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Transmission & Bearing Corp.

Technical Notes by Dr. Mel

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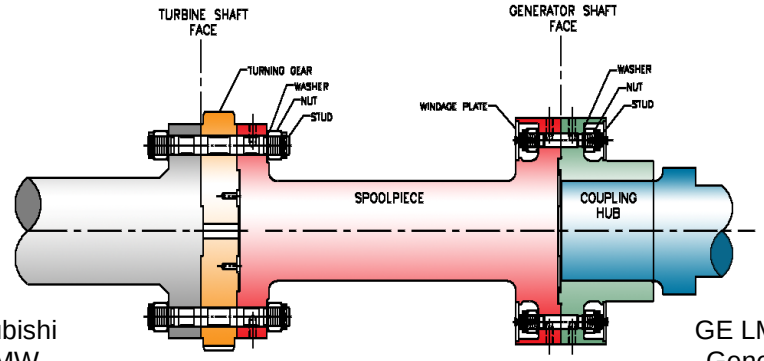
Engineering Services and Manufactured Components for A New Co-gen Facility



Mitsubishi 60 MW Steam-Turbine

TRI Spoolpiece

TRI Coupling Hub

GE LM6000 Generator

A Company that was committed to building a 60 MW Steam turbine-Generator from a series of parts realized that they did not have the engineering expertise to complete the rotating machinery train with confidence. After discussions with other engineering consultants, they approached TRI.

TRI agreed to work with them as their rotating machinery experts and to provide engineering services that included evaluation of the turbine, generator, and supporting auxiliaries related to rotor dynamics, and the design of the foundation, soleplates and keys for the generator, and couplings to connect the turbine to the generator.

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The existing turbine was a 60 MW Mitsubishi turbine from a decommissioned plant that they owned, and the Generator was from an unused LM6000 Gas Turbine-Generator that was abandoned by the prior owner. The initial design evaluation revealed that the existing coupling flange on the GE LM6000 generator rotor was too small for handling the "synchronizing out of phase torque" when the light weight gas turbine low-speed rotor was replaced with a heavy steam turbine rotor. Consequently, a higher strength coupling assembly to connect the turbine rotor to the generator rotor was needed.

As a basis for the coupling design, TRI performed torsional critical speed calculations for the combined rotor system. With this information, TRI then designed, manufactured, balanced and supplied a new shaft coupling spoolpiece, new coupling hub, and new hardware, along with installation instructions.

With the thrust bearing in the turbine, and with a solid coupling between the turbine and generator, the generator would move axially due to thermal expansion. Accordingly, the thrust bearings in the generator were removed.

LM 6000 generators typically are built on flexible steel structures and have a history of vibration issues. To avoid these problems, TRI designed and manufactured heavy soleplates with centering keys, axial and transverse, typical of the GE generators for main power plants that typically do not have vibration problems.

To minimize vibration issues further, TRI recommended extra concrete in the foundation and turbine deck as well as higher strength concrete than was initially planned. The heavy soleplates were installed in the foundation with epoxy grout and heavy hold down bolts per TRI instructions.

This LM 6000 Generator was designed for once through air cooling, but was converted to Totally Enclosed Water to Air Cooling (TEWAC) because the environment contained considerable dust particles and salt air most of the time.

On start-up, the unit came up to speed and ran so smoothly that no balance shots were required. The unit has achieved a maximum of 54 MW gross generation to date, and it has operated without any unplanned trip-outs.

TRI Provides More Upgraded Fluid Drives

Speed Control, Efficiency and Reliability Improvements

TRI continuously works to improve our Fluid Drive products, especially related to speed control, efficiency, and reliability.

One of the most common fluid drives in service in the US to drive main boiler feed pumps is the Size 270 Single Circuit Fluid Drive that was originally manufactured by American-Blower and then by American-Standard. TRI has been working to improve the performance and reliability of these drives since 1973 with success. By 1985, TRI had introduced a Heavy Duty TRI Align-A-Pad ® Bearing system that solved the rotor-vibration issues, and many of these fluid drives that are used in sliding pressure operation have been converted to this bearing system. In more recent years, TRI has developed and introduced other modifications in these fluid drives that minimize the speed fluctuations of the boiler feed pumps.

In the past few years, TRI has installed these upgrades in several units, including one recent application that included replacing the soleplates, the existing fluid drive of original design, the input flex coupling, and even the extension shaft and steady rest bearing in the turbine. Now this turbine-generator can run from a low of approximately 40 MW to a maximum of over 400 MW without any abnormal vibrations of the fluid drives, and it can do so with very good speed control. The intense foot massages on the turbine deck near the fluid drive and boiler feed pump are history !