



TST's Fuel Cells and Microturbines

A Case Study

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ABOUT TST

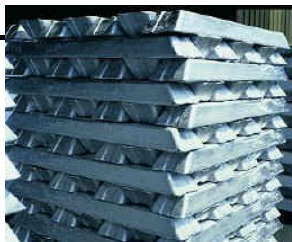
- Founded in 1946
- Comprised of three sister companies
- Combined Group Revenues exceed \$400MM US



Standard - Processes aluminum, copper and ferrous scrap



Tandem - Produces billet



Timco - Produces specification ingot

S – Standard

- Began as a local aluminum scrap processor
- Grown to be a leader in industrial ferrous and non-ferrous scrap
- A large capacity shredder and Eddy Current system allows the highest quality shredded aluminum for numerous applications



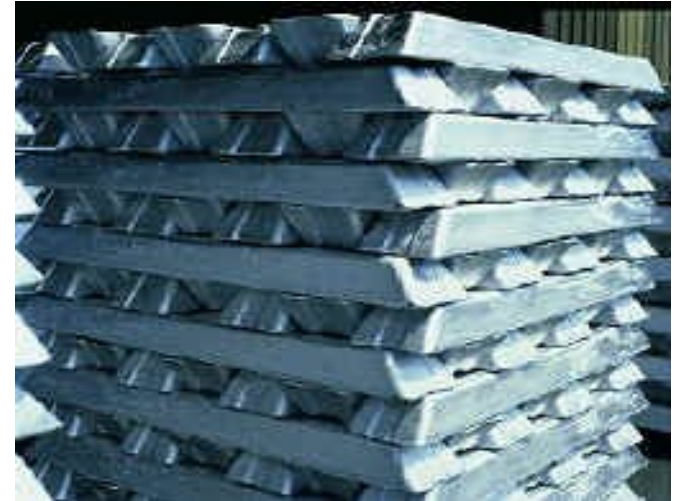
T – Tandem

- Supplies high quality billet to aluminum extruders and forgers
- State-of-the-art facility produces a variety of alloys including Aerospace, soft and hard alloys



T – TIMCO

- Largest specification aluminum ingot producer in the Western USA
- Capacity in excess of 5,000 MT per month
- Second location added in Sweetwater, TX, increasing capacity to 7,500 MT per month



Fuel Cells

FONTANA, CALIFORNIA

TST, Inc.

Direct FuelCell® (DFC®) Cogeneration Installation



500 kilowatts of Ultra-Clean Direct FuelCell® Power

Microturbines

TST INC. FONTANA, CALIFORNIA

Capstone Microturbine Cogeneration Installation



The image shows four white, rectangular microturbine units arranged in a row. They are connected to a complex network of yellow and grey pipes and ductwork. The units are housed in a clean, industrial environment with metal railings in the foreground.

DATES	LOCAL AUTHORITY	PROJECT COMPONENT
Construction Initiated: <i>April 2006</i>	TST Inc.	Four Capstone C60 Microturbines producing a total of 240kW in parallel with the electric Utility to reduce energy imported from the grid.
Startup Completed: <i>August 2006</i>		High temperature ducting to transfer the 600F microturbine exhaust into the foundry process to offset natural gas used in traditional burners.
Facility Dedicated: <i>October 2006</i>		



How TST Started on Power Generation

- Concern about reliability and cost of utility power
- Good incentives for self generation offered by major utilities and the State of California
- Innovative thinking
- Corporate citizenship - effort to use green technology
- California Cast Metals Association encouragement

TST's Approach

- Cautious Approach
- Decision made to pursue both a fuel cell project and a microturbine project
- Decision made to work with established entities such as Capstone, SCAQMD, Southern California Gas Company and Fuel Cell
- Information gathered on incentives and grants



Project Costs

Fuel Cell Project Cost:	\$2,876,875.00
Grants:	<u>\$2,315,000.00</u>
Net Project Cost:	\$ 561,875.00

Microturbine Project Cost:	\$152,605.00
	<u>\$132,000.00</u>
	\$284,605.00
SCAQMD Grant:	<u>\$132,000.00</u>
	\$152,605.00
SGIP Incentive:	<u>\$146,000.00</u>
Net Project Cost:	\$ 6,605.00



Permitting / Agreements / Contracts

- City of Fontana
- SCAQMD
- Product Liability Agreements
- Maintenance Agreements
- Interconnection Agreements with SCE
- Natural Gas Contracts with So. Cal
- SGIP Application

Project Time Table

- TST began projects in December, 2002
- Actual construction started in early 2006
- Construction completed in August, 2006

Costs versus Savings

- TST is saving close to \$72,000 per year on fuel cells
 - Includes the value of the thermal recovery
- As natural gas costs rise to \$1.00/therm, the microturbines are not cost effective, particularly in the hot summer where the microturbine efficiencies fall off drastically
- \$8,000/month savings were estimated with the microturbines at the start of the project when natural gas costs were about \$.50/therm

Current Performance Results

- Still evaluating performance and studying areas for improvements
- Microturbines have run 11,000 hours as of December, 2007.
- Replaced both Copeland compressors which operate with the four microturbines
 - Covered by maintenance contract with Capstone
- Evaluating microturbine seizure
- TST has maintenance contracts on both microturbines and Fuel Cells
- Both Fuel Cell and Capstone are honoring the terms of their respective maintenance contracts

Lessons Learned

- Units are not stand-alone and cannot operate when the grid goes down
- Microturbine efficiencies are lower than expected because of de-rating in high temperatures, etc.
- Permitting is a big issue and takes more time than expected. It's a complicated issue
- Changing rules such as interconnection requirements, exit fees, and permitting can have a tremendous impact on costs and schedule
- Grants and incentives played a dominant role in influencing TST to pursue power generation
- A 5-year Power Purchase Agreement was agreed upon for the Fuel Cells using a third party owner