

## Reapplied Equipment Increases Chemical Plant Capacity

### Customer:

Fertilizer Plant – Sulfuric Acid Process  
Central Florida

### Equipment:

Blower  
Multi-valve, multi-stage steam turbine  
Lubrication system

### Problem:

Capacity increase in the sulfuric acid  
production process

### Solution:

Elliott rerated three pieces of non-Elliott  
equipment to provide the needed  
process capacity on an expedited basis

In 2008, a chemical fertilizer plant in central Florida prepared to increase its phosphate fertilizer production capacity. The expansion would also increase production of sulfuric acid, a process byproduct, by 1,600 tons per day. The additional sulfuric acid would require an increase in the facility's process air capacity. The customer approached Elliott about providing a steam turbine to drive an out-of-service blower (single stage compressor) for the process air service. The shutdown for the plant expansion was scheduled to begin in only five months, not enough time for Elliott to design, manufacture, and deliver a new steam turbine.



*Out-of-service 1973 overhung impeller blower.*

While preparing the proposal, Elliott searched for a suitable “pre-owned” multi-valve, multi-stage (MVMS) steam turbine which could be modified to meet the fertilizer plant’s needs. Although the customer had no major Elliott equipment installed at this plant, previous blower repair work at Elliott’s Jacksonville service center had given the customer confidence that Elliott could deliver.

The scope of work awarded to Elliott included:

- ♦ Refurbishing the existing, 1973, 54-inch overhung impeller blower
- ♦ Sourcing and rerating a suitable steam turbine and spare rotor
- ♦ Sourcing and rerating a suitable lubrication system
- ♦ Providing a new baseplate and coupling for the equipment string

The selection of used steam turbines was limited by the steam conditions in the fertilizer plant (260 psig inlet and 30 psig exhaust). The turbine required a 10-inch or larger inlet, clockwise rotation, and up-oriented exhaust connection. Elliott located a vintage 1967, extraction-condensing turbine, originally from an ammonia plant, that could be rerated to drive the blower efficiently. Considering the age of the equipment, Elliott began inspections immediately. Elliott discovered that the turbine was missing the original 12-inch trip and throttle valve. A used 10-inch valve, which was acceptable for this application was located; Elliott fabricated a 12-inch to 10-inch reducer to accommodate the smaller valve. The short lead time forced Elliott to treat each component as critical path.

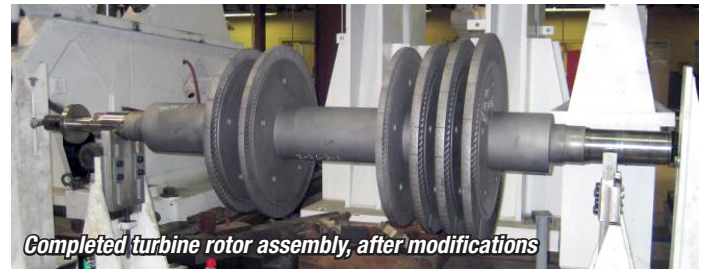
Elliott's Jacksonville service center began to refurbish the blower and turbine in the summer of 2008, with support from Elliott Engineered Solutions in Jeannette. Simultaneously, an existing, unused, 1981 lubrication system underwent the same process in the Pittsburgh Service Center.



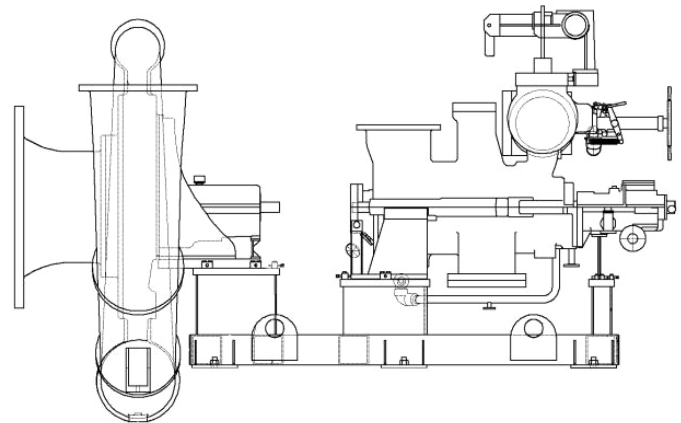
The MVMS turbine required significant modification for its new service. Rotor dynamic analysis confirmed that the turbine would be running on the first critical speed. A critical speed occurs when the rotational frequency matches the rotor's natural frequency, resulting in an amplification of noise and vibration. The turbine was originally rated for 9,656 hp at 6,730 rpm. The blower it would drive required only 5,200 hp at 4,350 rpm.

Elliott made several modifications to ensure that the turbine would meet the new operating conditions:

- ♦ Reduced main shaft diameter to adjust the first critical speed
- ♦ Eliminated one of five inlet valves
- ♦ Plugged portions of the turbine nozzle ring
- ♦ Removed the extraction equipment
- ♦ Installed new journal and thrust bearings
- ♦ Provided new gland condenser ejector package for turbine leak-offs



Additionally, Elliott Engineered Solutions designed a new baseplate for the equipment string. During the original 30 years of service, the turbine's outline drawing and detailed documentation were misplaced. To ensure that the package was designed accurately, Elliott physically measured the turbine in three dimensions, to locate all major and minor connections. These recorded dimensions were used to re-create the turbine outline drawing and finalize the baseplate and coupling plans.

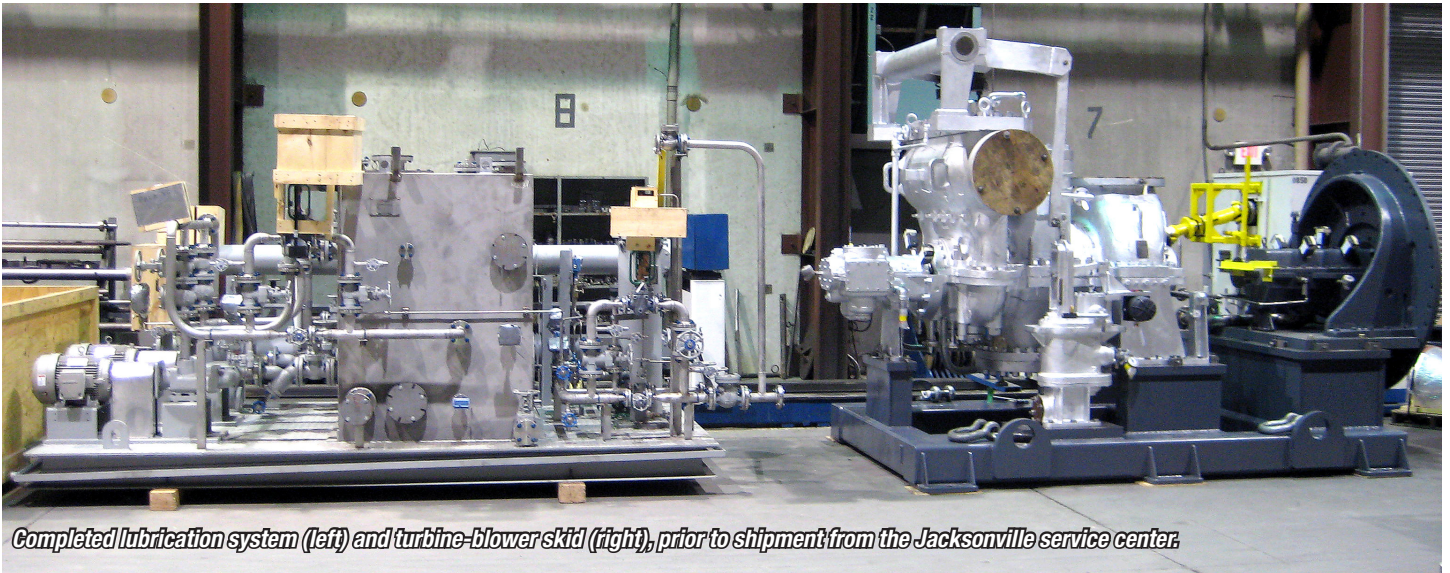


**MVMS turbine-blower skid outline**

Elliott's Pittsburgh service center rerated the 1981 lubrication system by installing new motors, pumps, valves, and instrumentation in order to provide the necessary lubrication and control oil to the turbine-blower skid.



The finished equipment was shipped to the customer in December 2008. The customer installed and commissioned the blower string under the direction of an Elliott Technical Advisor without delaying the planned startup schedule. Each piece of equipment was given an Elliott nameplate and serial number to facilitate future support.



During startup, the turbine experienced control issues while operating at speed. Elliott investigated and determined that the original 8-inch servo cylinder was unable to control the turbine's four governor valves under load. Elliott quickly corrected the problem by replacing the outdated servo with an Elliott servo assembly from Jeannette.

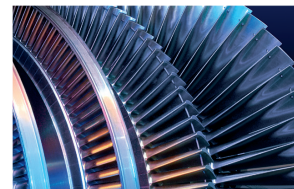
The customer was delighted with Elliott's performance on this project. Elliott successfully rerated and refurbished rotating equipment that had deteriorated and reached the end of its useful life. Multiple Elliott service centers and Elliott Engineered Solutions worked closely and effectively together, under a very tight schedule. This Florida fertilizer plant now appreciates why the world turns to Elliott for a single source of effective turbomachinery solutions.



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