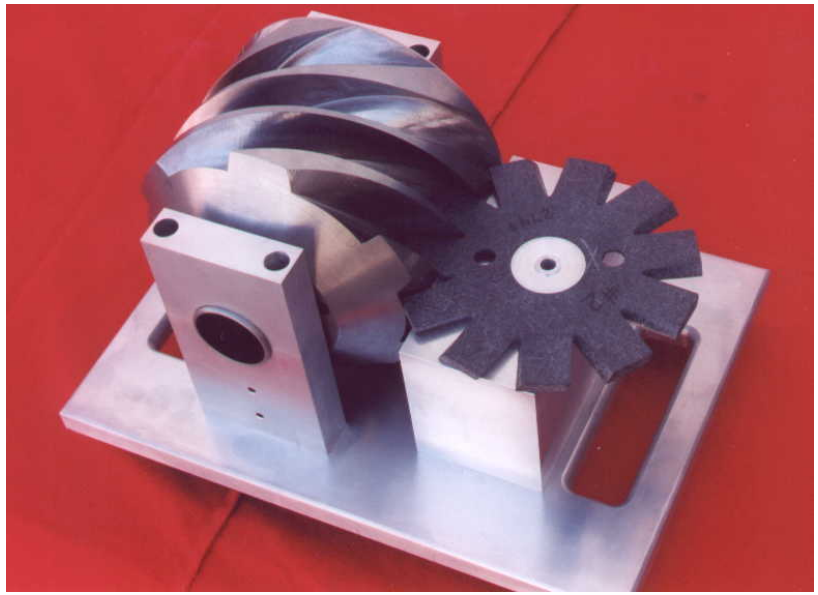
# Novel Hydrogen Screw Compressor




**C. David Livengood & Robert P. Larsen**

**Argonne National Laboratory**


**May 25, 2005**

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)*

| | 2010 | 2015 |
|---|---|---|
| – 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

(See Notes page for further information)

# 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

(See Notes page for further information)

# 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*

(See Notes page for further information)

# 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:

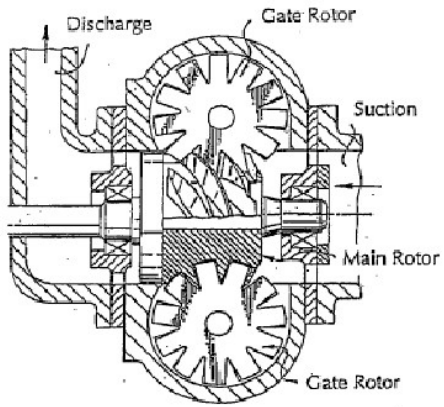
| | |
|---|---|
| Compressors | $1,200K |
| Storage | 90K |
| Dispensers | 150K |
| Dryer | 120K |
| Enclosures | 200K |
| Other equipment | 60K |
| Installation | 750K |
| Total | $2,570K |

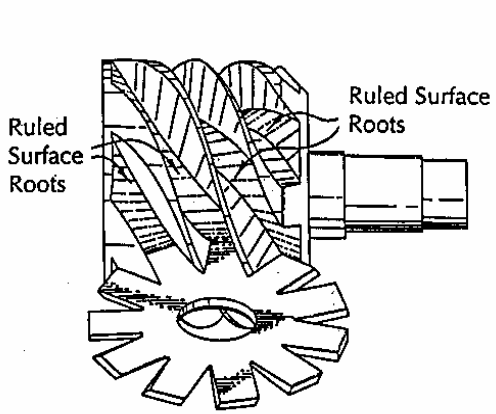
# Benefits Anticipated for the Single-Screw Compressor Are:

- *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*

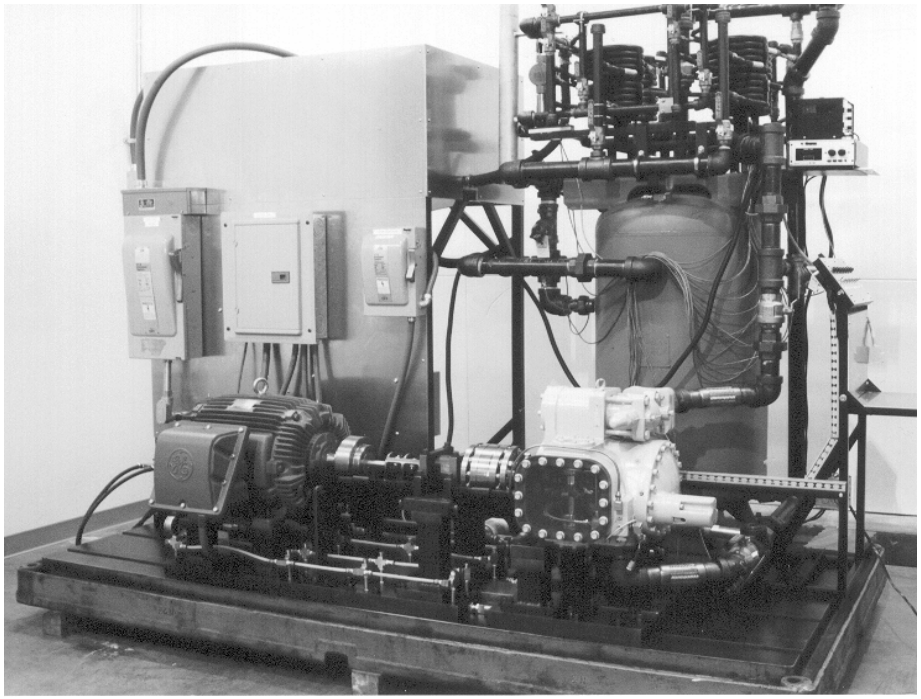


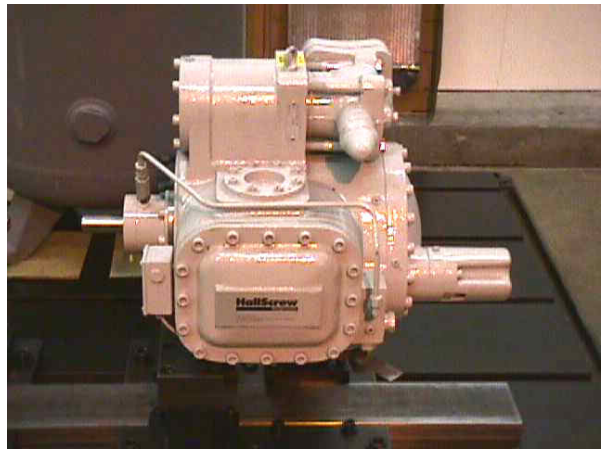




- *A new manufacturing process that allows much greater versatility in design and size of components*

# Tests Validated the Design and Production Process

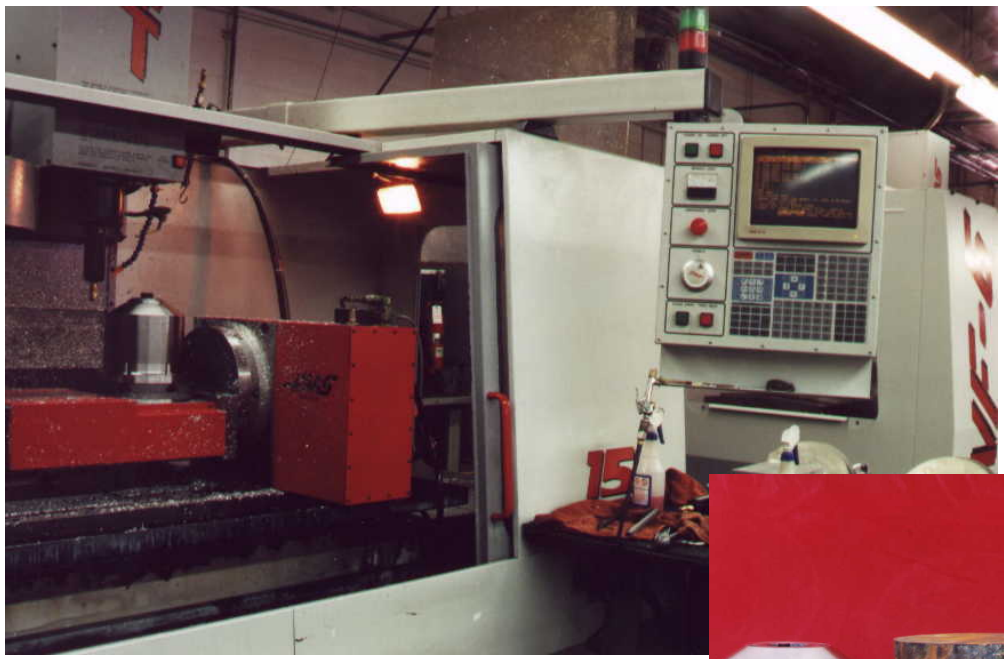
- *Test stand constructed and a commercial compressor of the older design was installed.*

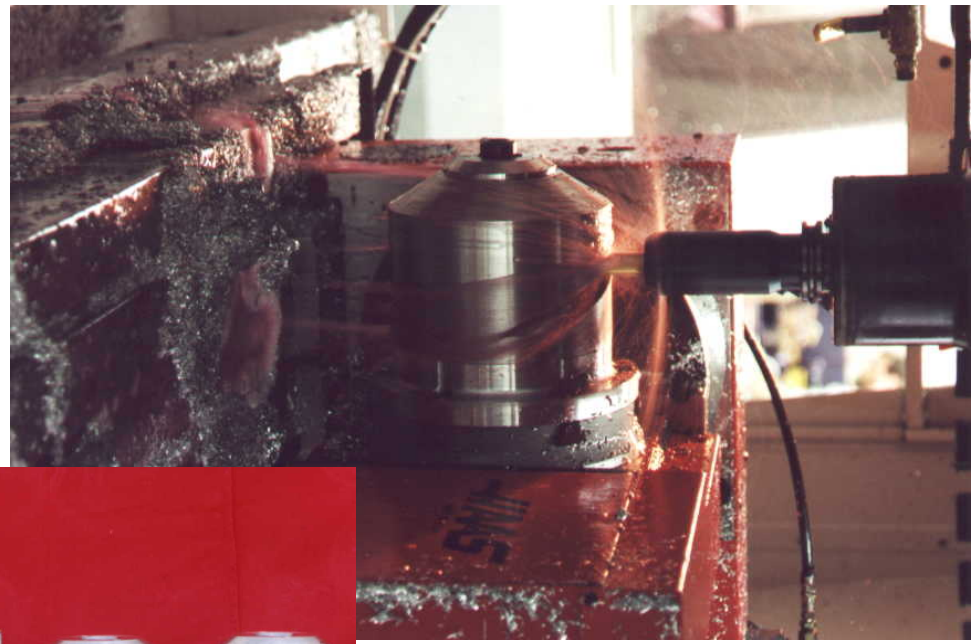




# Tests (cont.)

- *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.*

(See Notes page for further information)

# 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

(See Notes page for further information)

# 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.