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SGT6-5000F For IGCC Application

by

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IGCC & Syngas

- Gasification technology is utilized to produce Syngas fuel from relatively low cost coal.
- Syngas fuel can be combusted in IGCC (Integrated Gasification Combined Cycle) applications.



Coal → \$2.38/MMBtu (N. America 2011)
Natural gas → \$4.64/MMBtu (N. America 2011)



Gas Turbine Configuration

The SGT6-5000F can be modified with a syngas combustor.



Syngas is combusted to generate 235 MW of gas turbine power.



Syngas Combustor

2-stage diffusion flame burner capable of combusting syngas and/or natural gas.







Syngas Rig Testing

Syngas rig testing was conducted with a wide range of hydrogen content:

- Emissions
- ✓ Dynamics
- ✓ Flashback

| Test Rig Syngas Composition Range | | |
|-----------------------------------|-----|-----|
| mol% | Min | Max |
| H_2 | 11% | 73% |
| СО | 0% | 46% |
| CH ₄ | 0% | 5% |
| CO ₂ | 0% | 14% |
| N ₂ | 0% | 60% |





Syngas Emissions

➤ As the hydrogen content in syngas , the stoichiometric flame temperature , and NOx emissions .

> NOx emissions in this diffusion flame combustor are controlled via N_2 dilution or steam saturation.





Syngas Dynamics

Syngas combustion dynamics were relatively low compared to natural gas combustion dynamics.

<10 mbar for all frequency ranges.</p>





Syngas Flashback

The flame speed of hydrogren is ~10x that of natural gas!

The risk of flashback increases as the hydrogen content in syngas increases.





Compressor Surge and Turbine Flutter

Syngas fuel flow is ~10x that of natural gas for a given load.

► Increased pressure ratio increases the risk of a surge.



Surge Example

Increased exhaust flow increases the risk of flutter.







Recirculation





Recirculation of compressor surge extraction air is used such that inlet guide vanes can operate near the design point!



Co-Fire Operation

The gas turbine can be operated in co-fire mode where syngas and natural gas are combusted simultaneously.

A Wobbe meter is used to control the heat input of syngas in order to maintain gas turbine stability.



Summary



Syngas rig testing



IGCC experience



SGT6-5000F experience



- **SGT6-5000F for IGCC Applications**
- > 235 MW of reliable power on syngas fuel
- First fire on syngas scheduled for January 2014.

Thank You! Questions?