of damaged material to clean parent material surface
- Weld recovery of parent material with a suitable equivalent or enhanced overlay
- Machine to drawing dimension
- Full non-destructive test at final inspection



# The SpiralWeld™ Process Overview



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# The SpiralWeld™ process overview

**Versatile Overlay**

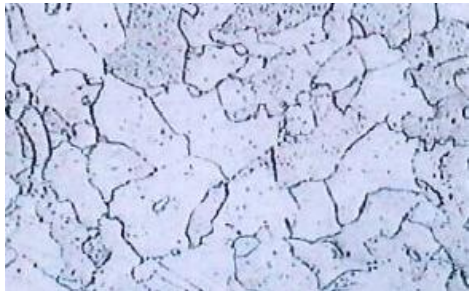
- Alloy steels
- Duplex/Super duplex
- Nickel based alloys & monels
- Cobalt alloys
- Bronzes

**Homogenous Bond**

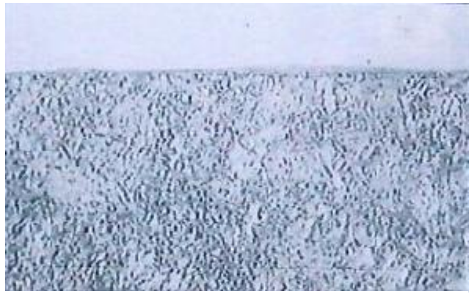
**Distortion Control**

**Low Metallurgical Change**

**WPQR report: 200x Magnification for SpiralWeld™ hard-facing weld certification**



Parent material



Heat affected zone

Hard-facing overlay

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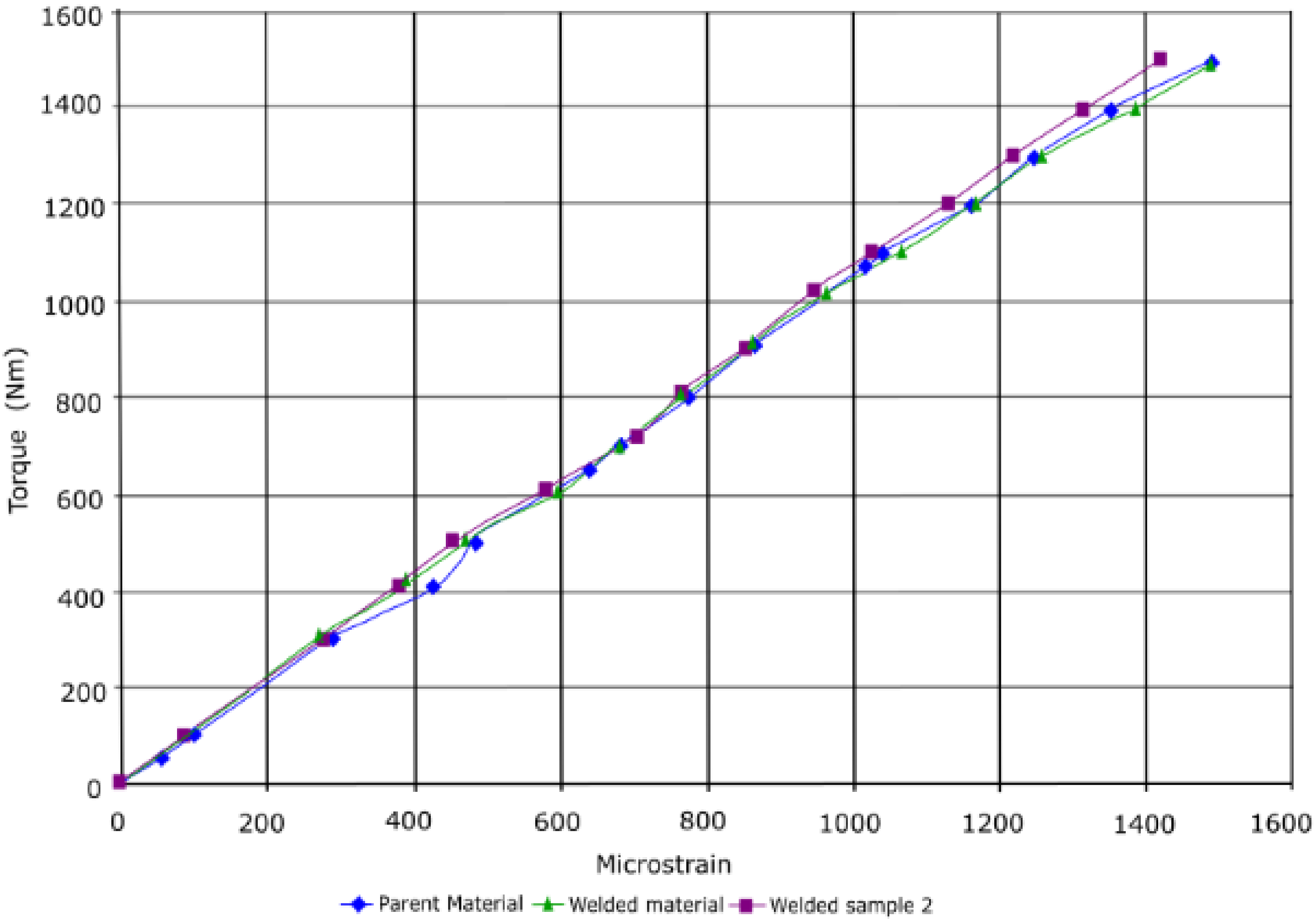
# EN56 nuclear generating station  main boiler feed pump material with ER410 overlay torsional comparison

Weld overlaid sample performs at least as well as, and even better than, a standard test piece of unwelded material

Comparison of loading characteristics of welded and non-welded test samples in torsion



# In Conclusion

# SpiralWeld™ Solutions

Steam Turbine Control Valves

Gas Fuel Preheater

HP/IP Bypass

HP/IP Feed Water Reg

LP Feed Water Reg

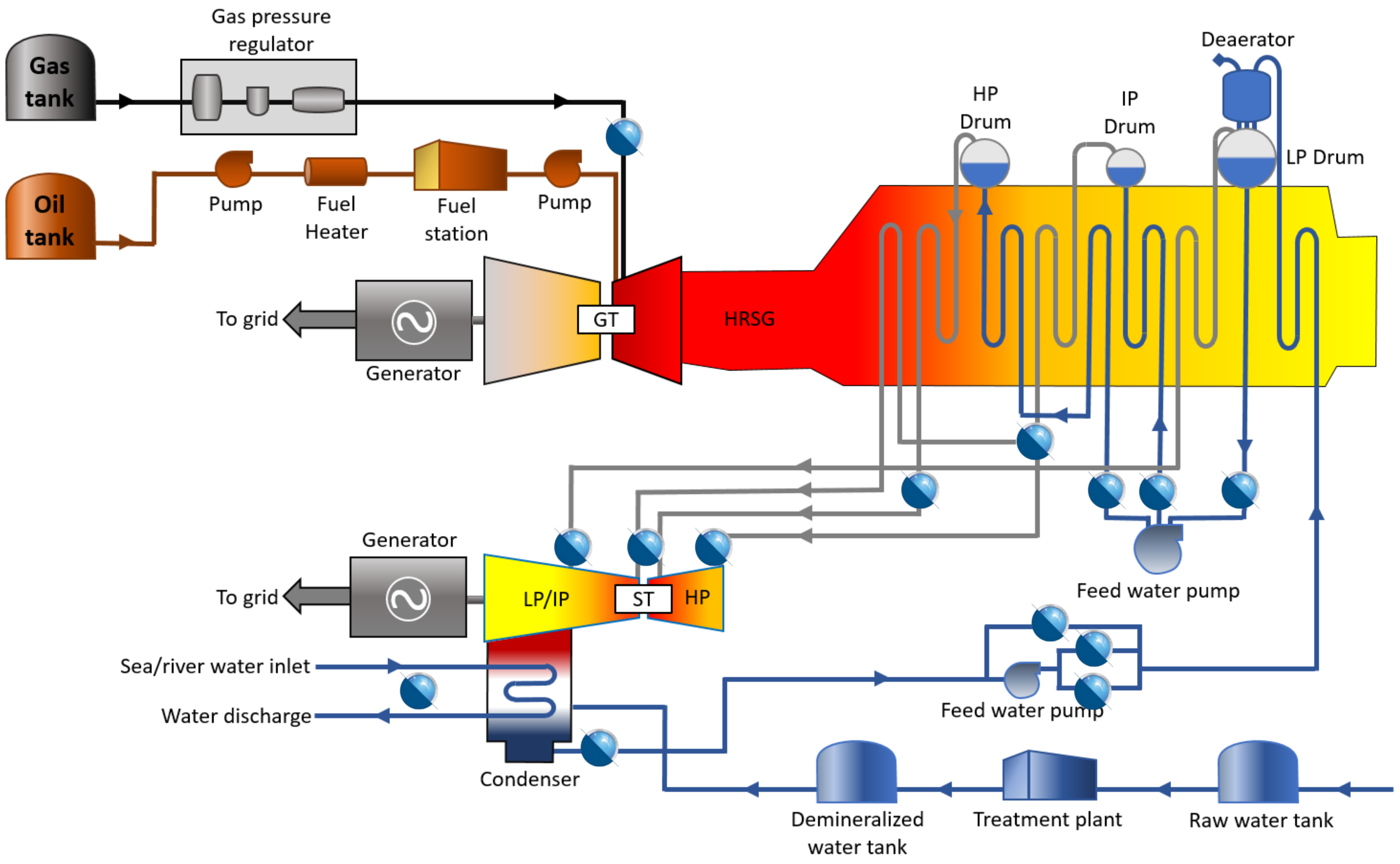
Feed Water Pump Min Flow Bypass

33% Feed Water Reg

100% Feed Water Reg

Condensate Discharge

Cooling Water Pump Equipment



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# SpiralWeld™ value added

- Reduce unplanned maintenance… increase Mean Time Between Failure
- Extend component life
- Lower maintenance cost
- Lower risk of production losses
- Lower inventory stock holding
- Minimise duration of unplanned maintenance through our outstanding levels of customer satisfaction for service and support