

ADVANCED LP LSB REPLACEMENT OPTIONS FROM ReGENco & TOSHIBA

As the average age approaches 30 years for many GE fossil fueled steam turbines with longer 30" and 33.5" last stage blades, operators are now examining various options for replacing worn and aging blades with new modern designs which require less inspection and maintenance, provide longer life of blade and better performance and allow higher backpressure operation. Upgraded designs now available from Toshiba can now help improve the reliability, maintainability and operating performance when compared to these earlier generation blades.

Toshiba state-of-the-art upgraded replacement blades for 30" and 33.5" LSBs feature an electron beam welded (EBW) Stellite* nosepiece for superior erosion resistance. The blades have an outstanding track record without any serious problems after almost 30 years in service. In fact, in North America there are nearly 80 rows of Toshiba designed 30" and 33.5" last stage blades currently in service in both Toshiba and GE machines. These blades also have many other advantages over originally supplied blades and upgraded blades available from other suppliers. A summary of their key technical advantages is listed below:

- 1) The solid EBW Stellite* nosepiece provides exceptional erosion resistance for longer blades such as the 30 and 33.5" LSB's. The Stellite* shield extends to the blade tip where severe erosion normally occurs. In addition, the runout portion of the EBW at the blade tip is machined off to remove weld defects. Toshiba has continuously manufactured EBW Stellite* shielded LSBs since 1979.
- 2) An advanced airfoil flow pattern produces higher efficiency.
- 3) The continuously coupled LSBs, as shown in Figure 1, provide a very low vibration stress level compared to group-coupled blades. Due to the low vibration level, the operating backpressure can be increased to 7"HgA for alarm and 9" HgA for trip at rated load. Thus these improvements provided for more flexible operation of the unit under different conditions.
- 4) The blades are detuned against blade-shaft coupled torsional resonant vibration. This was accomplished by modification of the airfoil section. Hence, the blades were detuned without increasing the blade length and thus their retrofit does not require the costly replacement or modification of the L-0 diaphragm. Telemetry tests and finite element analysis has verified that blade vibration due to out-of-phase electric current or steam flow is not close to multiples of running speed.
- 5) The airfoil portion has a low operating centrifugal stress due to its pre-twist design, and optimum stacking and smooth connection of airfoil sections. This includes the EBW erosion shield and the tip portion. There is a smoothly connected transition between erosion shield and airfoil.
- 6) The finger root attachment reliability was improved against stress corrosion/fatigue cracking by reducing the airfoil width in the lower part of the blades, and by reducing the load on the inlet side and outlet side fingers. This resulted in better total load distribution on all fingers.
- 7) The tenon hole reliability has been greatly improved against stress corrosion cracking and fretting fatigue. This was accomplished by slightly enlarging the tenon holes to reduce tight contact conditions, and by moving the tenon holes well away from the heat-affected zone and weld metal of the EBW erosion shield.

The Toshiba 30" and 33.5" blades with solid stellite nose pieces are available now through ReGENco and can be installed in your turbine on a planned basis during routine outages planned for the Fall 2007 or Spring 2008. In the event of an emergency, Toshiba has also elected to inventory several rows of pre-manufactured 30" and 33.5" last stage blades. For more information regarding these blades please contact your regional ReGENco Service Manager.

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