George Bush Intercontinental Airport

Energy Initiatives Project

December 21, 2016

CATEE 2016
Clean Air Through Energy Efficiency Conference

HOUSTON AIRPORTS

IAH Energy Initiatives Project

- Background
- IAH Terminal Redevelopment Program (ITRP) Overview
- Energy Initiatives Project Components
- Next Steps
- Open Discussion Opportunity

Houston, Texas ***among other cities in the United States***

4th Largest[1]

Fastest Growing

Most Diverse

Note 1: **"Chicago is the third-most-populous city in the nation, but perhaps not for much longer. If trends continue. . . . . Houston could pass Chicago in 10 years."** ***Source: Chicago Business Journal, May 19, 2016***

Houston Airport System – ***our guiding principles***

- Our Mission
  - We Exist To Connect The People, Businesses, Cultures And Economies Of The World To **Houston**

- Our Strategic Priorities
  1. Make The Passengers Happy
  2. Achieve Opening Day Fresh Conditions For Our Assets
  3. Build The Platforms For Future Success
  4. Invest In Our Employees And Our Partnerships

Houston Airports: ***the City's economic assets***

- Owned And Operated By City Of Houston
- Global Gateway
- Unprecedented Growth
- Two International Airports Within The City

Houston Airport System ***by the numbers***

- $27.5 Billion Economic Impact
- 55 Million Annual Passengers
- 51% Growth In Last 10 Years
- ~ 200 Domestic & International Destinations
- 19 Foreign Flag Carriers
- Only U.S. Airport Serving All 5 Continents

AEROMEXICO
AIR CANADA
AIR CHINA
AIR FRANCE
AIR NEW ZEALAND
ALL NIPPON AIRWAYS
AVIANCA
BRITISH AIRWAYS
EMIRATES
EVA AIR
INTERJET
KLM ROYAL DUTCH AIRLINES
KOREAN AIR
LUFTHANSA
QATAR AIRWAYS
SINGAPORE AIRLINES
TURKISH AIRLINES
VOLARIS
WESTJET

IAH Terminal Redevelopment Program (ITRP)

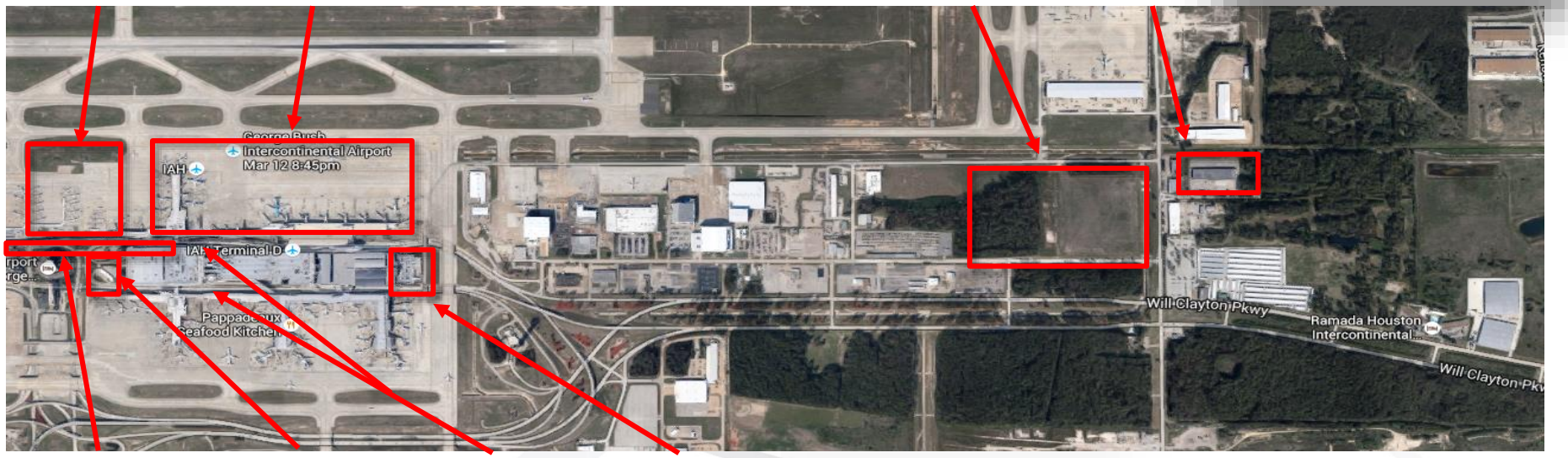
Scope Overview – Individual Projects

United New Terminal C North

MLIT, Taxiway, Apron & Landside Roadway Reconfiguration

East Aircraft Parking Hardstand

PMO Building



Enabling Utilities Landside

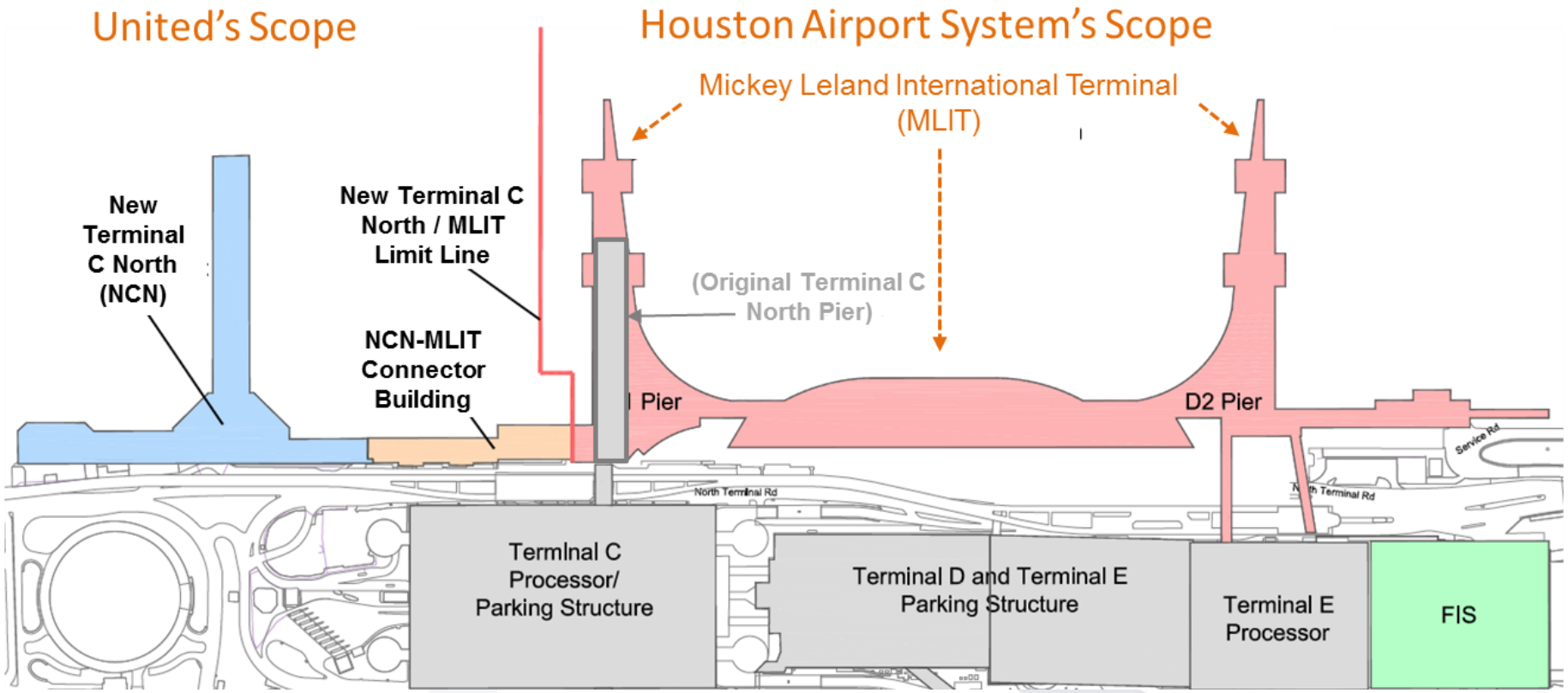
Terminal C West Garage Expansion

Landside Roadway Rehabilitation

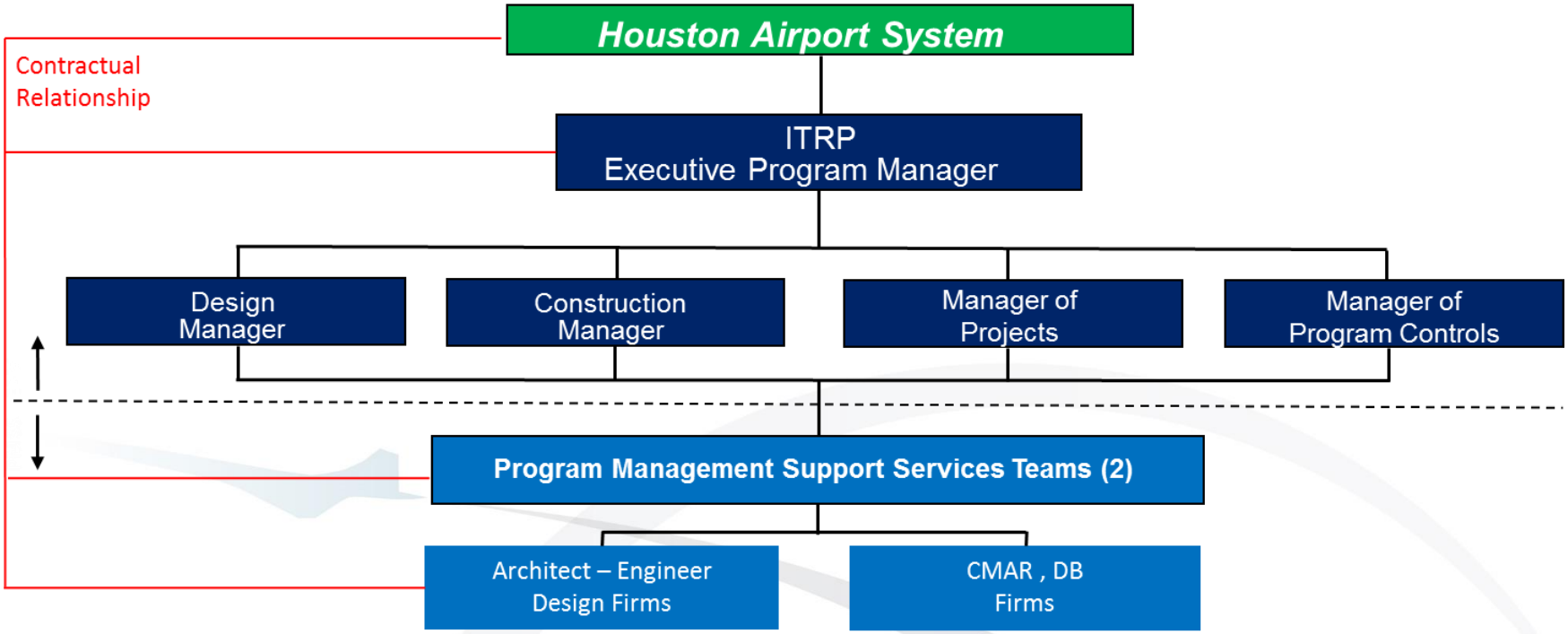
Federal Inspection Services

United Airlines-City Of Houston Partnership

Agreement with Airline to Facilitate Redevelopment of Gates and Facilities



ITRP Leadership And Management Approach



Energy-Related Challenges - 1

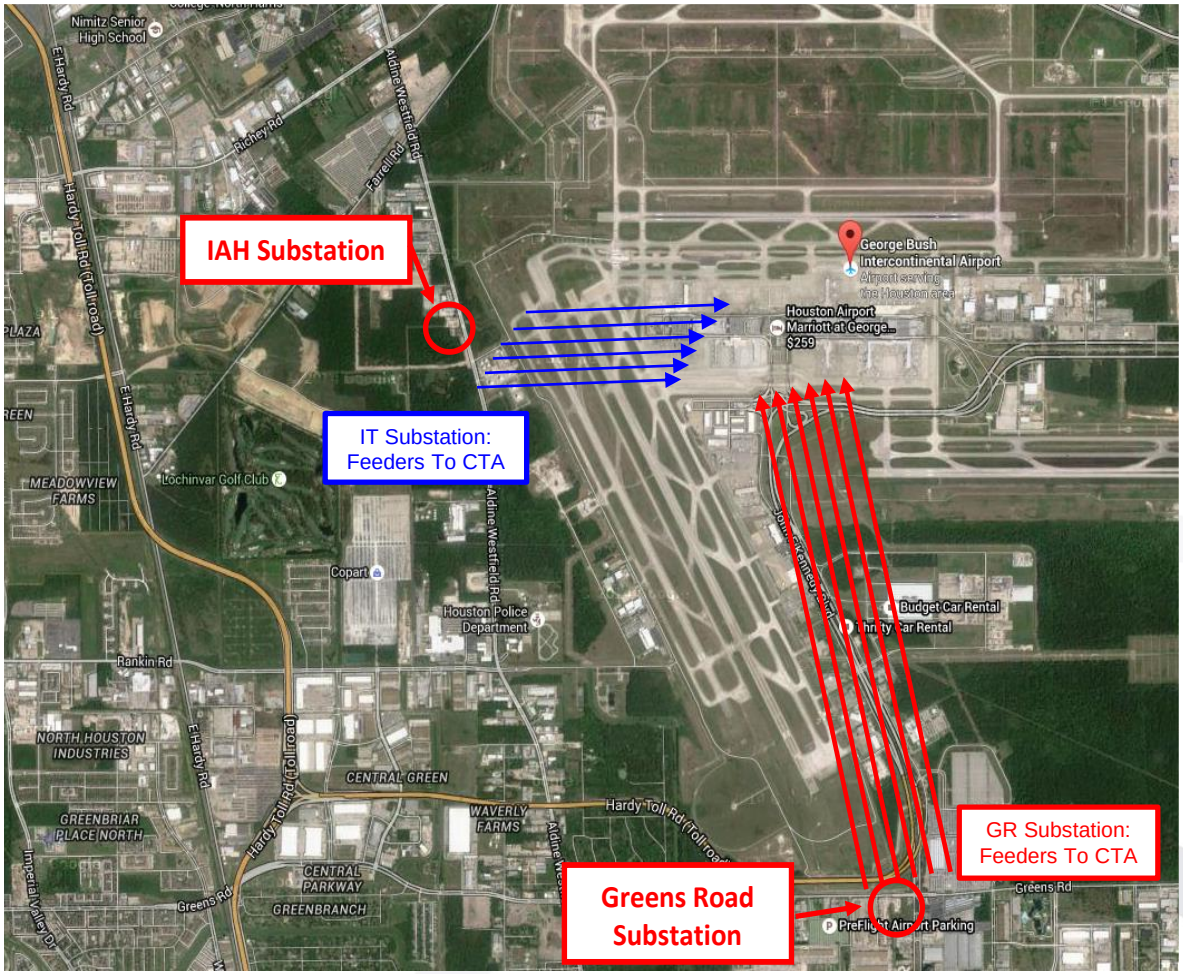
- General:
  - Majority Of In-Ground Infrastructure Dates To Original Installation, At Or Near End Of Service Life
    - Includes Potable Water, Electrical, And Thermal Product Distribution Systems
- Water Distribution System
  - Delivery Pressure Inadequate In Central Terminal Area (CTA)
    - Does Not Provide Adequate Customer Service
- Central Terminal Area (CTA) Electrical Distribution
  - Reliability, Resilience, Sustainability:
    - Some CTA 12.5 kV Feeds Operating Over 50% Load
    - Not All Critical CTA Loads Are Protected By Automatic Throw Over Switches

Energy-Related Challenges - 2

- CTA Electrical Distribution (continued)
  - CTA Infrastructure (Transformers, Switchgear) Nearing End Of Service Life
  - Distribution System Is Utility Owned And Operated, Does Not Support Sustainable Owner Strategies
  - Overly Complex – 51 Individual CTA Service Point Entrances
- Central Utilities Plant (CUP)
  - Efficiency, Reliability
    - High Pressure Boilers And Turbine-Driven Chillers Inefficient, At End Of Service Life
    - Electrical Distribution To CUP Is Utility Owned And Operated, Does Not Support Sustainable Owner Strategies

IAH Electrical Substations and Feeders

Present Configuration



- **Substations And CTA Distribution Owned And Operated By Utility**
- **Infrastructure Cost And O&M Recovered Through Electrical Service Transmission & Distribution (T&D) Cost Component Of Rate Structure**
- **Each Facility Has Individual Service Point Entrance With Dual Substation Feeds, Transformers And HAS-owned Switchgear**

Configuration For Illustration Purposes Only

IAH Energy Initiatives Project
Overall Objectives - 1

- Net Zero Energy Initiative: A Broader And Real-World Application By The City Of Houston

Through Retro-Commissioning And Demand Side Initiatives In Existing Facilities, And Focus On Energy Efficient Strategies And Opportunities During The MLIT Design, Reduce The Energy Consumption In The IAH Central Terminal Area Below That Experienced During August 2016 After Opening Of The MLIT.

DOE Releases Common Definition for Zero Energy Buildings, Campuses, and Communities

WASHINGTON, DC – Today the U.S. Department of Energy (DOE) reached a significant milestone in bringing the building community together by releasing a common definition for a zero energy building, or what is also referred to as a "net zero energy" or "zero net energy" building.

After leading an extensive stakeholder engagement process over the past year and a half, the Energy Department released its findings in the recently published A Common Definition for Zero Energy Buildings, which states that a Zero Energy Building is "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." This definition also applies to campuses, portfolios, and communities. In addition to providing clarity across the industry, this new DOE publication provides important guidelines for measurement and implementation, specifically explaining how to utilize this definition for building projects.

www.energy.gov - September 16, 2015 - 5:38pm

IAH Energy Initiatives Project
Overall Objectives - 2

- Specific Utilities Initiatives
  1. Implement The Utilities Master Plan Recommendations
  2. Renew Systems During The ITRP That Will Have Less Than 10-Years Remaining Service Life At Time Of Opening The MLIT
  3. Construct Waste Water Reclamation And Reuse System
  4. Renew, Centralize And Simplify Electrical Distribution Feeders; Take City Ownership Of Distribution System
- Electrical Supply Strategy At IAH
  1. Position City, Through Ownership, For Benefiting From Energy Supply Alternatives To Reduce Costs And Improve Resilience
     A. Combined Heat & Power? Renewables? Long Term Power Purchase Agreement?
     B. IAH-Only Benefit? City-Wide Benefit?

Potential Electrical And Thermal Loads

Load	Min (MW)	Max (MW)
Central Utilities Plant	6	11
Central Terminal Area (HAS)	19	21
Central Terminal Area (UAL)	5	7
Anticipated Growth	4	4
Total IAH Affected Load	**34**	**43**

Load	Min (MW)	Max (MW)
City of Houston (including HAS)	206	241
United Airlines (CTA Only)	5	7
Anticipated Growth	4	4
Total City Affected Load	**215**	**252**

CUP Thermal Product	Min	Max
Chilled Water	7.0 Tons	26.4 Tons
Heating Water	44 MMBtu	44 MMBtu

IAH Energy Initiatives Project – Next Steps - 1

- Utilities Distribution Systems' Renewal
  - ✓ Scope Included In ITRP Enabling Utilities Landside Project; Design/Build Project Advertisement Pending
- Net Zero Energy Initiative
  - ✓ Existing Facility Condition Assessments Completed
  - ✓ Continuous Commissioning® In Progress
  - ✓ Partnering With Texas A&M Energy Systems Laboratory For On-Going Review Of MLIT Design To Ensure Energy Efficiency Opportunities Considered

TEXAS A&M ENGINEERING EXPERIMENT STATION

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IAH Energy Initiatives Project – Next Steps - 2

- IAH Electrical Supply Strategy – Sustainability, Efficiency
  - Scope:
    1. Reconfigure Electrical Supply To Support Alternative Energy Sourcing Strategies And / Or Combined Heat & Power Tri-Generation Plant
    2. Replace Aging CUP High Pressure Boilers And Turbine Chillers With More Efficient Production Equipment
    3. Install 138kV Feed From Intercontinental Substation For Added Redundancy
  - Next Steps:
    - ✓ Collaborated With Houston Advanced Research Center (HARC) And Completed Feasibility Survey
    - ✓ Hosted Public Outreach Conference To Inform Industry And Request Technical Input

HARC

    1. Advertise Formal Request For Information
    2. Continue Collaboration With HARC, Complete Investment Grade Financial Analyses
       A. Separate Alternatives: (1) IAH Only; (2) City-Wide Application
    3. Confirm Utility Interest In 138kV Feeder Installation
    4. Advertise Request For Qualifications

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