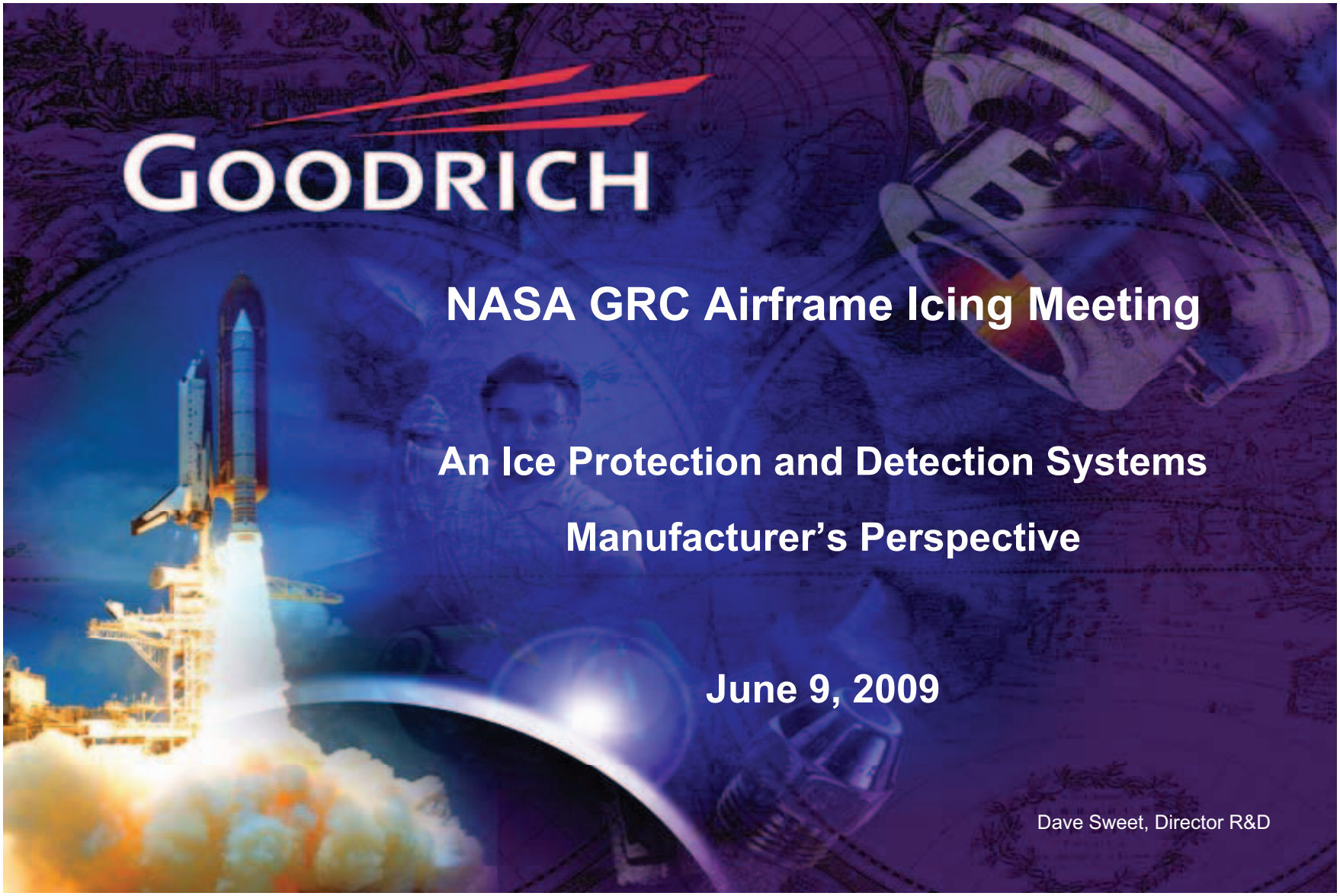
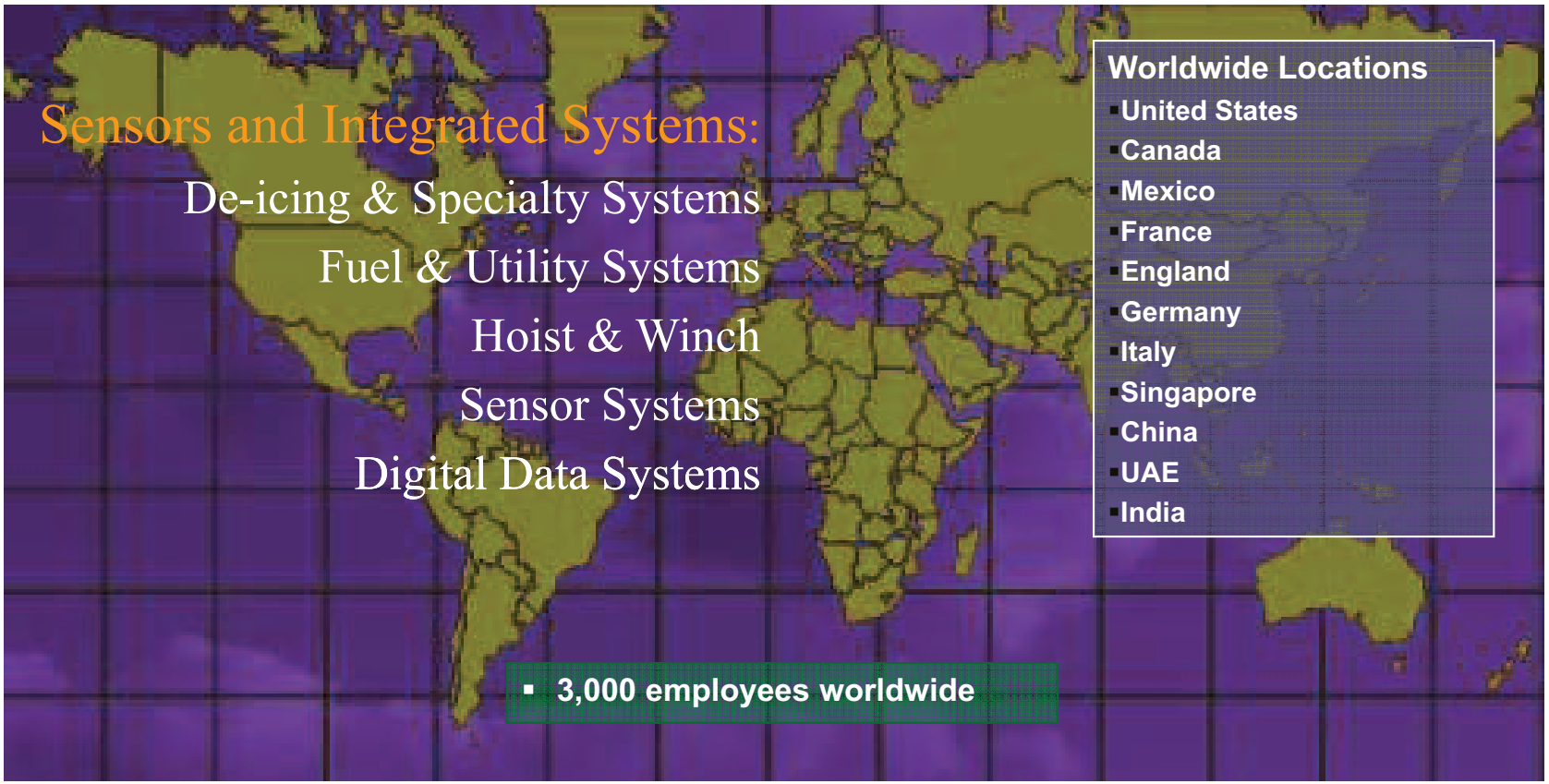

GOODRICH
NASA GRC Airframe Icing Meeting
An Ice Protection and Detection Systems
Manufacturer's Perspective
June 9, 2009
Dave Sweet, Director R&D

GOODRICH
Sensors and Integrated Systems

NASA GRC Airframe Icing Meeting



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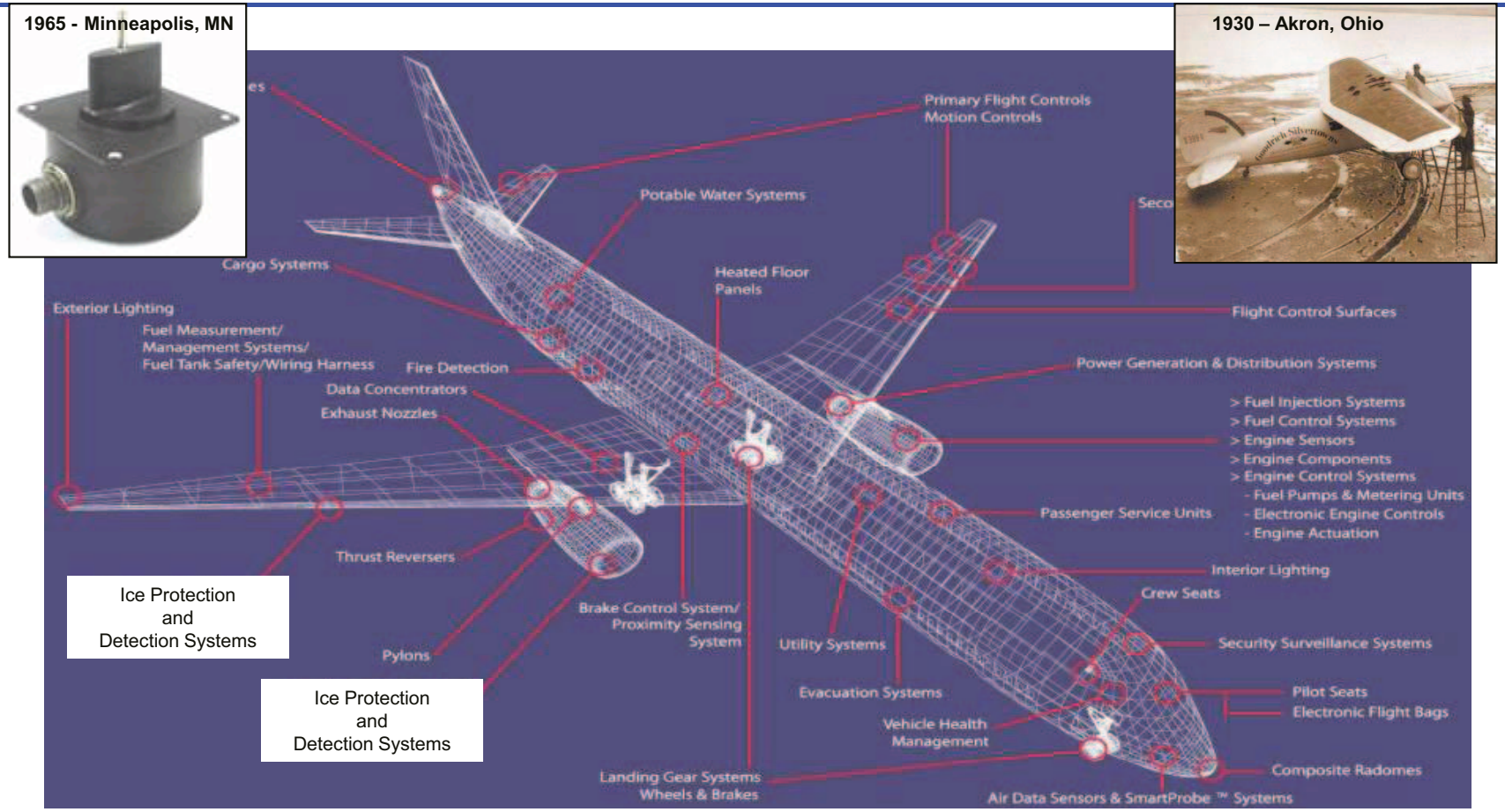
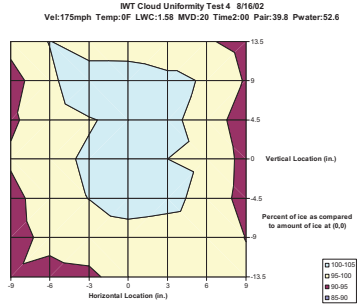
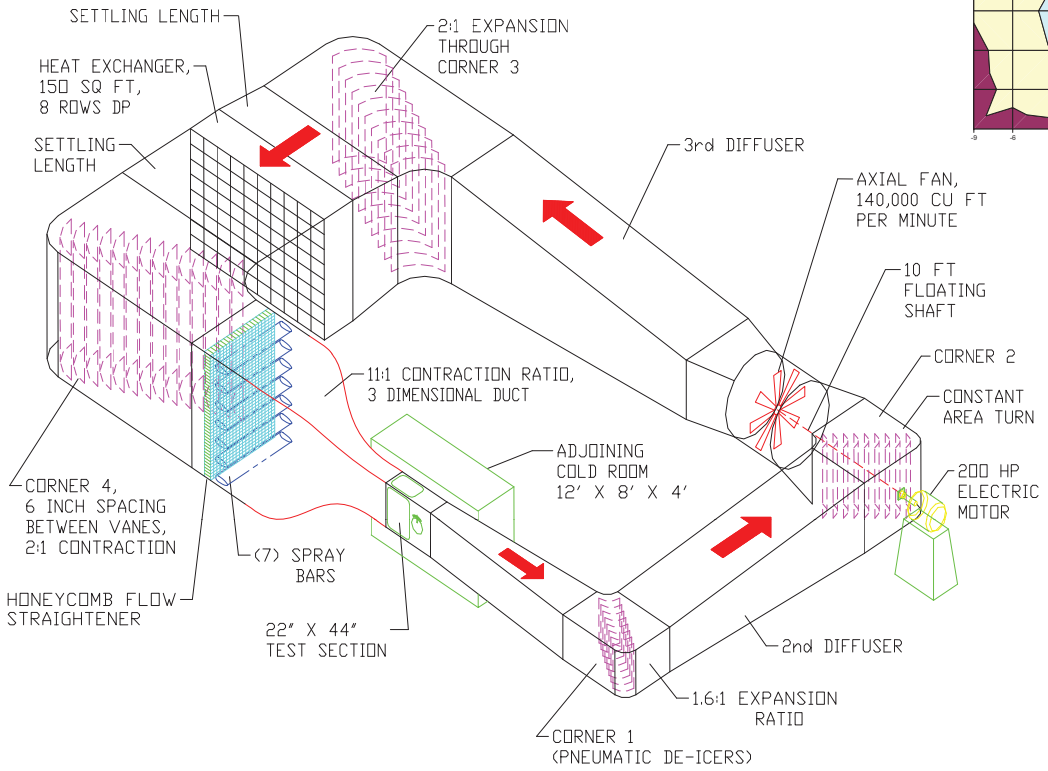
Sensors and Integrated Systems

NASA GRC Airframe Icing Meeting



Goodrich, SIS-OH Icing Wind Tunnel





June 9, 2009

- Accomplishments – NASA GRC
  - World Class Aircraft Icing Research Center and Facility
  - Primary Sponsor / Partner - Aircraft Icing Consortia / Meetings
  - Icing Research Tunnel
  - Icing Test Aircraft
  - Icing Codes – LEWICE / Scaling, et al
  - Development of New Technologies (SBIR, STTR, et al)
    - Example: Look Ahead Ice Detection
  - Pilot Training Materials
  - Full Cooperation with Academia, Government and Industry

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- Recommendations - Codes
  - User Friendly - 3D LEWICE
    - Incorporation of Runback / Evaporation Module
    - Coupled Aero / Thermal / Runback / Ice Shapes
      - Aero with Enhanced Near Field Effects
    - Temperatures / Conditions at which Ice will not Accrete
    - Include SLD and Ice Crystals (Mixed Phase)
      - Splash / Loss of Large Droplets
    - LEWICE Verification
    - Suggestions:
      - Form LEWICE Consortium (User Community Team)
      - Regular User Community Updates through SAE / AIAA, et al
      - Conduct Training Sessions

- Recommendations - Codes
  - Model Icing Wind Tunnels
    - UIUC Proposal – Model IRT – Extend for other tunnels
    - Explain Differences between Facilities
    - Explain Differences between IWT and Flight
  - Develop Thermal Scaling Laws
    - Critical for Next Generation Electrothermal IPS
  - Engine Icing – Internal
  - Rotating Components – Propeller / Propfan / Rotorblade
    - Wind Turbine
  - Ice Shed Trajectory Model
    - How Shed Ice Breaks-Up in the Air Stream
    - Where Shed Ice Strikes the Aircraft

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- Other Recommendations
  - IRT / Test Facilities
    - Develop SLD / Mixed Phase / Ice Crystal Test Capabilities
    - Engine Test Facility
      - Nacelle Inlets to Fan
      - Internal to Engine
    - Cost
  - Basic Icing Research
      - Impact Ice Formation
      - Ice Adhesion
      - Impact Ice Physical Properties

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