Rotating Machinery Services, Inc.

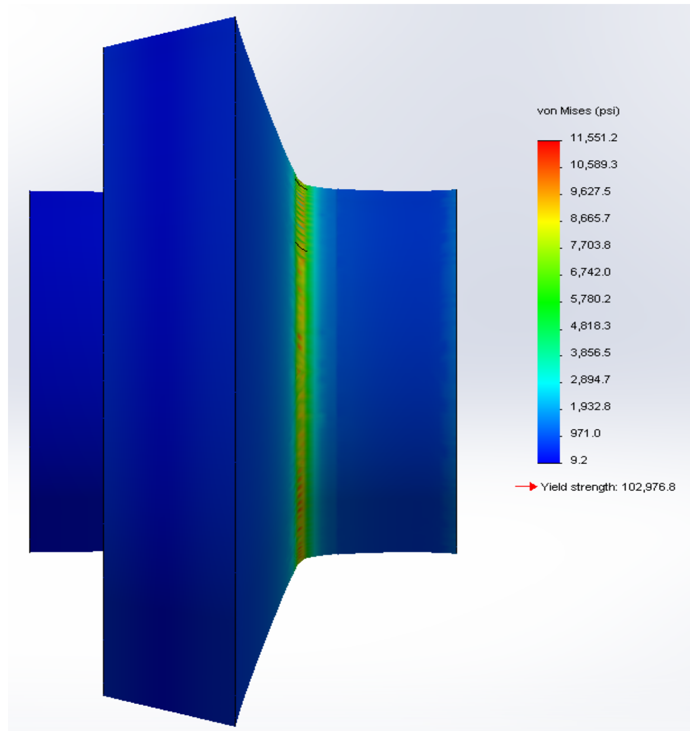
# STEAM TURBINE ENGINEERED REPAIRS

*By Tim Coull*

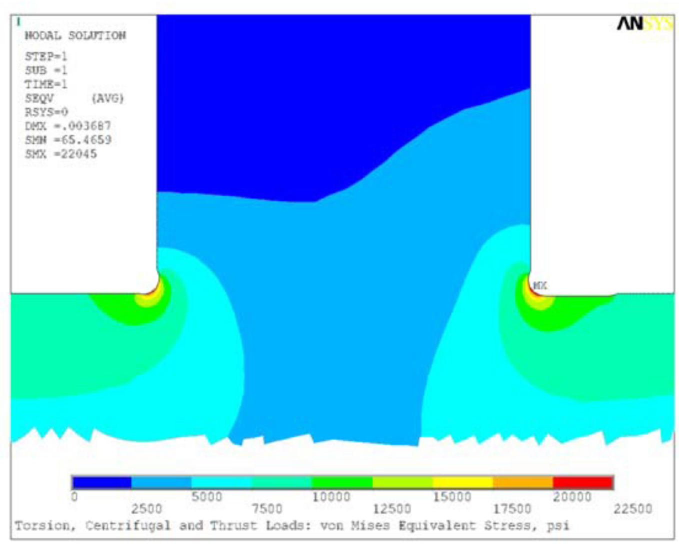
RMS recently received a 13-stage integral steam turbine rotor that had previously been inspected by a competitor who had recommended significant repair work to be done prior to returning the rotor to operation. This recommendation was based on overly conservative OEM criteria rather than a sound investigation of the machine geometry and actual operating conditions. RMS was contracted to perform our own thorough inspection of the rotor. Upon inspection and through FEA analysis and experiential engineering judgment, RMS found that less invasive and therefore more financially attractive repairs were a better option.

Our competitor's inspection showed linear indications in the thrust-collar, and significant material was previously machined off in order to remove them. Furthermore, hardened material was encountered on the thrust-collar during machining, which was subsequently halted. Any additional machining to remove the hardened material would have pushed the OEM beyond their lower limit for thrust-collar thickness. Therefore, their recommendation for the thrust-collar was to machine it down, weld it back up, and final machine to a thickness acceptable per their criteria. Such repair also would have required simultaneous weld build-up and machining of the journal to counteract any distortion from welding the thrust-collar. Not to mention that any distortion could potentially introduce large runouts of the shaft-end or even bowing of the shaft.

RMS conducted a preliminary finite element analysis (FEA) using SolidWorks SimulationXpress. A 3-D model was created using real geometry less .100" material removal from the thrust-collar, and an axial load applied using the ultimate load for standard bearings of similar size. Preliminary analysis showed that peak stresses were well below yield with a design factor of about 7.5.




A more in-depth ANSYS 2-D axisymmetric model with out-of-plane loading capabilities was built to get higher resolution in highly stressed areas. A base-case model confirmed the SolidWorks results within a reasonable amount of accuracy. Another model was built



to account for centrifugal and torque transmission loads, since the coupling on this machine is on the thrust-end. These results obviously showed higher max stresses than the base case, though still well below yield, with a design factor of about 4. These analyses clearly showed that further material removal would not pose a problem during operation.

Significant material removal obviously requires manufacturing a large shim to keep the bearing against the collar. However, this plus a single machining operation is clearly a more attractive option than three machining and two welding operations, plus the possibility of significant shaft distortion. With a little forethought, abandonment of presuppositions, and utilization of modern technology, RMS leveraged its experience to deliver reliable machine repair options with our customer's best interest in mind.

*For more information:*
Email: RMS@rotatingmachinery.com
Tel: 484-821-0702

**Headquarters**
2760 Baglyos Cir.
Bethlehem, PA 18020

**Houston Office**
16676 Northchase Dr., Ste 400
Houston, TX 77060

RMS
Rotating Machinery Services, Inc.

**rotatingmachinery.com**
Tel: 484-821-0702
Parts: rms@rotatingmachinery.com

**Rotating Machinery Services, Inc.** | 2760 Baglyos Circle, Bethlehem, PA 18020 | Tel: 484-821-0702