



# Gas Turbines & Advanced Manufacturing

... this isn't a linear progression

NETL University Turbines System Research (UTSR)

Workshop November 3, 2015

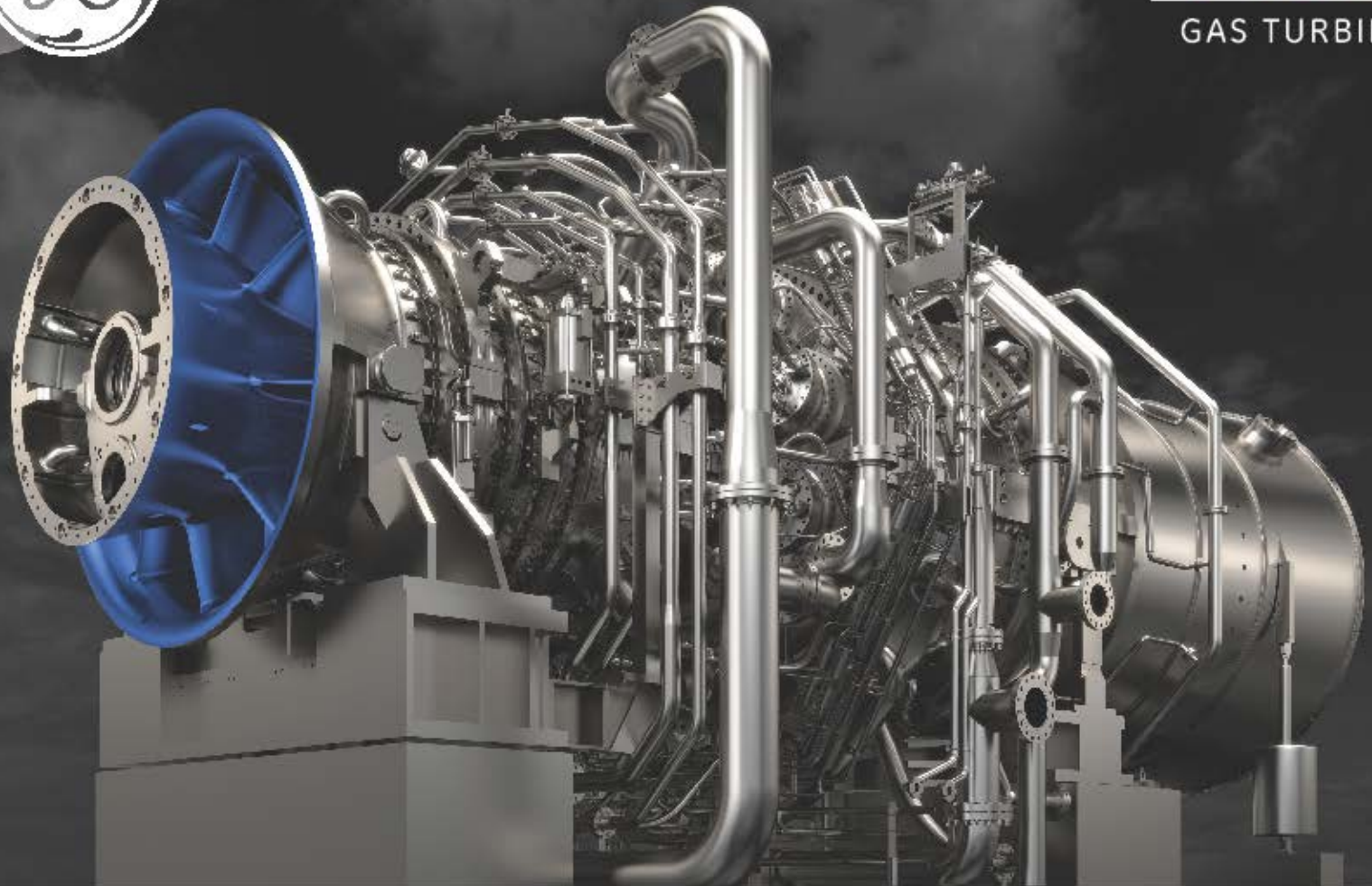
Bryan Dods

**Imagination at work.**



# 7HA

GAS TURBINE



## HEAVY METAL IS COOL AGAIN

WORLD'S LARGEST, MOST EFFICIENT GAS TURBINE FOR 60HZ APPLICATIONS

# Changes and Implications



## Challenge:

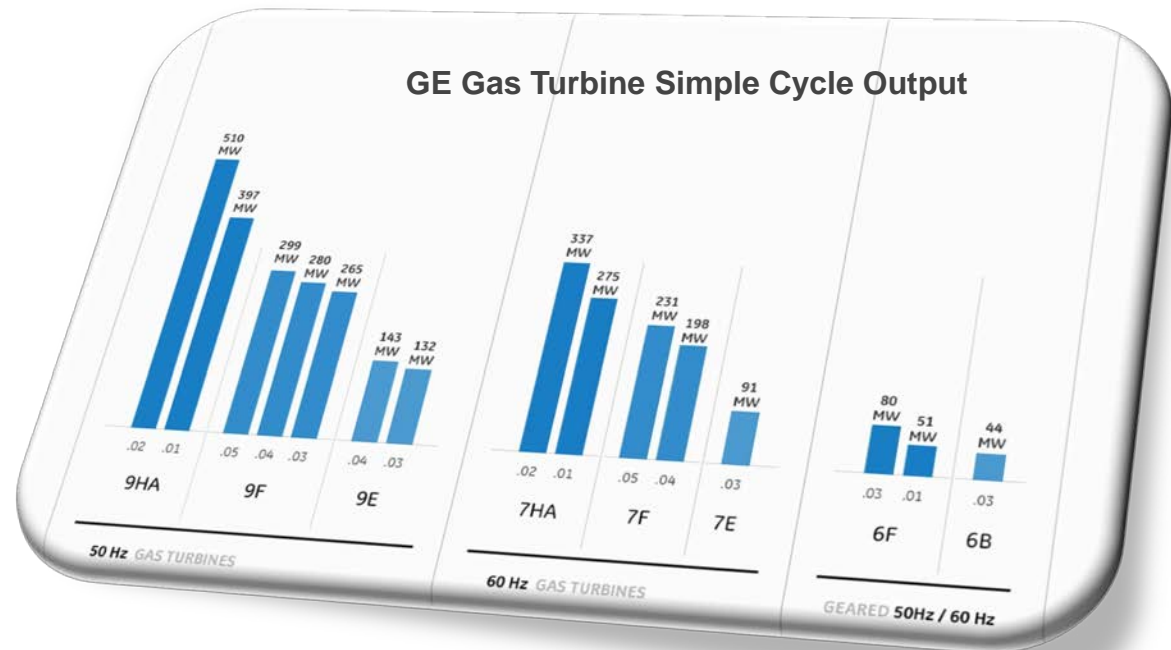
- 65% - 67% efficiency
  - Reduced assembly clearances
  - Tighter part tolerances
- 3100°F Firing Temperature
  - Harder to manufacture alloys
  - New cooling schemes
- Output
  - Larger machines, part size and number of stages
  - Higher compression

**Competitiveness of US Gas Turbine Manufacturers**

March 29, 2013

Submitted to:  
Gas Turbine Association

Submitted by:  
ICF International  
9300 Lee Highway  
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# Advanced Production Systems

## Concept of Operations

People & Culture	<i>Enable people to pursue their interests and achieve their potential</i>
Ecosystem	<i>Customers, suppliers, competitors, and other industries are making moves that must be included in scenario planning</i>
Infrastructure	<i>Factories, logistics, and customers physical assets</i>
Business Process	<i>Brilliant factory &amp; industrial internet; ERP, where the competitive advantage/business value is captured</i>
Architecture	<i>Service bus, industrial plug n play; hardware and IT systems interfaces; machine to machine; factory to factory or supplier to</i>
Network	<i>Supplier networks, information transfer corridors; Cyber security; Array of wireless technologies and hardware systems</i>
Modeling, Simulation & Controls	<i>Model Based Enterprise, physics based models, &amp; HPC speed, higher quality, higher capability, decisioning / algorithms,</i>
Value Stream Application	<i>Raw material conversion to finish product; leadtime; lean , waste, set-ups</i>
Processes	<i>Emerging &amp; existing capabilities; machine cycle, part features, consumables</i>
Equipment / Hardware	<i>Machine design, analysis &amp; characterization, performance, tools/fixtures</i>
Data Management & Analysis	<i>Data structures, aggregation, signal processing, graphing, transfer</i>
Data Input / Sensor	<i>Digital capability, sensor integration, near real time</i>



# Critical Advanced Manufacturing Technologies

## Model Based Enterprise

- MBd, MBm, MBs
- Modeling & Simulation
- HPC as the next controls platform

## Additive Manufacturing

- Polymers
- Metals
- Ceramics

## Composites

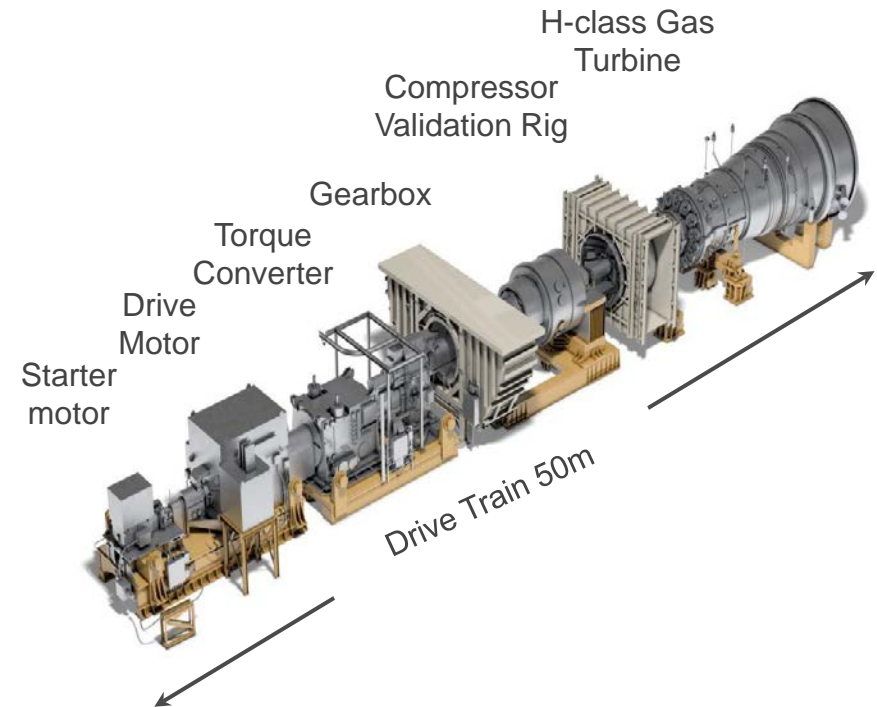
- Large scale composite structures
- High temperature fiber/resin systems (800°F – 1100°F)
- 3D Manufacturing - Pultrusion, 3D Weaving, Cont. Compression Molding
- Ceramic matrix composites

## Industrial Internet....Brilliant Factories

- Robotics
- Automation



# GE Greenville World's Only FSFL Validation Facility



- Over \$170MM invested
- > 7000 data streams; 1 terrabyte/hour
- > 500,000 horsepower generated
- Accelerates New Product Introduction by  $\approx$  1 year
- Supplied by on-site LNG facility for fuel flexibility



# And What's Next... Advanced Manufacturing Works



***\$73MM Investment***  
***132K sq ft***  
***80+ new Advanced Manufacturing jobs***

***Opening - November 4***

