Turning Points

ELLIOTT GROUP

Restoration of Two Spare Rotors Gives New Life to Steam Turbine Generator Train

Customer

Energy Company, Florida

Equipment

High Pressure/Intermediate Pressure (HP/IP) steam turbine and Low Pressure (LP) steam turbine

Challenge

Qualify and repair two non-Elliott steam turbine rotors for use as spares for a different steam turbine generator train.

Solution

Elliott assessed the remaining useful life, performed inspections, and completed repairs on the two non-Elliott rotors and shipped them in advance of the deadline.

One of the largest energy companies in the United States wanted to qualify and refurbish two spare steam turbine rotors at its facility in Florida to be used as spares for another facility. The company planned to use the rotors in its 130MW steam turbine generator train which included a High Pressure/ Intermediate Pressure (HP/IP) steam turbine and a double flow Low Pressure (LP) steam turbine. Although the steam turbines associated with this project were not originally manufactured by Elliott, the energy company turned to Elliott to complete the work.

Elliott's scope of work included:

- Remaining useful life assessment
- Comprehensive rotor inspections
- Extensive repairs on each rotor including weld restoration of the HP/IP rotor and blade replacement on both rotors
- Stress relief of the HP/IP rotor
- High-speed rotor balancing

The HP/IP and LP rotors were shipped to Elliott's Jacksonville Service Center for the inspection and repairs. Elliott technicians performed simultaneous inspections on the rotors which included blast cleaning, non-destructive tests (NDTs), dimensional inspections, and runout inspections.

The spare rotors had been in operation since 1958. With a nearly 60-year running time frame, including numerous starts and stops, it was important to perform a remaining useful life assessment on both rotors to verify that the rotor forgings still had life left. After conducting the assessment at the Jacksonville Service Center, Elliott determined that both rotors had useful life remaining, and therefore, it was worthwhile to proceed with the necessary repairs.

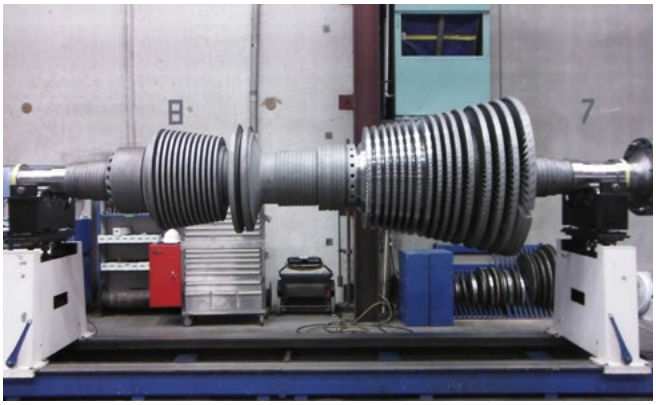
HP/IP rotor prior to inspection and repair at the Jacksonville Service Center.

HP/IP Rotor Repair

Elliott was aware that this particular HP/IP rotor had a history of disk cracking, so the service center took extra precaution during the NDT and removed rows of blades, one by one, to inspect for cracks. NDT revealed cracks in the first seven stages of the IP section of the rotor. Elliott determined the best plan of action and most cost-effective solution was a rotor weld restoration.

To repair the HP/IP rotor, Elliott machined down the rotor body blade slots, weld restored the rotor body, re-machined the blade slots, installed new blades, and balanced the rotor.

HP/IP rotor before inspection and repair.



HP/IP rotor after inspection and repair.

Rotor weld restoration requires specialized training, advanced techniques, and special procedures to re-establish rotor integrity. The Jacksonville Service Center performed automated submerged arc welding (SAW) of high-chrome alloy metal which requires very high interpass temperatures. The welding process was performed around the clock, non-stop, for 12 days (24 shifts).

Sub arc welding process.

Once the welding process was complete, the rotor required vertically hung stress relief.

Vertically hung stress relief process.

Double Flow LP Rotor Repair

The inspection of the double flow LP rotor revealed foreign object damage to the inlet stages and excessive erosion damage to multiple stages on both ends of the rotor. This repair required re-blading of six stages – three on the turbine end, and three on the generator end.

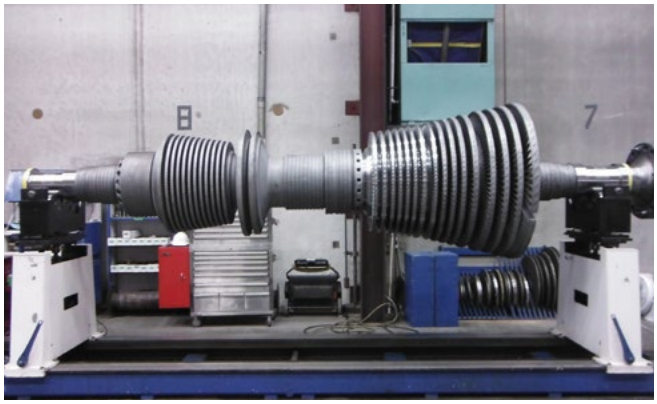
Technicians performing Phased Array Ultrasonic Testing (PAUT) to the shrunk on L-0 disks.

Re-blading a rotor is a complex process that requires precision, accuracy, and teamwork. The last stage of this double flow LP rotor, for instance, was a double lashing lug design that required multiple technicians working at the same time. One technician was welding, one was grinding, and one was dye penetrant testing.

Three Elliott technicians welding and back grinding blade lashing lugs.

Once the HP/IP rotor and the double flow LP rotor were repaired, both were high speed balanced to ensure reliable operation.

Final balance of the LP rotor.



Final balance of the HP/IP rotor.

Elliott's rotor repair expertise, specialized welding techniques, and attention to detail ensured the simultaneous restoration of the two rotors for the steam turbine generator train. The Jacksonville Service Center worked within the energy company's required timeline, and shipped the repaired rotors back to the Florida facility in advance of its deadline.

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