Development of a “Green” On-Board Inert Gas Generation System (GOBIGGS™)

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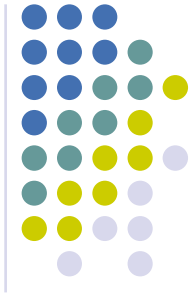
Aviation Fuels Issues – Role for Phyre Technologies

- **Fire Safety**
- **Contamination control**
- **Environmental**

- **Fire Safety**
- **Microbial growth**

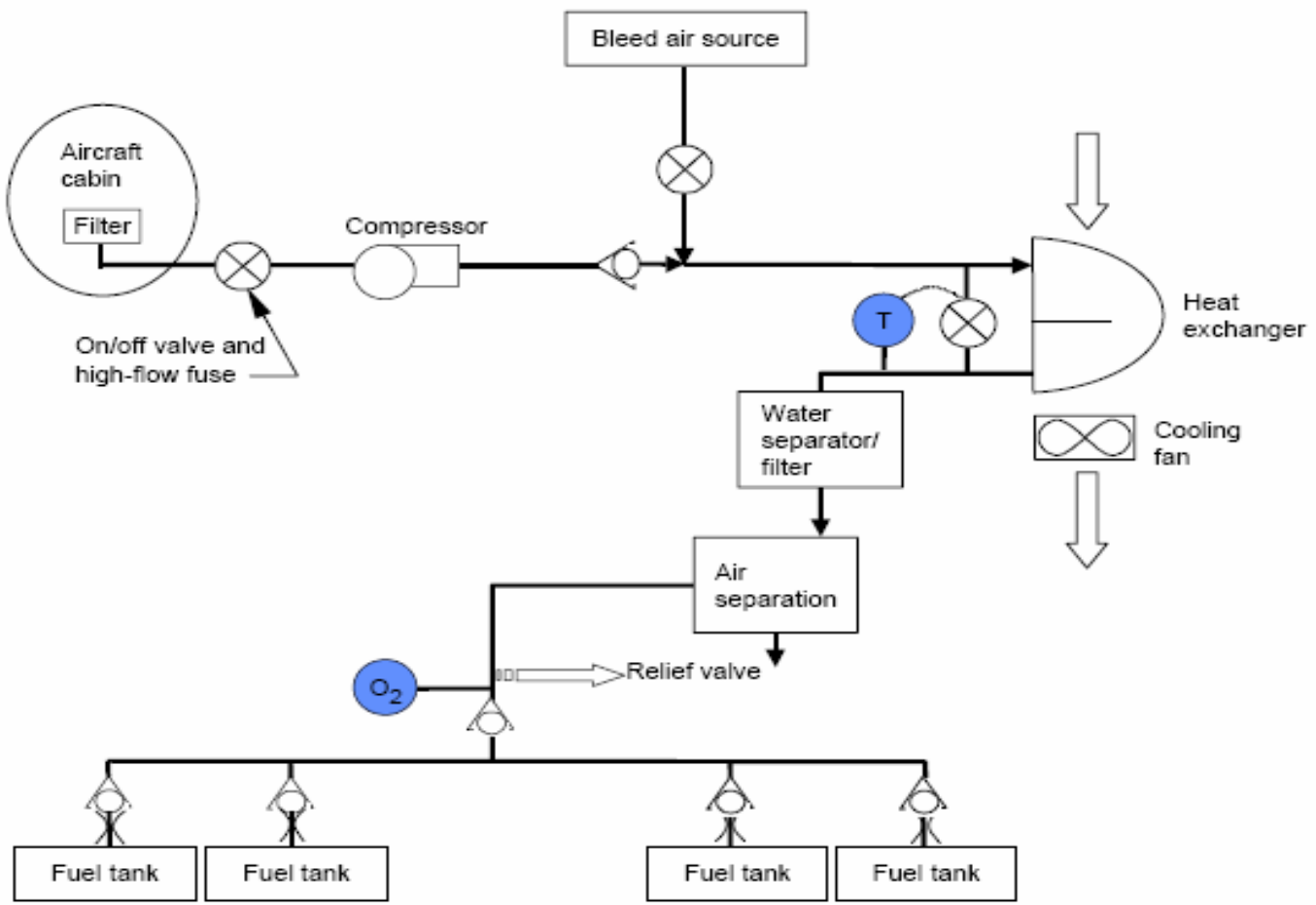
- **Fire Safety**
- **Fuel Thermal Stability**

Inerting System Goals

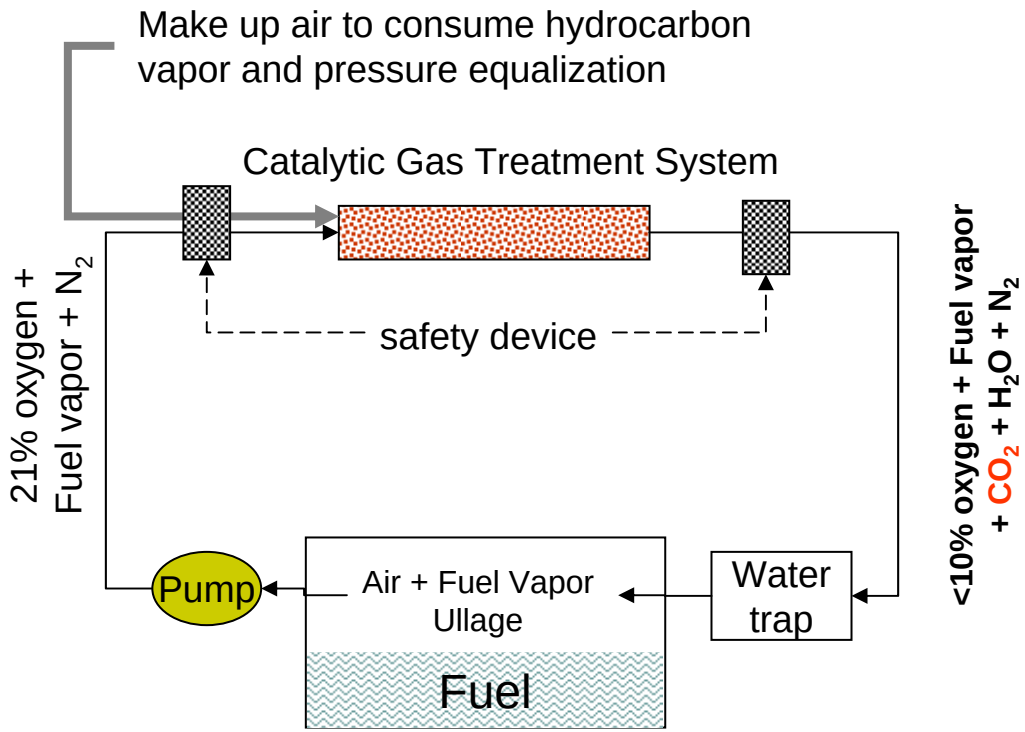


- Safety
  - Reduction of O_2 level below 12% for commercial aircraft. (9% for military aircraft)
  - Maintenance of non-flammable environment throughout all stages of operation (>97% of the operating time)
- Operational Flexibility
  - Minimal operational impact
  - Low cost of installation and operation
- Environmental Impact
  - Minimal emissions from fuel tank
  - Minimal impact on efficiency

State-of-the-Art Aviation inerting system



Phyre's GOBIGGS™

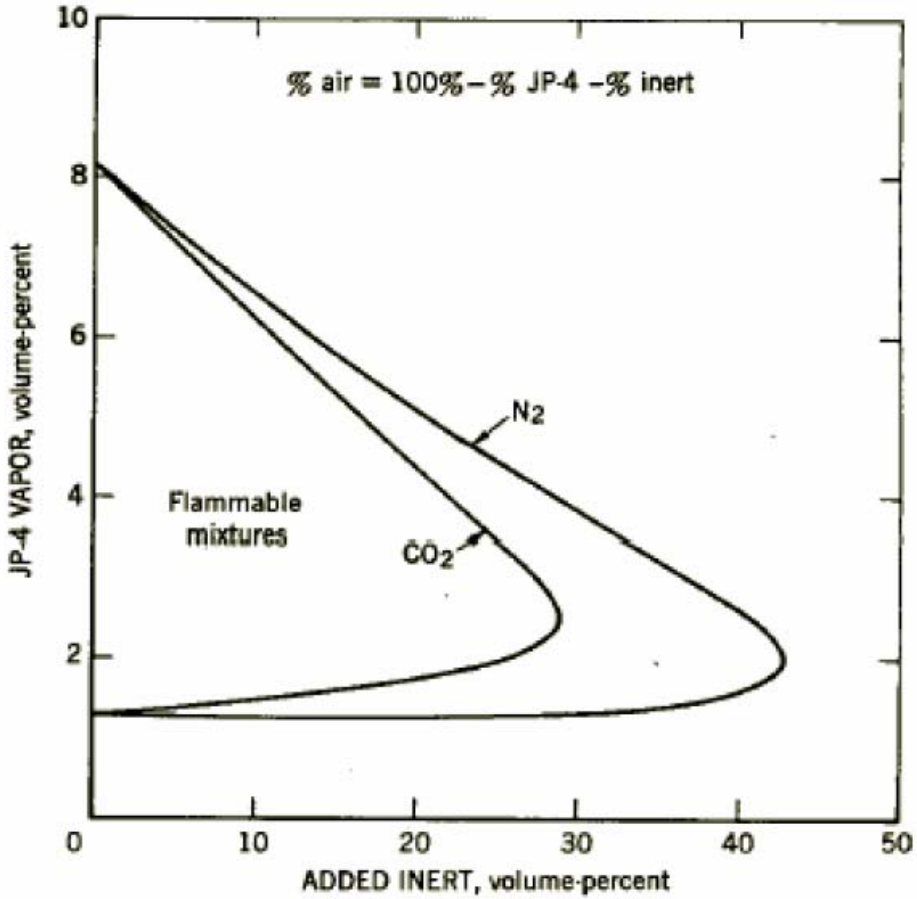


PATENT PENDING

The system uses a negative low pressure draw to operate

SAFETY
OPERATIONAL FLEXIBILITY
ENVIRONMENTAL IMPACT

Flammability Limits for JP-4 with Inerting



Flammability limits of JP-4 vapor-CO_2-Air and JP-4 vapor-N_2-Air Mixtures at 27° C and atmospheric pressure. (Zabetakis, 1965)

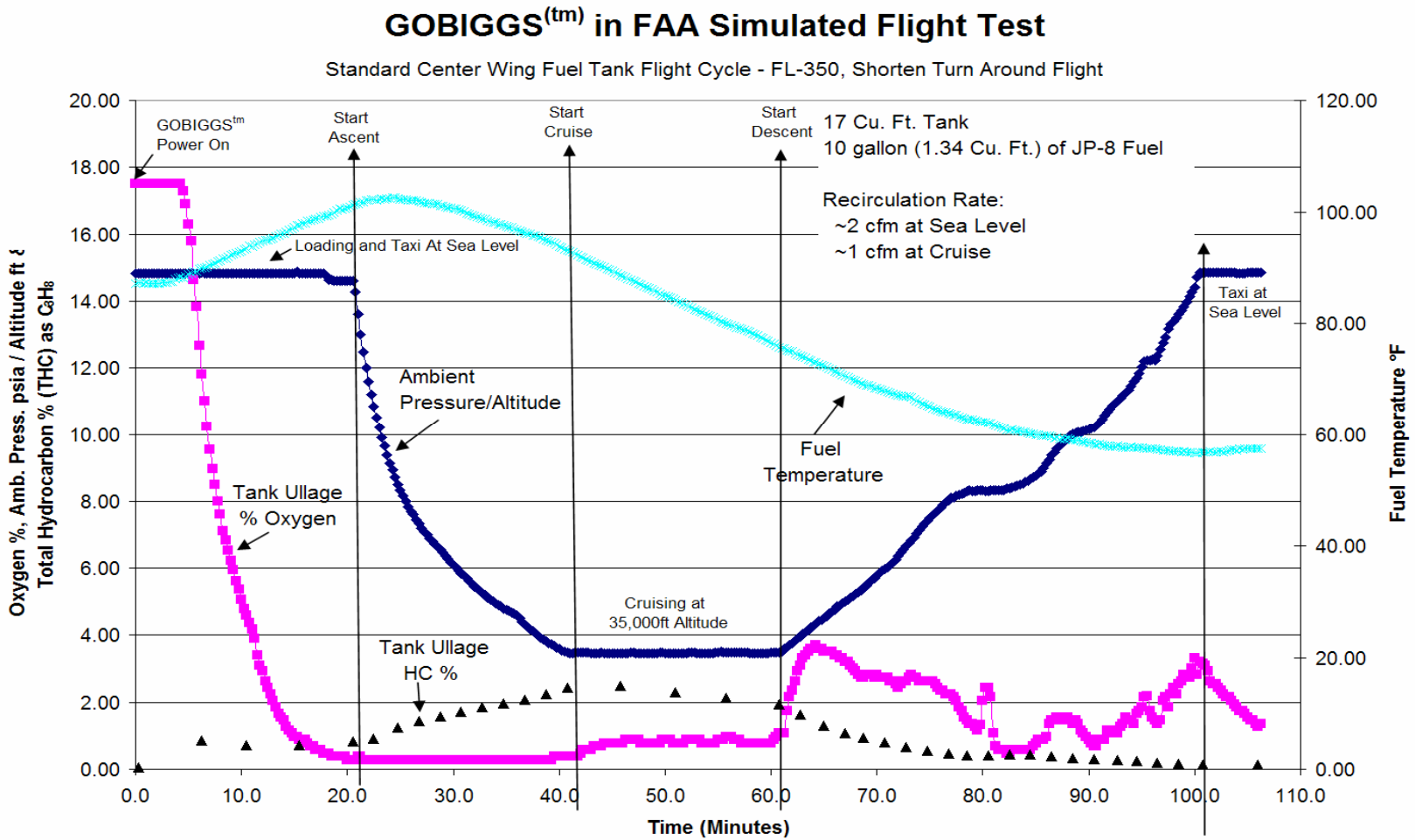
BlazeTech

GOBIGGS™ 60


PHYRE
GOBIGGS™ 60
GREEN ON-BOARD INERT GAS GENERATION SYSTEM

FAA Environmental Test Unit

Safety - FAA Flight Test



Operational Flexibility

- GOBIGGS™ does not require bleed air
  - No need for the continued engine operation on the ground – a necessity for state-of-the-art OBIGGS
  - Can use ground power
- Shorter inerting time

Environmental Impact – Fuel Conservation

SIR RICHARD BRONSON
- “instead of turning engines on when you're at the gate and using two tons of fuel to get to the end of the runway, we're towing planes to the runway with an electric tug.” - -

GOBIGGS™ is capable of operation even when the engine is not running

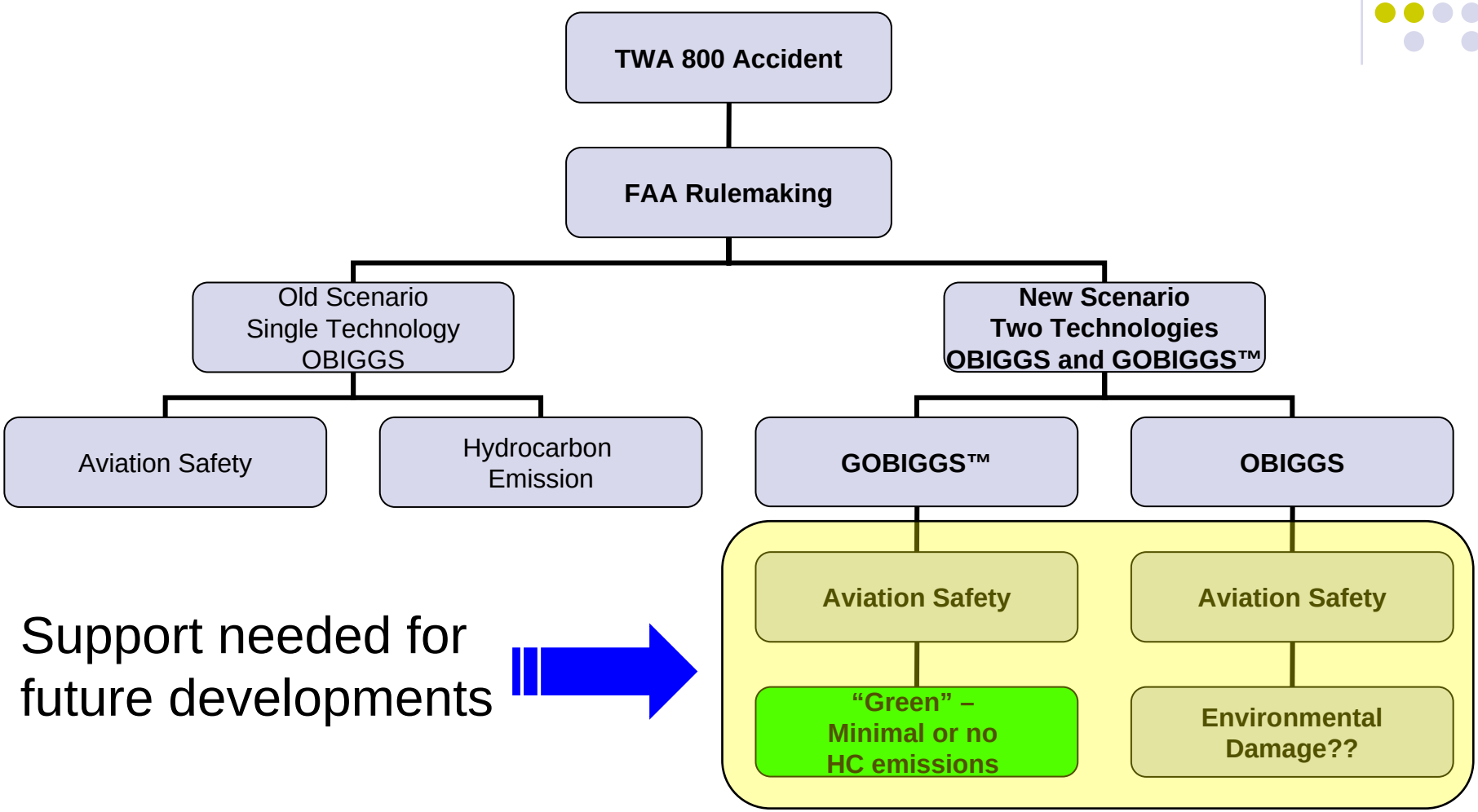
Environmental Impact (while aircraft are on the ground)

- Hydrocarbons ventilated while planes on the ground.
- Approx. 10,000,000 flights per year in the US.
- Approx. 28,000 plane hours per day of HC ventilated over every airport in the United States (while on the ground). Assumes one hour average turn time.

Fuel Consumption/CO_2 and H_2O generation

- Boeing 737 CWT example
  - Assumptions
    - Total CWT volume approx. 600 cubic feet
    - Two complete cycles of 21% to 0% oxygen levels in a flight (total volume of 1200 cubic feet)
    - Model fuel composition C_9H_{20}
  - Amount of fuel vapor consumed approx. 2700 gm
  - Amount of CO_2 produced approx. 9000 gm
  - Amount of H2O produced approx. 4000 gm (4 liter)

The GOBIGGS™ implications



Support needed for future developments

What are the advantages of GOBIGGS™?

- On board inerting system, useful in multiple platforms including aviation, marine and land based storage units
- Phyre's GOBIGGS™ takes existing mixture of flammable gas and renders it non-flammable with minimal or no hydrocarbon emissions as a result of the process - "Green"
- It reduces hydrocarbon level as well as oxygen level; thus providing double protection
- GOBIGGS™ can render the fuel tank non-flammable throughout the flight profile (ground, taxi, take-off, cruise, descend, landing)
- Significantly quicker inerting time when compared to existing OBIGGS technology
- Ability to run without the engines operating. (current systems are based upon bleed air from engines)
- Ability to shut down inerting system once non-flammable conditions are reached

Questions?