Material Integrity Solutions, Inc.

PROJECT BULLETIN

3254 Adeline Street, Suite 200, Berkeley, CA 94703
(510) 594-0300; Fax: (510) 594-0333; www.MISolution.com

The Rotor Integrity Program (RIP)

Background

Turbine rotors in fossil, nuclear, hydro, and geothermal facilities operate in harsh environments which can cause damage and cracking to the rotor in a number of areas, including the blade-fit (*Figs. 1 & 2*), disks-to-shaft fillets, bore, and heat groove areas. During overhauls detected cracks are recommended by the rotor manufacturers to be removed by grinding and weld repair. In extreme cases, the rotors are recommended to be replaced. Repair or replacement of a rotor is very costly and can cause long outages. However, if the condition of a rotor can be accurately assessed, the need for its repair or replacement can be evaluated by the utility engineer. To accurately and quickly evaluate the problem, engineers need to answer questions such as:

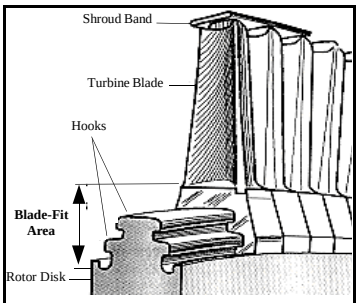

Figure 1. Parts of turbine rotor

- *Can the cracks be left in place?*
- *What is the critical crack size?*
- *When and how should the rotor be reinspected?*
- *How much grinding is acceptable?*
- *What is the acceptable material change for weld repairs?*

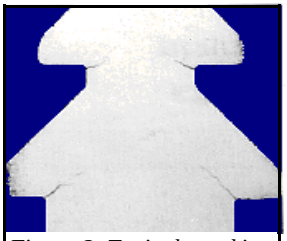
Figure 2. Typical cracking in a blade-fit area

In response to these issues, MIS developed The Rotor Integrity Program (RIP) to help engineers accurately and quickly analyze a turbine rotor with cracks and other defects to decide what corrective action, if any, needs to be implemented.

Discussion

To evaluate rotor cracking problems, MIS integrated computer-aided design (CAD), finite element (FE), and fracture mechanics (FM) modules into a single workstation environment with a simple user interface (*Fig. 3*). We call this a *Proactive Failure Prevention Plan* that allows engineers to model and analyze cracked components easily, expediently, and accurately. The RIP workstation allows engineers to determine the condition of a rotor by performing base-line analyses and simulating cracking scenarios to investigate their criticality (*Fig. 4*).

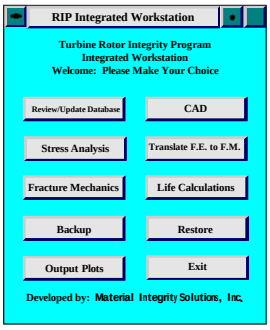

Figure 3. The RIP User Interface

Conclusion

The RIP system is part of a proactive failure prevention plan. This state-of-the-art stress/fracture analysis and condition assessment tool enables engineers to evaluate numerous rotor integrity problems. RIP helps engineers identify critical crack sizes, find stress conditions for a proposed weld repair,

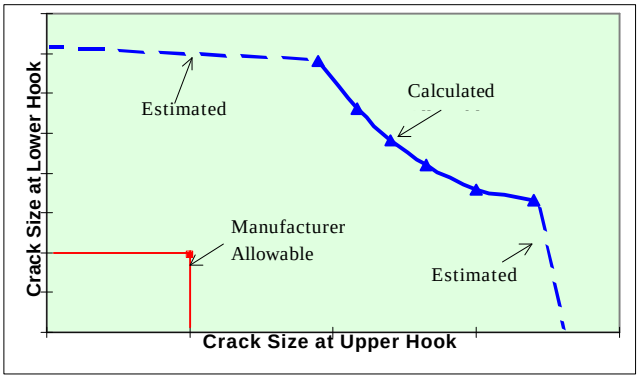

Figure 4. Calculated Allowable Crack Sizes

and make recommendations for future inspections.

The system developed by MIS consists of an integrated workstation, whose hardware and software are designed to provide quick and accurate integrity analysis of turbine rotors. RIP is easy to use by engineers familiar with basic engineering concepts. The RIP system can be easily expanded into other areas such as generators, feedwater heaters, boiler headers, and turbine