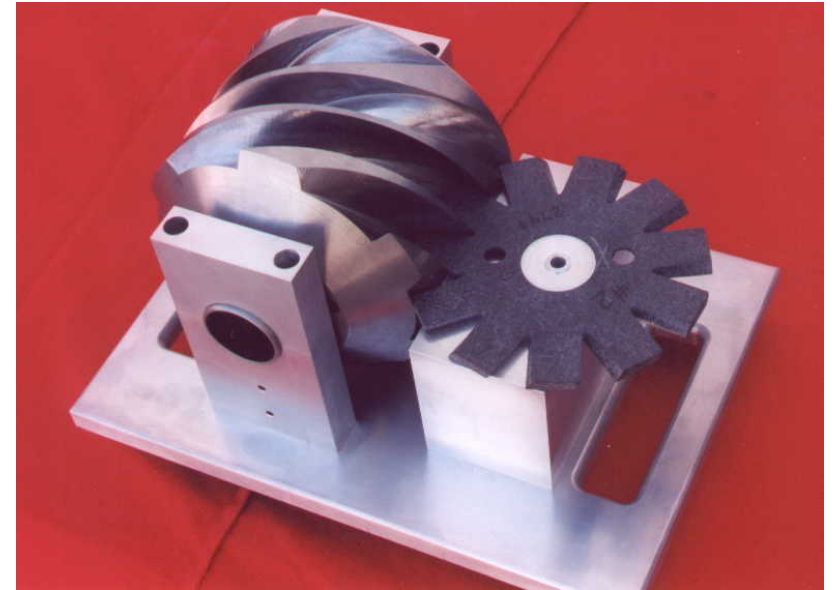


Novel Hydrogen Screw Compressor



C. David Livengood & Robert P. Larsen
Argonne National Laboratory
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This presentation does not contain any proprietary or confidential information

Project ID #
PDP53

Project Overview

- *Barriers Addressed*

- Reliability and Costs of Hydrogen Compression

- *Technical Targets (Refueling Sites)*

	<u>2010</u>	<u>2015</u>
– Reliability (%):	90	99
– Energy Efficiency:	95	96
– Contamination:	Reduced	None
– Cost Contribution (\$/gge):	0.40	0.25

Project Overview (cont.)

- *Partners*

- Sigma Engineering, Rochester, Michigan; developer and holder of key design and manufacturing patents

- *Budget*

- FY04 Funding: 0
- FY05 Funding: \$50K (initial phase)
- Total Project Funding: TBD

- *Timeline*

- Project Start: October 2004
- Project End: September 2005 (initial phase)
- Total Project Duration: TBD

Project Objectives

- *Initial Phase:*
 - Evaluate the feasibility of adapting a novel single-screw compressor concept for hydrogen compression
 - Identify key development requirements
 - Provide recommendations for follow-on R&D
- *Follow-on R&D*
 - Optimize compressor design for hydrogen
 - Reduce/eliminate lubrication through advanced materials and coatings
 - Design and test prototype compressor

Approach (initial phase)

- *Identify potential compressor applications*
 - Hydrogen production
 - Transmission
 - Fueling systems
- *Establish performance criteria*
- *Evaluate compressor potential for identified applications*
 - Application of existing models
 - Engineering assessment

Approach (follow-on)

- *Optimize design for hydrogen service*
- *Reduce/eliminate lubricant requirements through advanced materials and coatings*
- *Develop prototype compressor design and cost analysis*
- *Construct and test prototype compressor in collaboration with industrial partner*

Earlier Studies Identified Areas for Fueling System Improvement

- *Experience with CNG has shown that compression is the major cost component in a gaseous fueling system.*

– Estimate for 75 bus transit system:

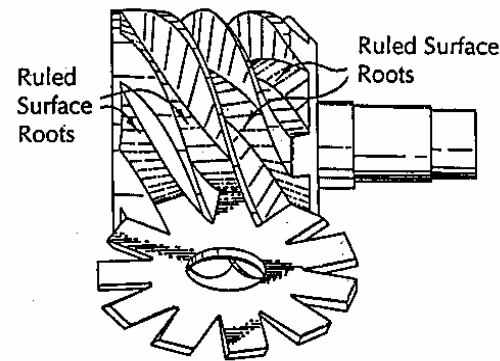
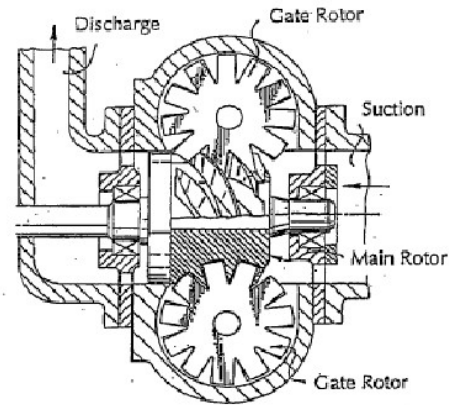
• Compressors	\$1,200K
• Storage	90K
• Dispensers	150K
• Dryer	120K
• Enclosures	200K
• Other equipment	60K
• Installation	750K
• Total	\$2,570K

Benefits Anticipated for the Single-Screw Compressor Are:

- *Capital cost savings of 1/3 to 1/2 over current gas compressor technology*
- *Low noise and vibration (all rotary motion)*
- *Reduction in number of compressor stages*
- *Use of direct motor drive and higher rpm*
- *Ease of service in the field*
- *Design and manufacturing method easily adapted to a variety of applications and sizes*

Key Improvements on the Single-Screw Concept Include:

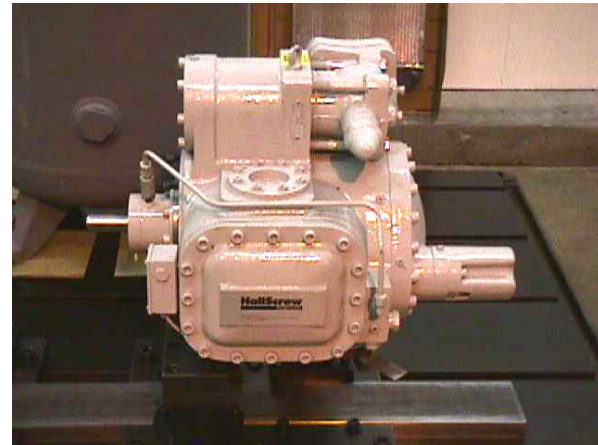
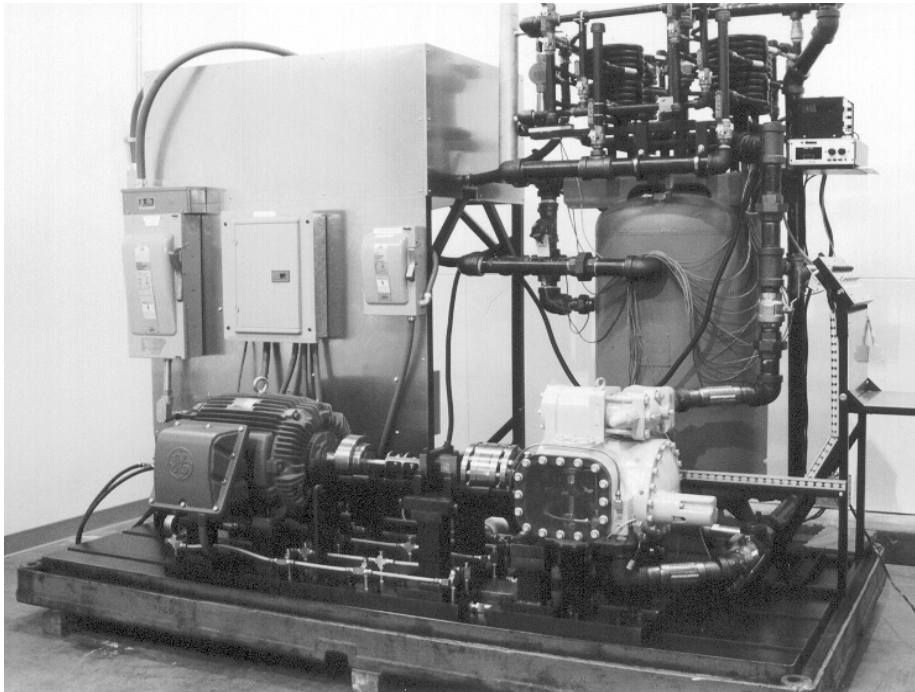
- *Patented design changes that greatly ease the manufacturing process*



- *A new manufacturing process that allows much greater versatility in design and size of components*

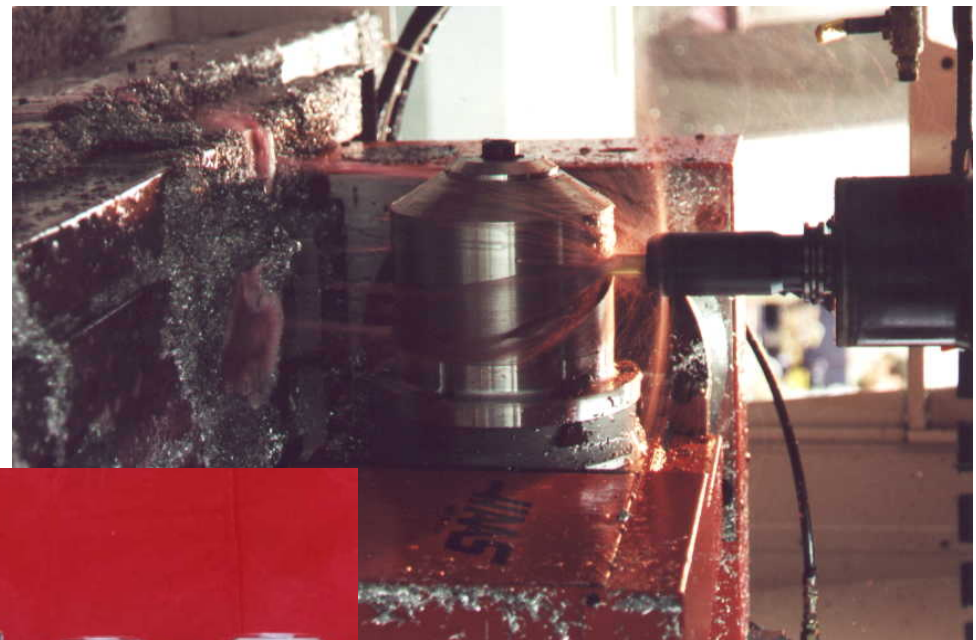
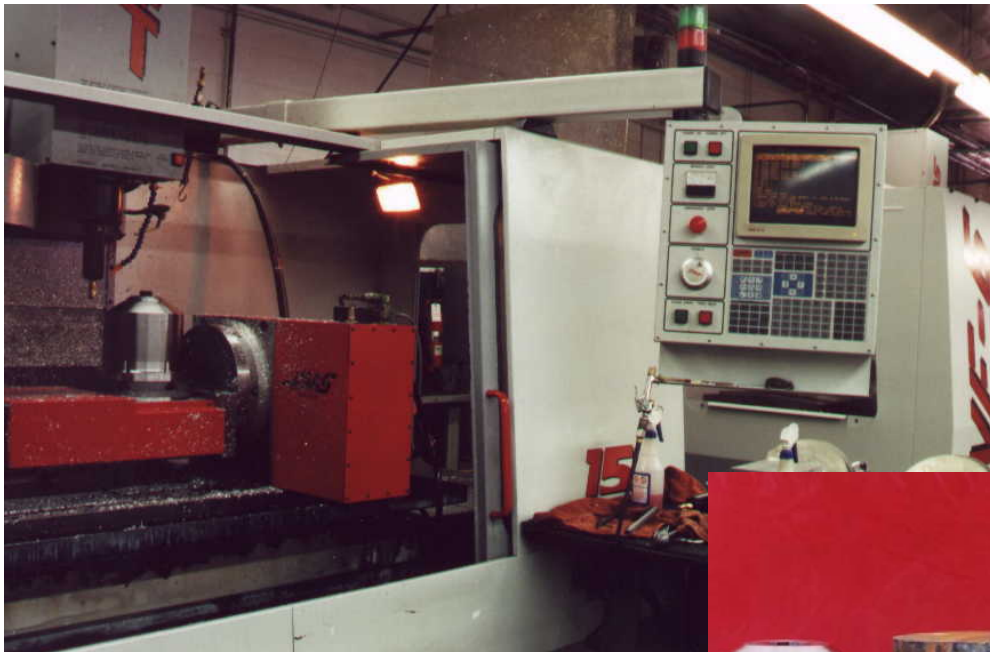
Tests Validated the Design and Production Process

- *Test stand constructed and a commercial compressor of the older design was installed.*



Tests (cont.)

- *New internal components were produced using the patented design and method*



Tests (cont.)

- *The complex geometry of the components was shown to be correct*
- *The rapid manufacturing process worked as predicted*
- *Internal clearances were reduced and more consistent*
- *Compressor performance was equivalent to or improved over original*

Progress in Current Project

- *A performance model for a similar compressor design has been identified and is being evaluated for applicability.*

Future Plans

- *Remainder of FY05*
 - Identify potential compressor applications and technical requirements
 - Model compressor performance
 - Develop recommendations for follow-on research and development program
- *Future years*
 - Optimize compressor design for hydrogen
 - Apply advanced coatings technology for sealing
 - Develop prototype design and cost estimate
 - Build and test prototype compressor

Publications and Presentations

1. Livengood, C.D., and R.P. Larsen, *Novel Hydrogen Screw Compressor*, poster presentation at 2005 DOE Hydrogen Program Review, Arlington, Virginia, (May 23-26, 2005).

Hydrogen Safety

There are no hydrogen hazards associated with the initial phase of this project. Follow-on research and development will require a safety analysis at a later date.