Material Trends Affecting the Fossil Energy Fleet

Advanced Coating Compositions and Microstructures to Improve Uptime and Operational Flexibility in Cyclic, Low-Load Coal Plants

Project Description and Objectives

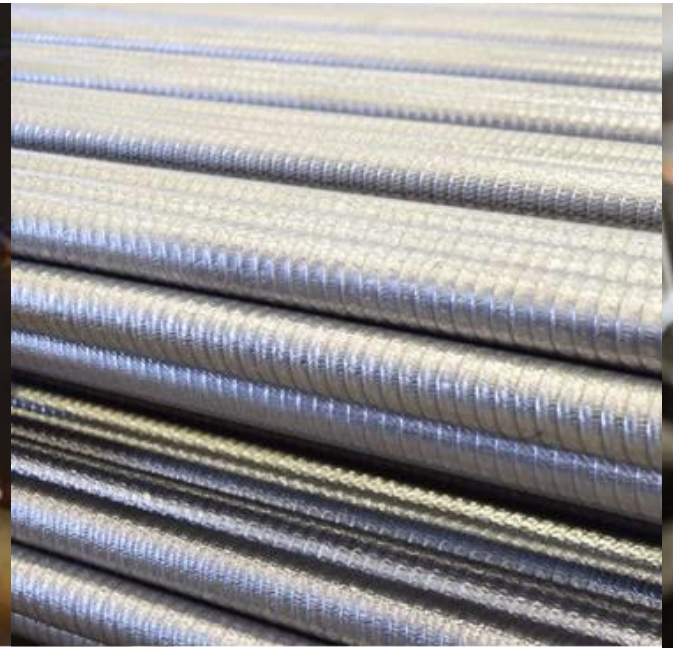
Advanced Coating Compositions and Microstructures to Improve Uptime and Operational Flexibility in Cyclic, Low-Load Coal Plants

- Develop weld overlay compositions to reduce cost and increase time between boiler outages.
- Develop multi-layer coating for steam turbine coatings to increase max operation temperature and increase time between turbine outages.

Project Update

Advanced Coating Compositions and Microstructures to Improve Uptime and Operational Flexibility in Cyclic, Low-Load Coal Plants

- Project agreement between DOE and GE will be finalized in the near term.
- GE is presently aligning internal resources and materials for this project.



Preparing Project for Next Steps

Advanced Coating Compositions and Microstructures to Improve Uptime and Operational Flexibility in Cyclic, Low-Load Coal Plants

Market Benefits/Assessment

- Enable a 25%-50% increase in time between outages for both boilers and HP turbines.
- Eliminate or significantly reduce the Ni content in weld overlay to mitigate cost.
- Provide adequate oxidation resistance for HP turbine inlet steam at >620°C and >220 bar.
- Apply coatings to actual components, using today's production-scale methods.

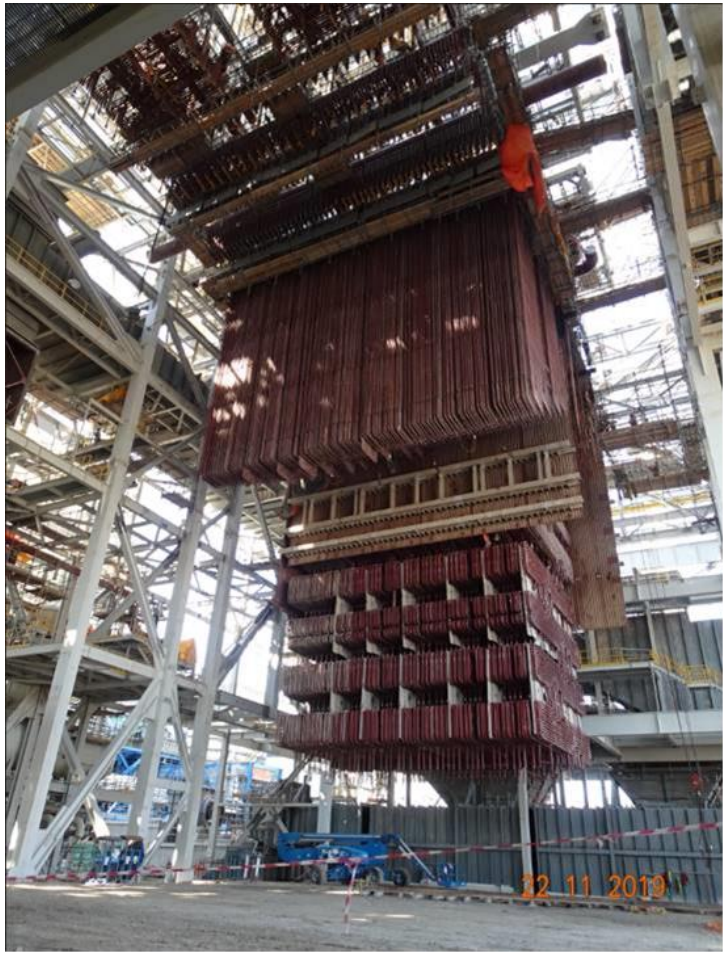
Technology-to-Market Path

- Once the new coatings are developed, then lab testing will begin.
- If the lab test are successful, then field testing can be setup at an actual power plant.
- Determine if production methods for applying coating can be utilized.
- Can coatings be used in other components in the power plant/fleet?

Concluding Remarks

Advanced Coating Compositions and Microstructures to Improve Uptime and Operational Flexibility in Cyclic, Low-Load Coal Plants

- The development of new low cost coatings for boiler tubes will be required to address corrosion from:
  - Lower grade coals being fired.
  - Supplemental fuels such as biomass and municipal waste.
  - Cycling, low load operation and extended time between major outages.
- For high temperature/pressure steam turbines (HP turbines) these new coatings will:
  - Help reduce solid particle erosion presently experienced under modern loading conditions.
  - Reduce the effects of oxidation on high temperature steam turbine blades.



Material Trends Affecting the Fossil Energy Fleet

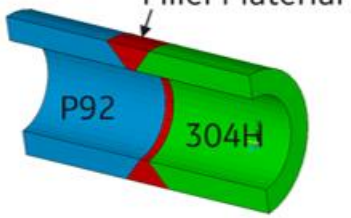
Robust Dissimilar Metal Friction Welded Spool for Enhanced Capability for Steam Power Components

Project Description and Objectives

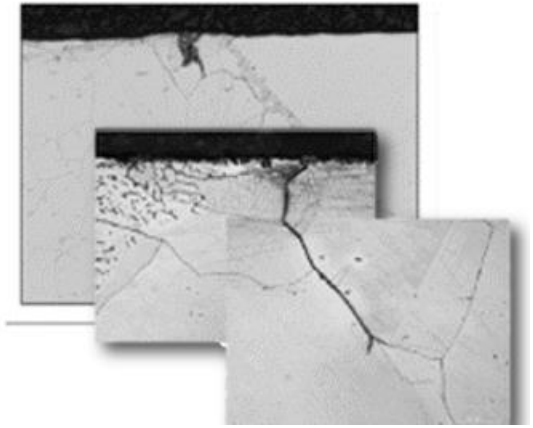
Robust Dissimilar Metal Friction Welded Spool for Enhanced Capability for Steam Power Components

- Develop a friction-welded dissimilar-metal spool utilizing the higher capability transition material of a Nanostructured Ferritic Alloy (NFA) and a differential oxidation protective coating.

Traditional DMWs

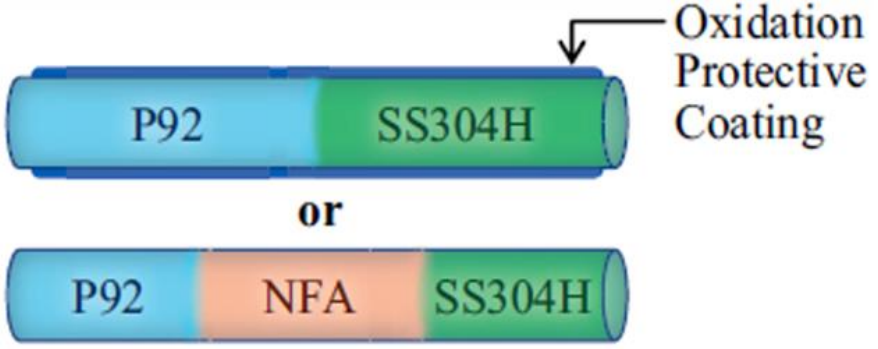


Oxide notching and cracking near fusion line and HAZ



Proposed Solution

Friction Welded DMW spool



Project Update

Robust Dissimilar Metal Friction Welded Spool for Enhanced Capability for Steam Power Components

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Preparing Project for Next Steps

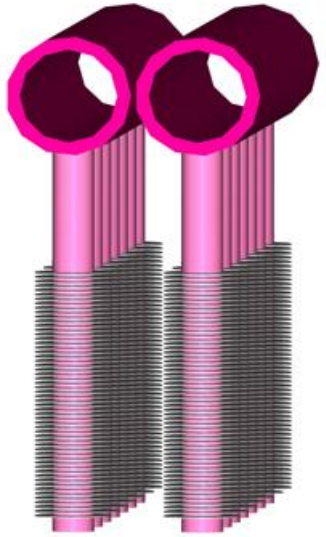
Robust Dissimilar Metal Friction Welded Spool for Enhanced Capability for Steam Power Components

Market Benefits/Assessment

- Provide extended life of dissimilar metal welds in HRSG construction.
- There may be an application to utility boilers designed for advance cyclic efficiencies.

Technology-to-Market Path

- GE will finalize the development of the new Friction Welded DMW spool.
- GE will work with an industrial partner to produce the new DMW spool pieces on a large scale.
- Integrate the new DMW sections into the HRSG shop processes.
- The NFA material may be used in many other products or markets.



OCC™ Design

Concluding Remarks

Robust Dissimilar Metal Friction Welded Spool for Enhanced Capability for Steam Power Components

- Due to the increase use of renewable energy, combined cycle plants will be required to come on and off line more often. This means that:
  - There will be an increase number of cold starts.
  - Cycling behavior of the steam fleet will increase.
- Therefore, there is a need to improve the creep and fatigue behavior of DMWs. The new Friction Welded DMW spool pieces will replace existing DMWs and new construction to increase joint life.
- The new FWA process will be a great solution in jointing newly developed materials used in high temperature cycles.