Integrated Short Contact Time Hydrogen Generator DOE Project Review Meeting

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Project ID # PD10

Overview

Timeline

Project start date: 01/01/2005 Project end date: 12/31/2007 Percent complete: 8%

Budget

Total project funding

> DOE share: \$2.6M

Contractor share: \$1.4MFunding received in FY04: \$0.00Funding for FY05: TBD

Barriers

- Technical Barriers Addressed:
 - A. Cost of Fuel Processor
 - C. Operation and Maintenance (O&M)
 - D. Feedstock Issues
- Technical Targets (2010):
 - Total Energy Efficiency (%LHV) > 75%
 - Total H_2 Cost < \$1.50/gge H2

Partners

- Argonne National Lab

• University of Minnesota





H₂ Production Technology Objectives

Develop a compact H_2 generator that delivers H_2 at a cost of \$1.50/kg (based on DOE H_2A model) with >75% (LHV) efficiency

Year 1:

- Complete system analysis & develop conceptual design
- Demonstrate SCPO feasibility with energy & economic analysis
- Identify base-case catalysts & generate initial lab-scale results



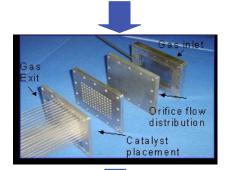
GE Research Approach

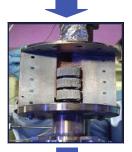
• Catalyst development -Short contact time catalyst .CPO (GE/UoM) .SMR (GE/ANL) .Shift catalyst (GE) -High throughput screening & bench scale

experiments (GE)

- •System development
 - –Design compact H₂ generator by staging catalysts (GE)
 - –Demonstrate concept feasibility on a pilot scale system (GE)



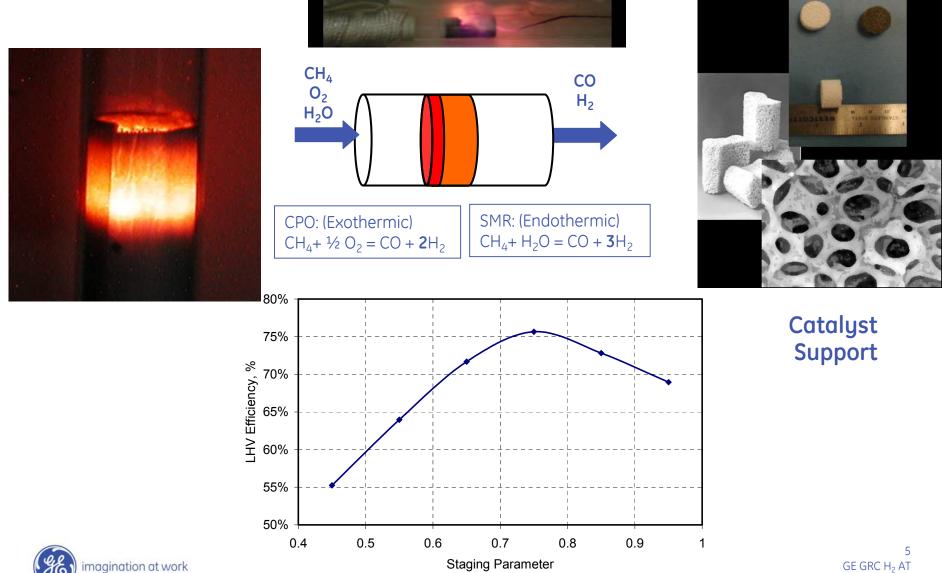








Why staged catalytic partial oxidation? (SCPO)



Leverage GE HTS Capabilities

- Rapid screening of catalyst-reactant pairs
- Miniaturization to reduce test time/cost
- Large screening area = large design space explored
- Adjacent technology: NOx emissions reduction
 - -Expertise in high T catalysis development
 - –Demonstrated HTS hardware & data capabilities

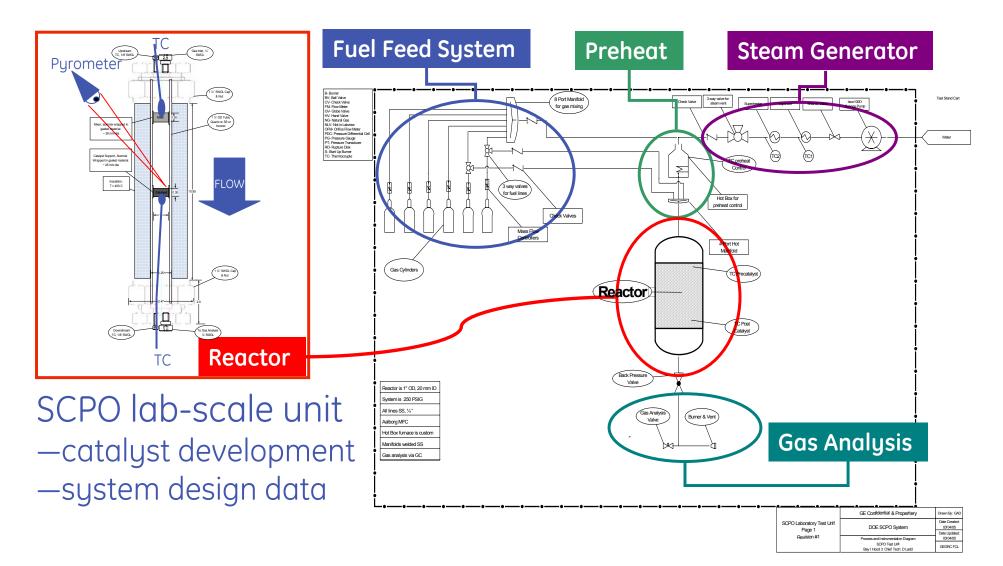




High-throughput screening (HTS) reactor



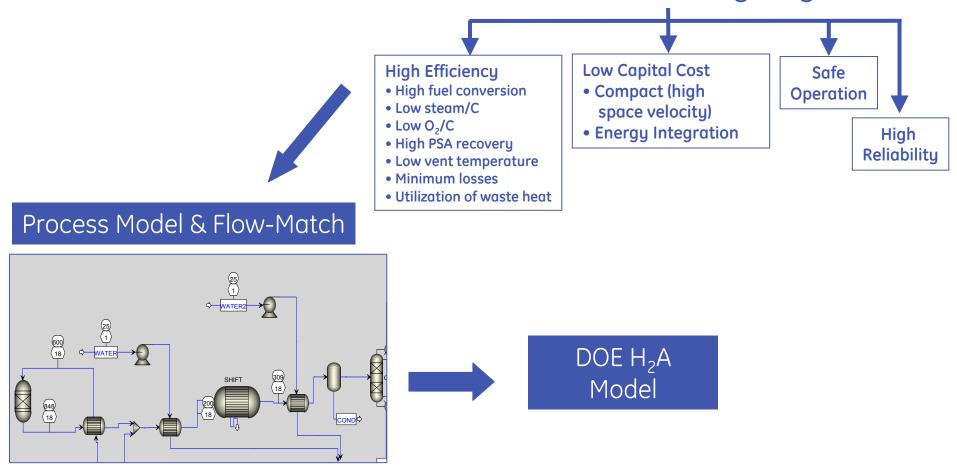
Leverage GE Reformer Design Experience



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Quantify Performance/Cost Trade-offs

Minimize "cost of hydrogen"

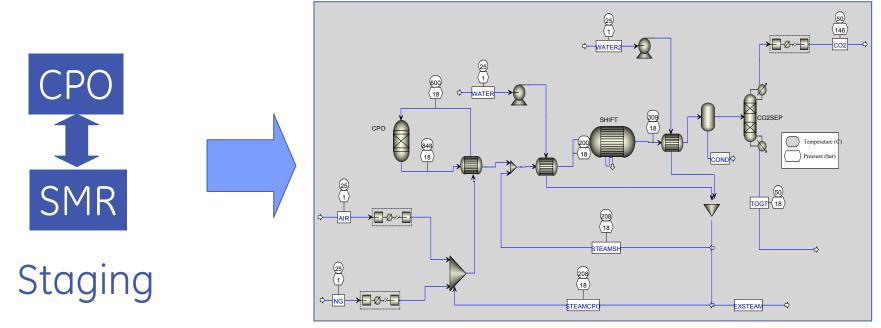




Analyze System Concepts

Catalyst staging & Heat exchange Scenarios

Scenario analysis process modelling (example)



Aspen Plus



Assess "cost of hydrogen": DOE H2A

Model output

Hydrogen cost for 10 year life of refueling station

Key inputs

- Detailed installed capital costs
- Process operating efficiencies
- Feedstock costs
- 0&M

Enables

Comparison across alternative reforming technologies



GE Path Forward

Reminder of Year 1

- Complete system analysis, & develop conceptual design for a compact H₂ generator
- Demonstrate SCPO feasibility through energy & economic analysis
- Identify base-case catalysts and demonstrate preliminary lab-scale results

Year 2

- Go/No-Go decision based on energy & economic analysis
- Catalyst optimization
- Design of pilot-scale H₂ generator

Year 3

- Demonstrate catalyst durability
- Demonstration of the $\rm H_2$ generator feasibility through operation of pilot-scale unit .



Supplemental Slides

The following three slides are for the purposes of the reviewers only – they are not to be presented as part of your oral or poster presentation. They will be included in the hardcopies of your presentation that might be made for review purposes.



Publications and Presentations

No publications so far.



Hydrogen Safety

The most significant hydrogen hazard associated with this project is:

The most significant risk associated with SCPO reformer will be the mixing of fuel (natural gas, syngas) and air at elevated temperatures under abnormal conditions such as leak or control system failure.



Hydrogen Safety

Our approach to deal with this hazard is:

The preliminary approach to minimizing this risk is to design the entire reformer skid to meet standards of NEMA and ASME. GE performs a three step safety review; preliminary hazard assessment (PHA), hazardous operation review (HazOp) and accident scenario review (ASR).

Sample HazOp

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Sample ASR

