Development of a Centrifugal Hydrogen Pipeline Gas Compressor

Colin Osborne/Francis A. DiBella
Concepts NREC

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Project ID: PDP9

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Overview

Time Line

Start date: June 2008

End date: May 2011

Percent Complete: Just started

Barriers

Reliability - High

Hydrogen Energy Efficiency - > 98%

Capital Cost - < $9 million/200,000 kg/day

Maintenance - < 3%/year of total capital investment

Hydrogen Purity – Zero contamination

Budget

Total project funding - $3.75 million

DOE funding – $ 3.0 million

Contractor - $ 0.75 million

Funding received to date – Project not started

Partners

Praxair, Inc

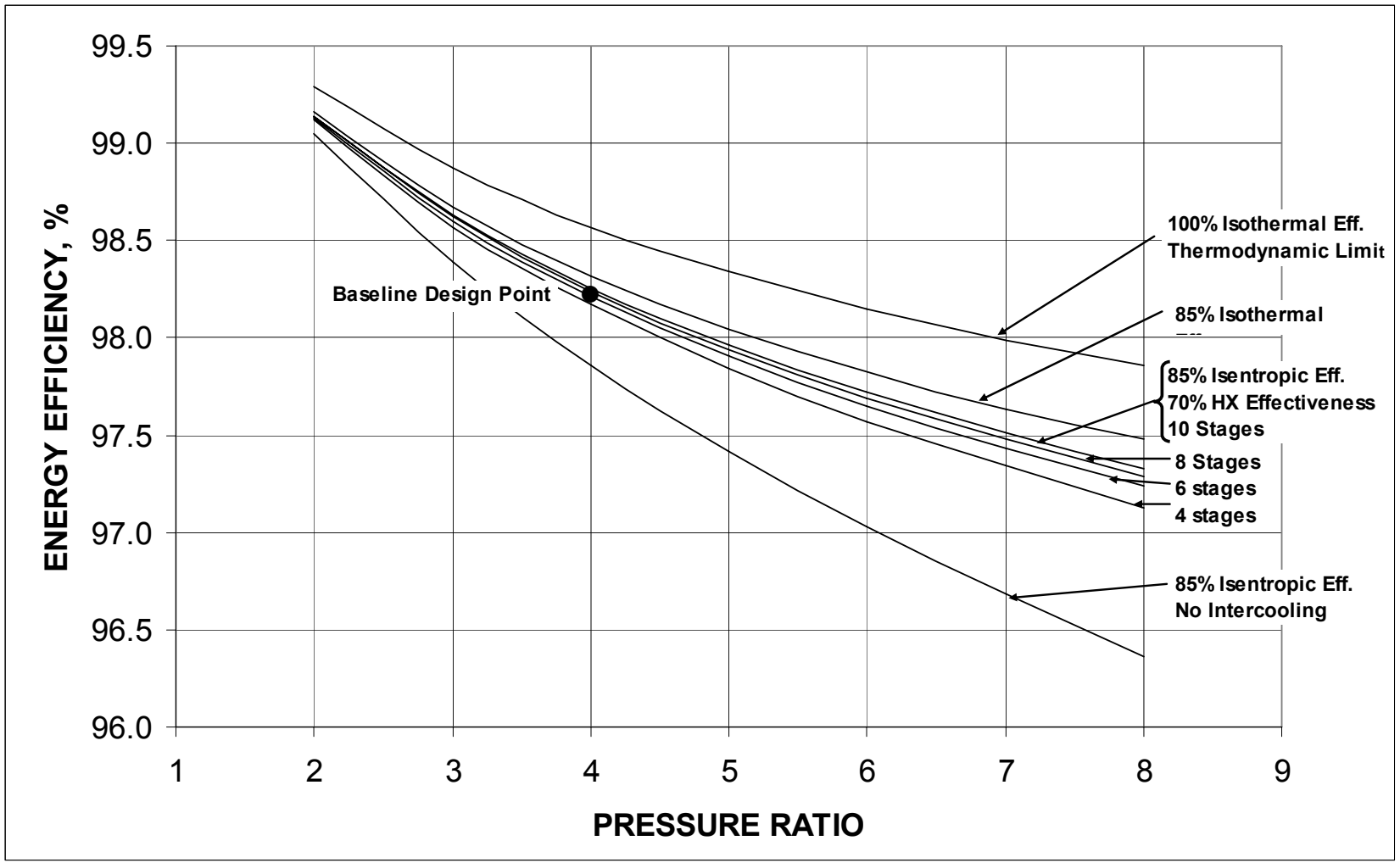
HyGen Industries

Texas A&M University

Objective

- Design and Demonstrate Advanced Centrifugal Compressor for High-Pressure Hydrogen Pipeline Transport
  - Investigate alternative system sizes, design options, operating conditions and costs
  - Select baseline design able to meet near-term applications
  - Identify critical areas of development and operational limitations
  - Design and test critical components under design conditions
  - Build and demonstrate full-scale components in an integrated compressor system
- Prepare Development Plan for Industrial Pipeline Application

Compressor Hydrogen Efficiency at Alternative Design and Operating Conditions



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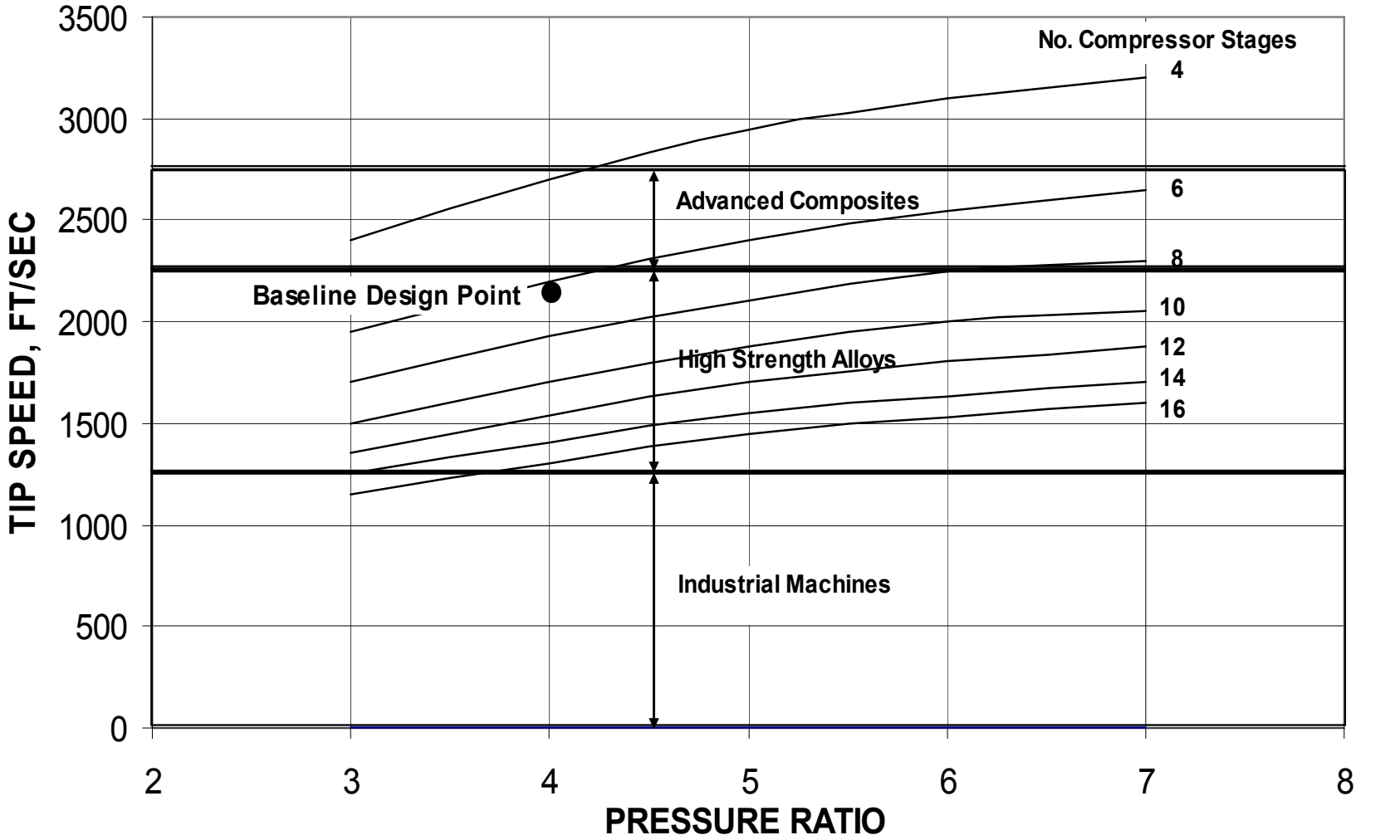
Generalized Design Limitations for Hydrogen Compression



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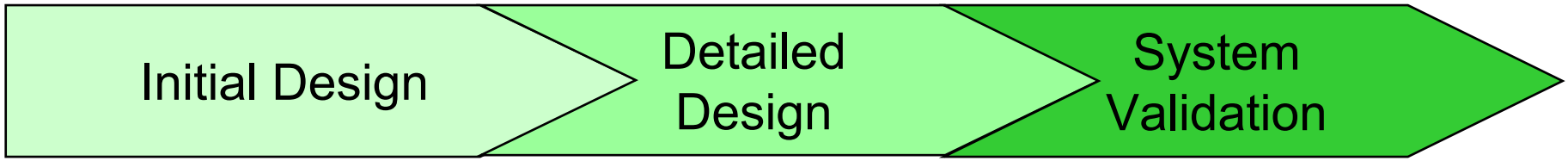
Milestones

- August 2009 – Go/No-Go Decision – Alternative system designs reviewed and selection made of preferred approach. Materials and components testing will be completed and a material selected for compressor rotor.
- May 2010 - Go/No-Go Decision – Detailed design and cost analysis of full-scale pipeline system completed. Design of Laboratory Validation System finalized.
- June 2011 – Go/No-Go Decision – Fabrication and testing of two-stage Laboratory Validation System completed. Revised design and updated manufacturing cost analysis completed.

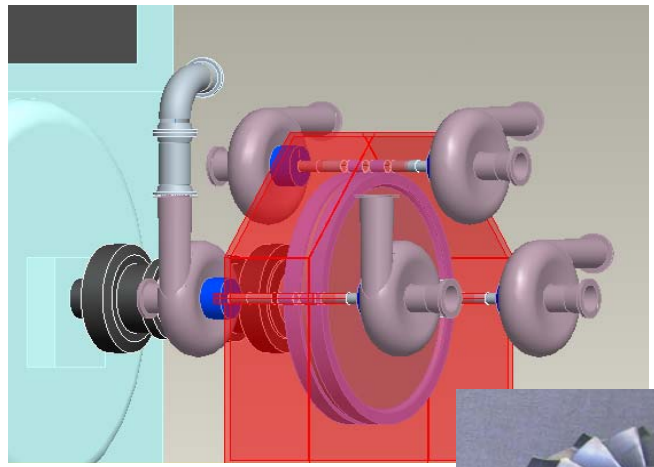
Approach

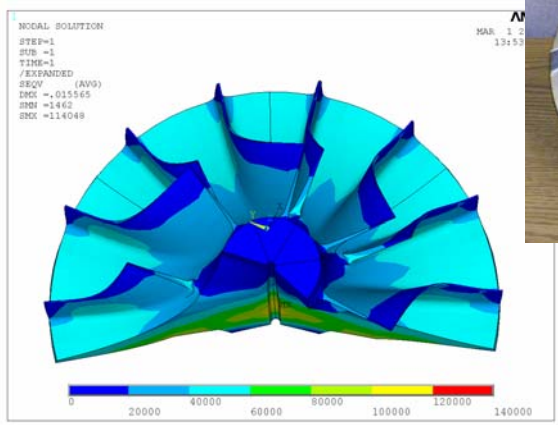


Initial Design	Detailed Design	System Validation
•Initial design criteria and performance specifications. •Initial integrated systems design and cost analysis. •Aerodynamic and structural analysis of compressor. •Materials and/or coatings investigated for use in high-pressure hydrogen environment. •Final design specifications.	•Detailed integrated systems analysis. •Critical components design and testing. •Detailed design of full-scale and laboratory validation systems. •Detailed cost analysis of full-scale system.	•Two-stage centrifugal compressor system fabricated and tested to validate design. •Final design of full-scale system completed. •Field demonstration program plan prepared.

Program Accomplishments to Date

- Final contract negotiations in progress.
- Initial design approaches have been defined and a baseline concept has been established.





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Future Work

- Complete contract negotiations.
- Prepare initial systems analysis to determine components/subsystems design specifications.
- Design compressor for high pressure ratio operation in hydrogen.
- Investigate and select materials for impeller design in a high-pressure hydrogen environment.

Summary

- Development program for efficient hydrogen pipeline compressor underway.
- Subcontractor team in place.
- Initial activities will focus on materials selection and compressor design.
  - Advanced aerodynamic and structural designs to minimize impeller stresses.
- Initial design specifications targeting current pipeline compressor requirements.
  - Provides for early introduction into the developing hydrogen pipeline infrastructure.