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Applying GIS Technology to Arc Flash Study at BWI Thurgood Marshall Airport

David Lin, PE, LC, LEED AP

Ken Lepera

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Presentation Overview

- Arc Flash Study at BWI Thurgood Marshall Airport
  - Arc Flash
  - Arc Flash Labelling
- GIS
- GIS application for our study

Arc Flash Study at Baltimore-Washington International Thurgood Marshall Airport

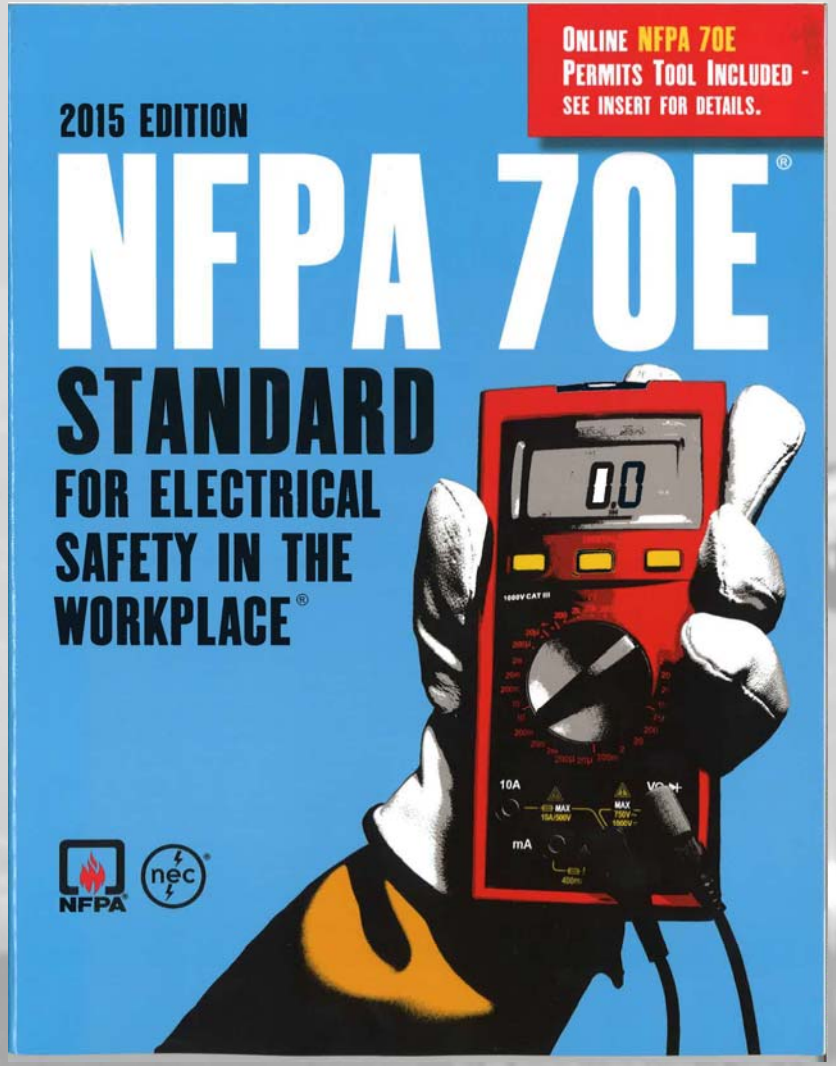
Arc Flash Study at Baltimore-Washington International Thurgood Marshall Airport

- Maryland Aviation Administration (MAA)

- AECOM

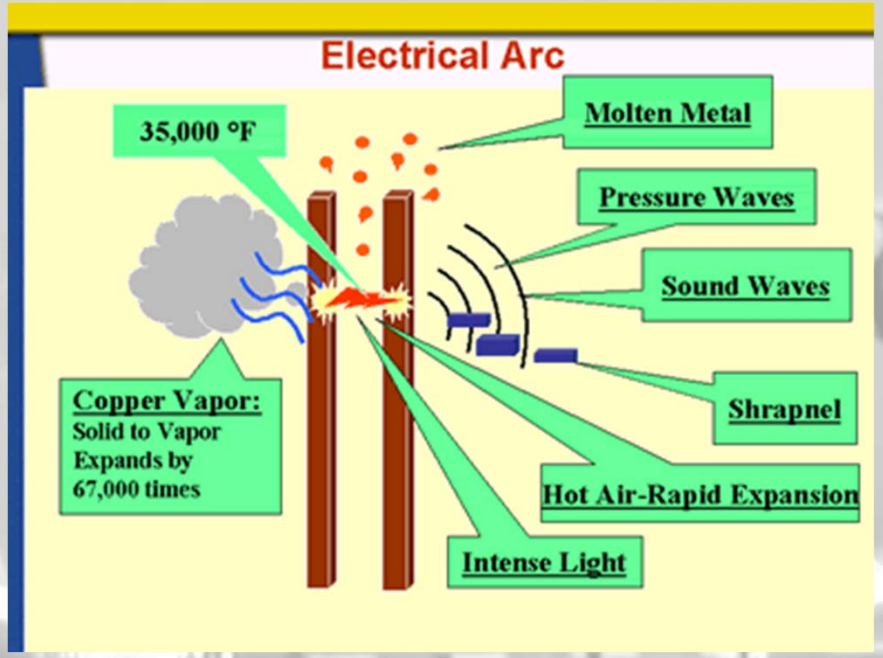
- Baltimore-Washington International Thurgood Marshall Airport

What is Arc Flash?



What is Arc Flash?

- NFPA 70E-2015 Article 100. Arc Flash Hazard
  - A dangerous condition associated with the possible release of energy caused by an electric arc



What electrical tasks at an airport may cause Arc Flash?

- Per NFPA 70E Table 130.7(C)(15)(A)(a)

- Work on energized electrical conductors and circuit parts, including voltage testing

- Removal or installation of circuit breakers or switches

What tasks at an airport may cause Arc Flash?

- Removal of bolted covers (to expose bare energized electrical conductors and circuit parts)

- Open hinged doors or covers (to expose bare energized electrical conductors and circuit parts)

- Insertion or removal of individual starter buckets from motor control center (MCC)

What tasks at an airport may cause Arc Flash?

- Insertion or removal of plug-in devices into or from busways

- In general, electrical tasks involve any exposed energized electrical component.

Standards Covering Arc Flash

NFPA 70E Standard For Electrical Safety in the Workplace

Occupational Safety and Health Administration (OSHA)

- OSHA 29 CFR Part 1910

Institute of Electrical and Electronics Engineers (IEEE)

- IEEE standard 1584

NFPA 70 National Electrical Code (NEC)

- NEC 110.16 Flash Protection

U.S. Bureau of Labor Statistics

- 2,000 fatal and 24,000 non-fatal electrical injuries from an arc flash in the last 10 years.
- Over 2,000 people admitted to burn centers yearly with severe arc flash burns
- 80% of electrically related accidents, incidents and fatalities among qualified workers are caused by arc flash

De-energized Equipment

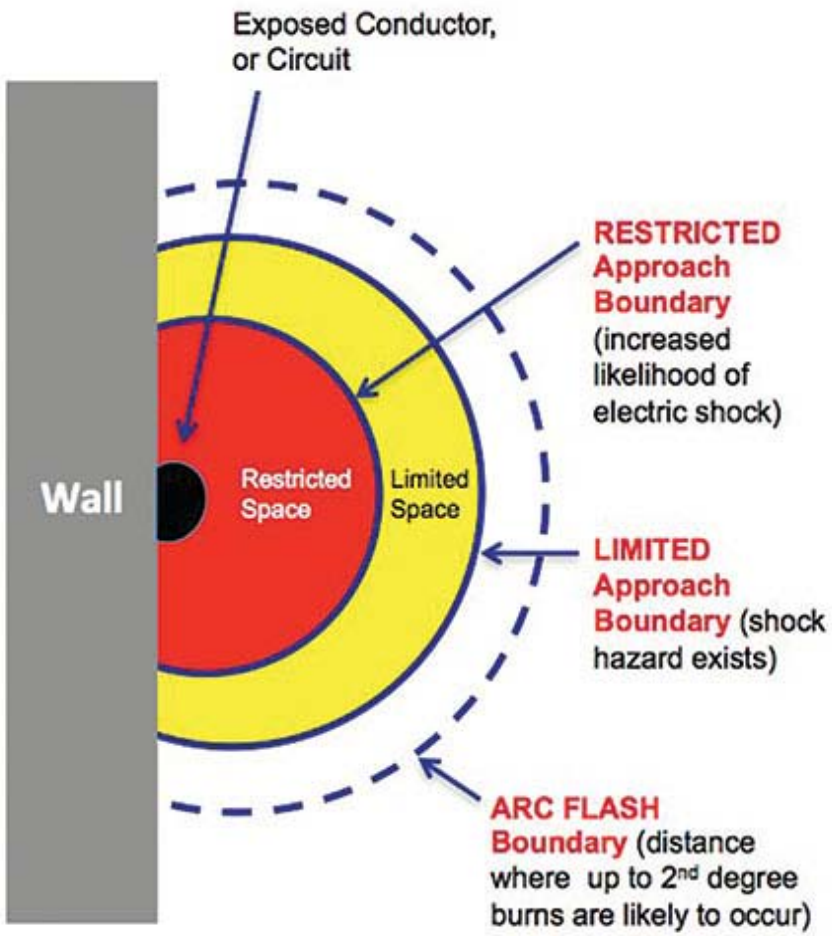
– The most effective way to eliminate the risk of electrical shock or arc flash is to simply de-energize the equipment

Arc flash released incident energy

- Incident energy expressed in cal/cm^2
- 1 cal/cm^2 energy approximately equal to hottest part of lighter in 1 sec

- **1.2 cal/cm^2** exposure will cause **second degree burns** on human skin

Arc flash Boundary Definitions in NFPA 70E - 2015



2015 Arc Flash Boundaries

Selection of PPE

- Arc Flash PPE Categories Method
- Incident Energy Analysis Method

Selection of PPE
Arc Flash PPE Categories Method

- NFPA Tables: NFPA 70E – 2015
  - Tables 130.7(C)(15)(A) and (B)
  - Table 130.7(C)(16)
  - Voltage rating
  - Maximum available short-circuit current

- Pro: Easiest and quickest

- Con: Provides the least amount of accuracy. Limited equipment are listed in tables.

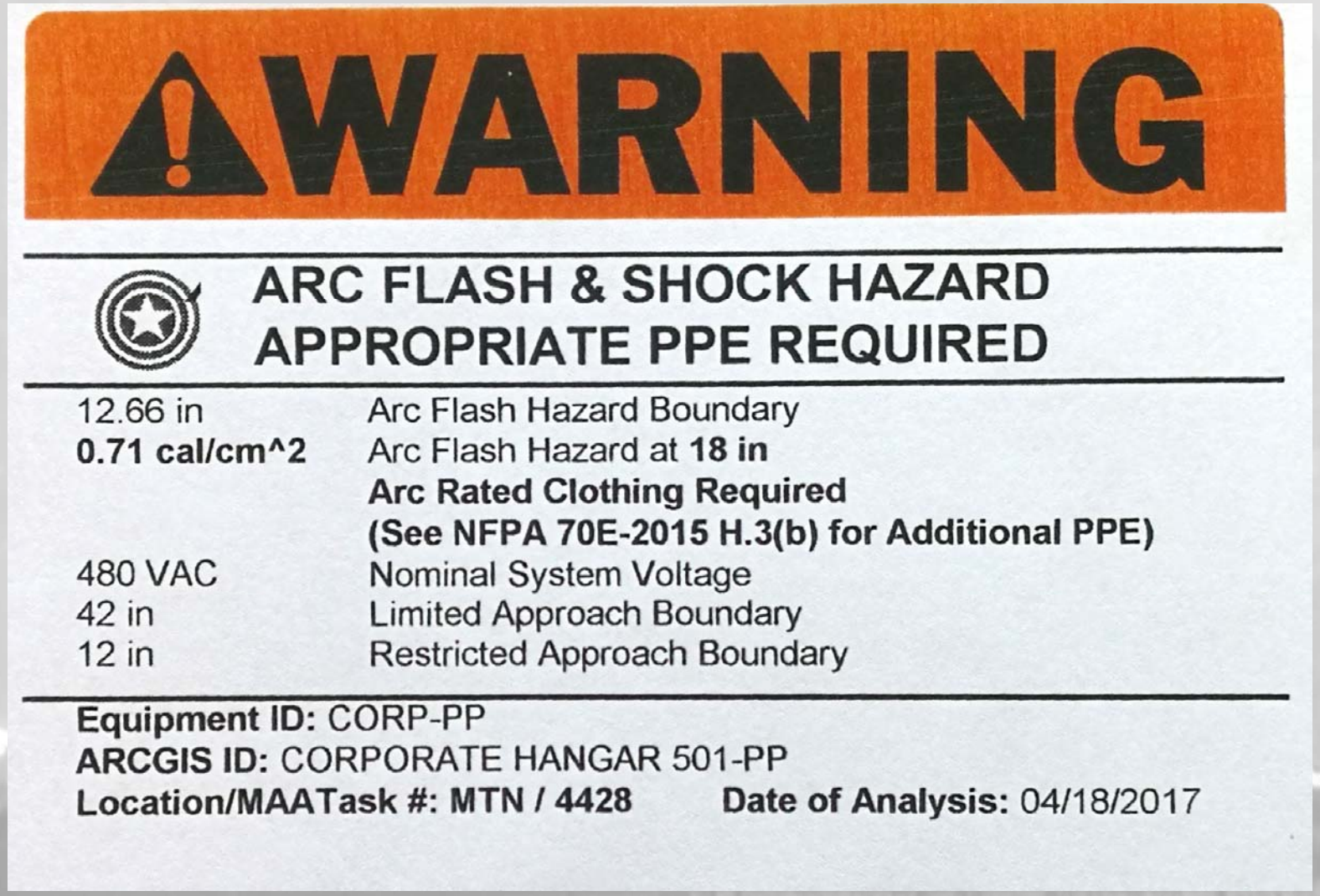
Selection of PPE
Incident Energy Analysis Method

- Electrical modeling
- Pro: More accurate result
- Con: Cost and time

Arc Flash Label

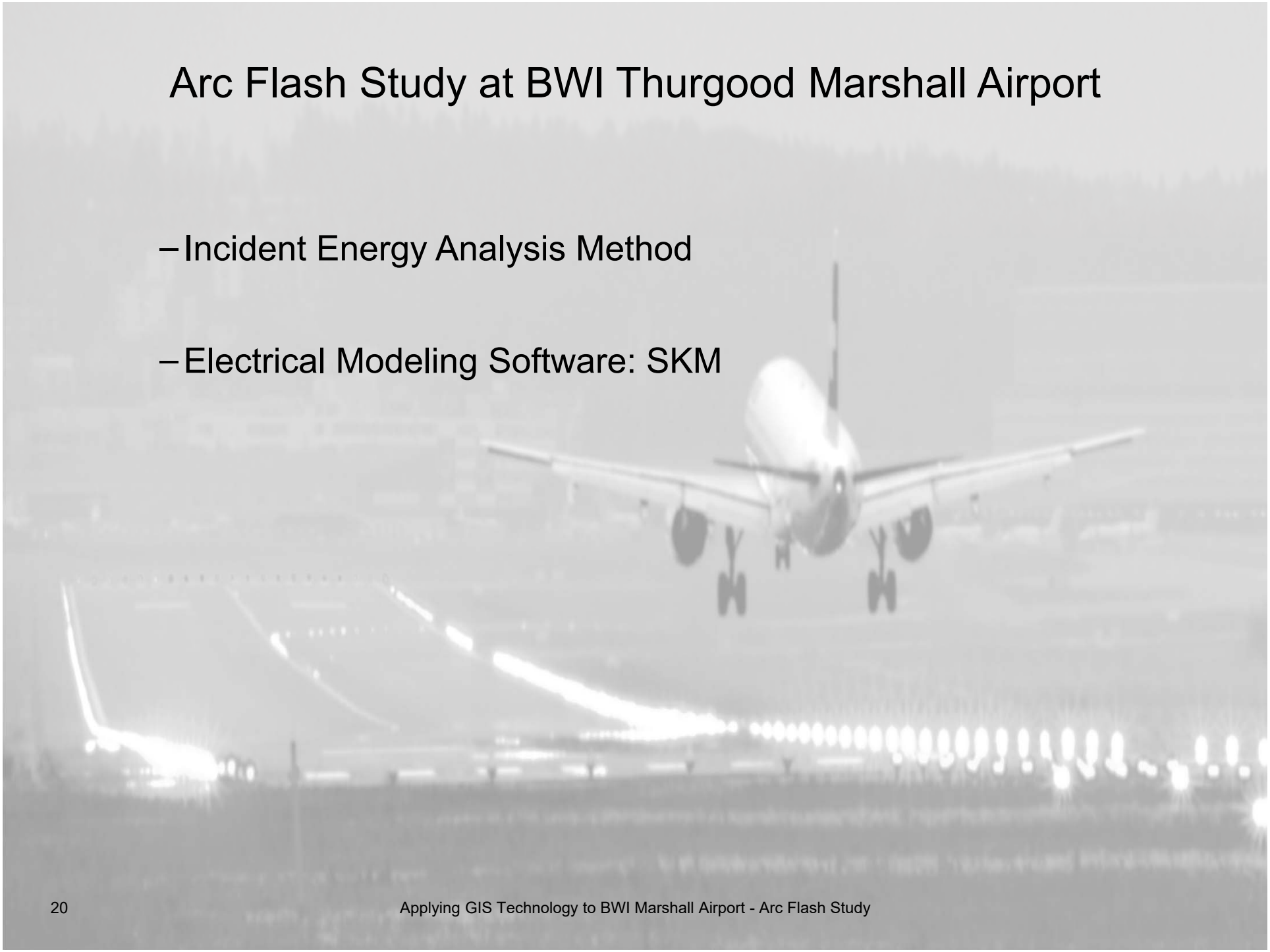
- Equipment ID (name)
- Nominal system voltage
- Arc flash boundary
- One of the following (Not Both):
    1. Available incident energy and the corresponding working distance (Minimum arc rating of clothing required)
    2. Arc flash PPE category from NFPA -70E Tables

Arc Flash Protection Label

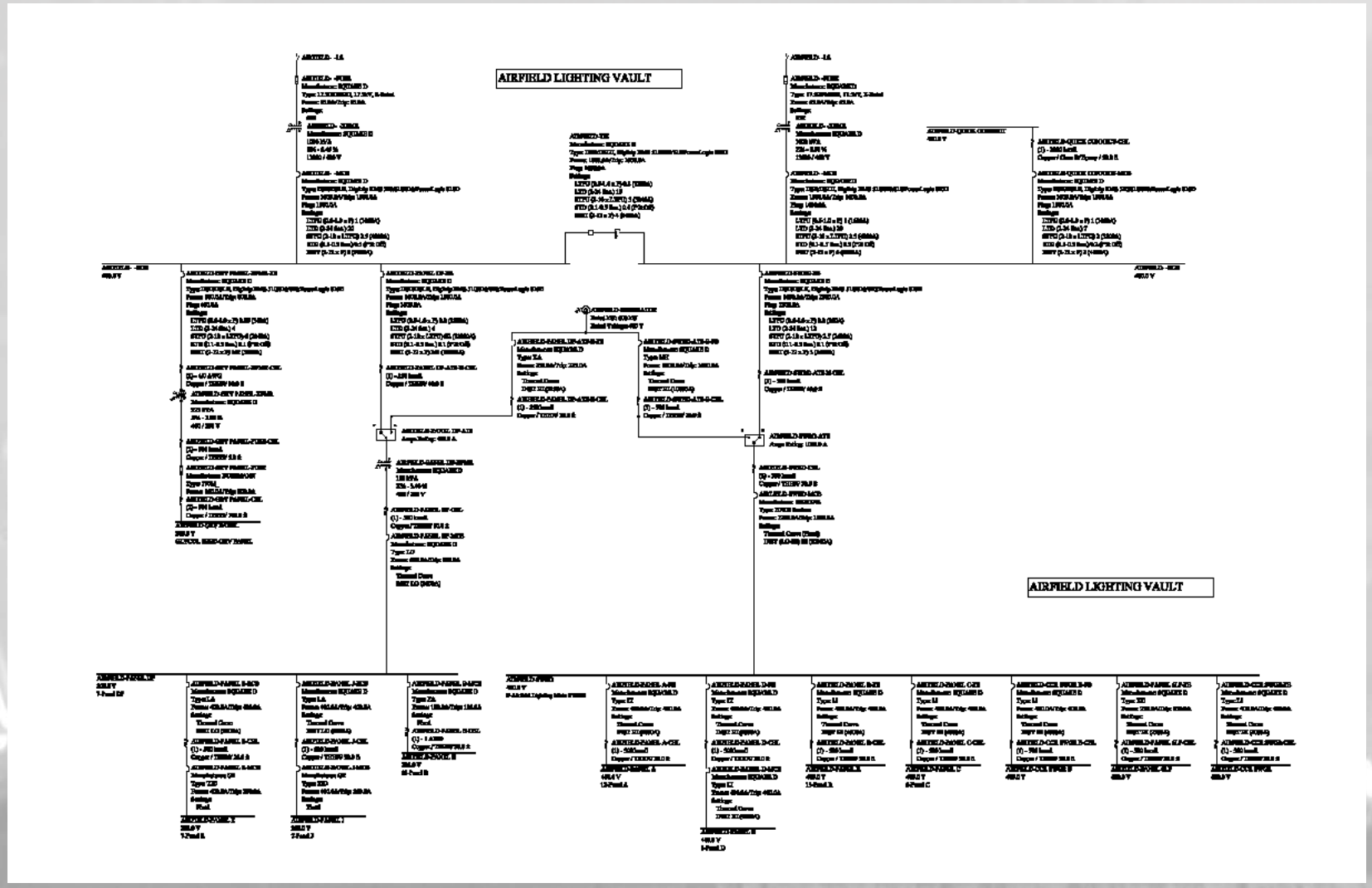


Arc Flash Study at BWI Thurgood Marshall Airport

- Incident Energy Analysis Method
- Electrical Modeling Software: SKM



SKM Single Line Model – Airfield Lighting Substation



Information needed for SKM Modeling

- Available fault current of power source from utility company

- switchgear/switchboard information

Information needed for SKM Modeling

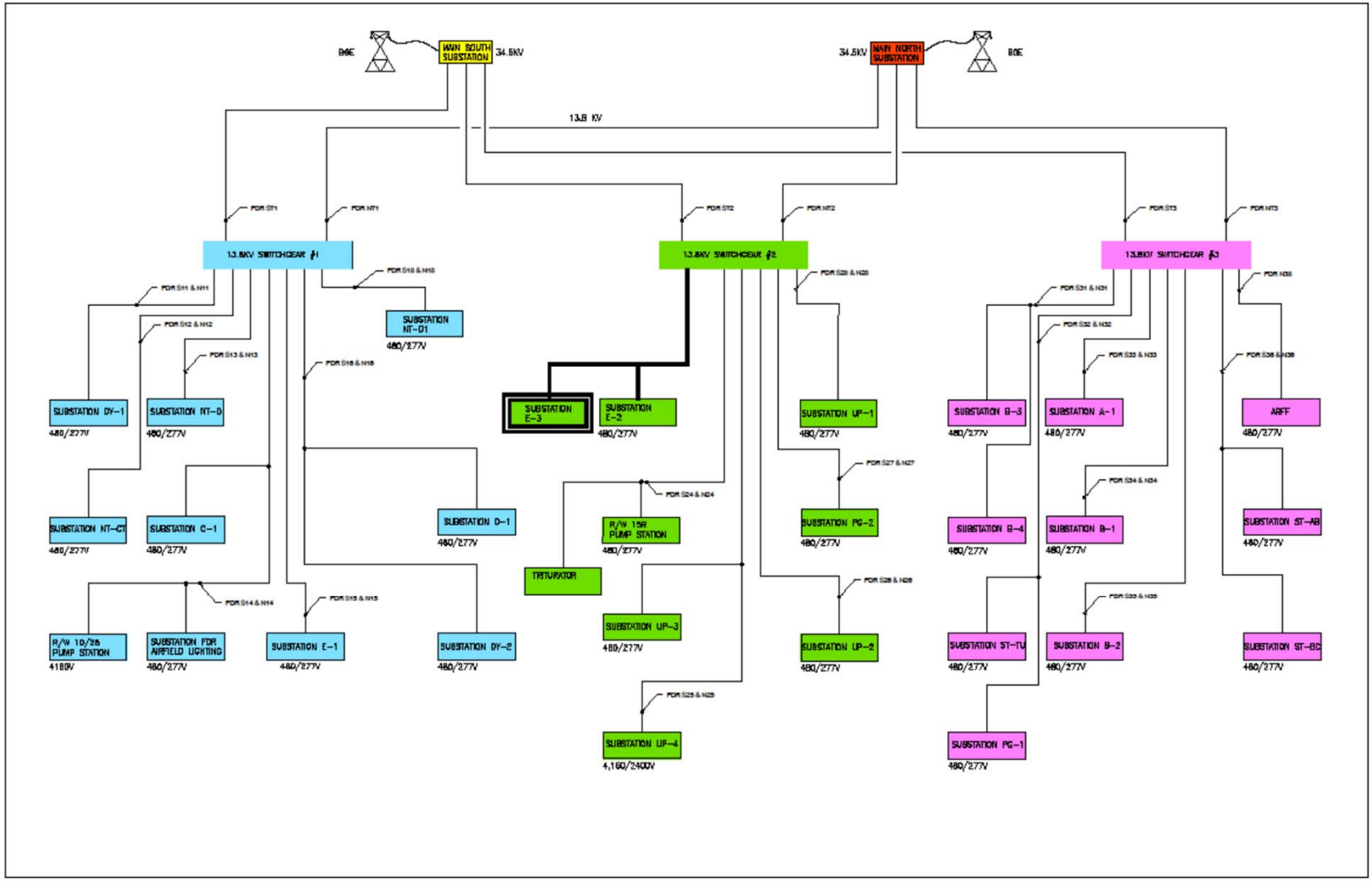
- transformer information

- panelboard information

- feeder information

- Connection between electrical equipment.
  - (The most difficult task)

Existing Electrical Power Distribution System at BWI Thurgood Marshall Airport



Friendship International Airport 1950

Baltimore Washington International Airport 1972

Substations ST-AB, NT-CT, NT-D

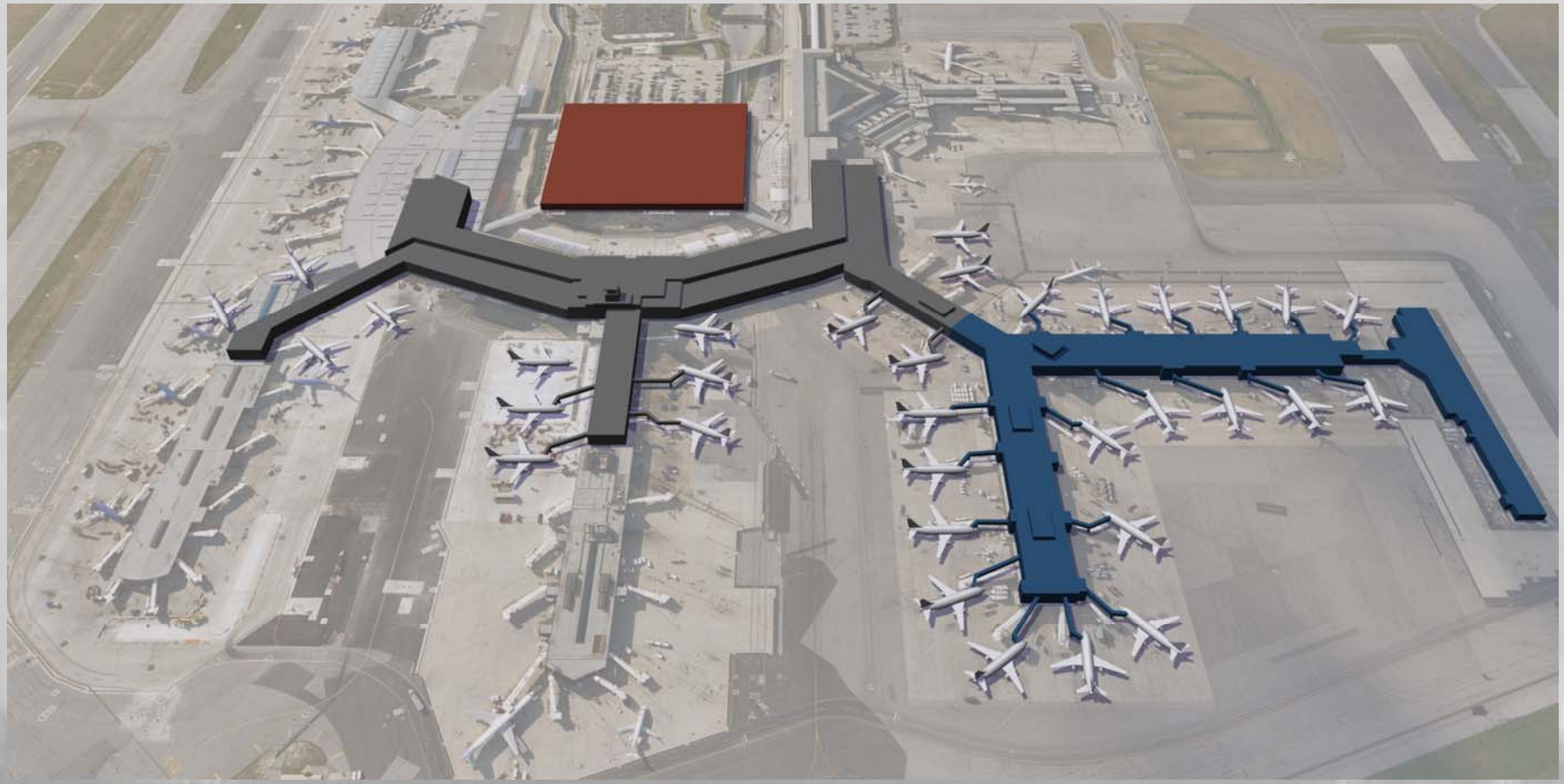
Terminal D Extension 1983

Substation D-1

Terminal DY Extension 1988

Substations DY-1 and DY-2

Hourly Garage 1991
Substation PG-1



Terminal C Extension 1994

Substation C-1

Terminal B Extension/Parking Garage Addition 1998

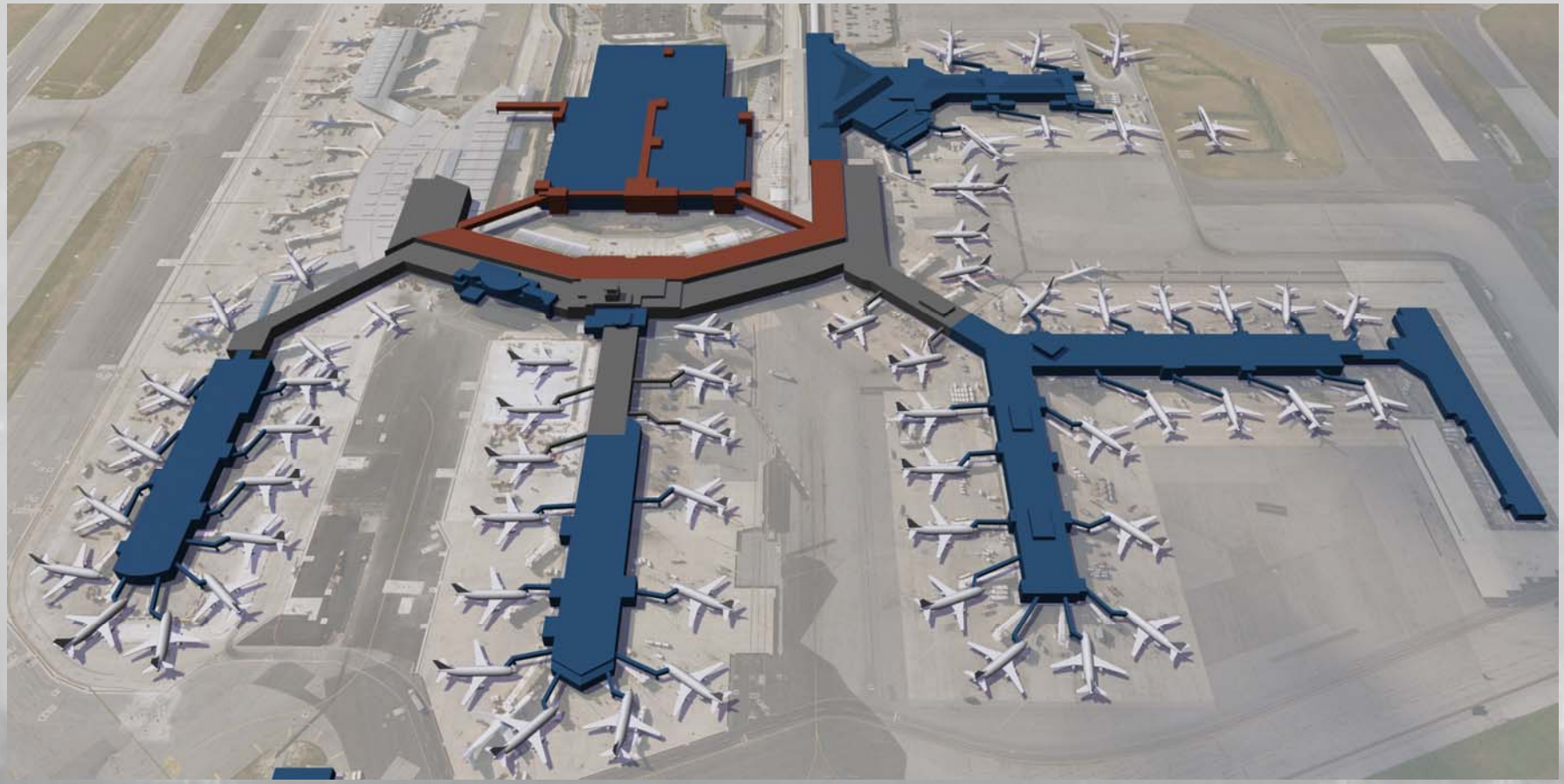
Substations B-3, B-4, PG-1 (Expansion)

International Terminal (Pier E) 1999

Substations E-1, E-2

Terminal Curbside Expansion & Skywalks 2004

Substation ST-TU



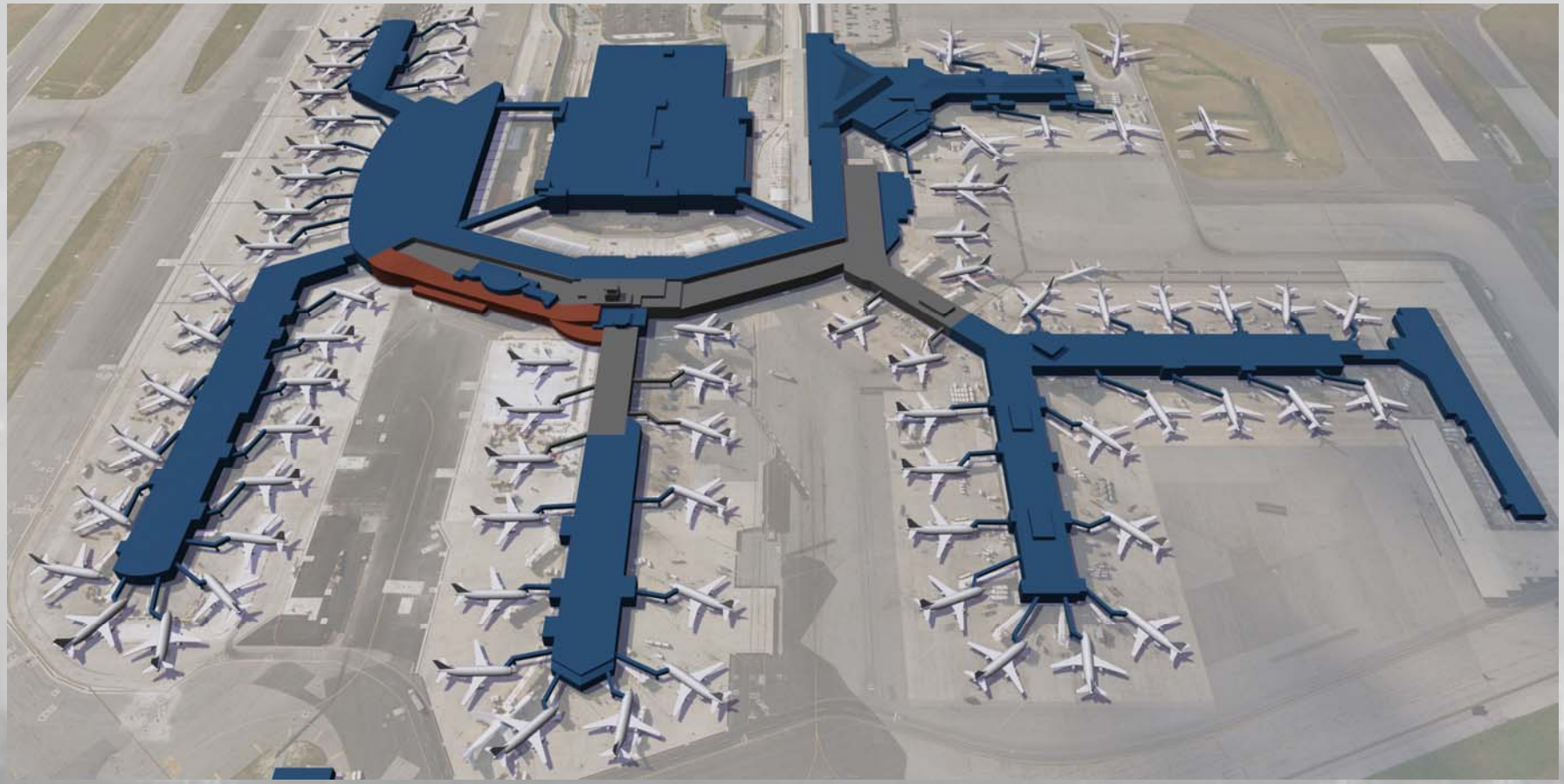
Terminal A/B Expansion 2005

Substations A-1, B-1, B-2

DE Baggage System Claim Improvement (DEBSCI) 2010

Major Modification to Substation E-1

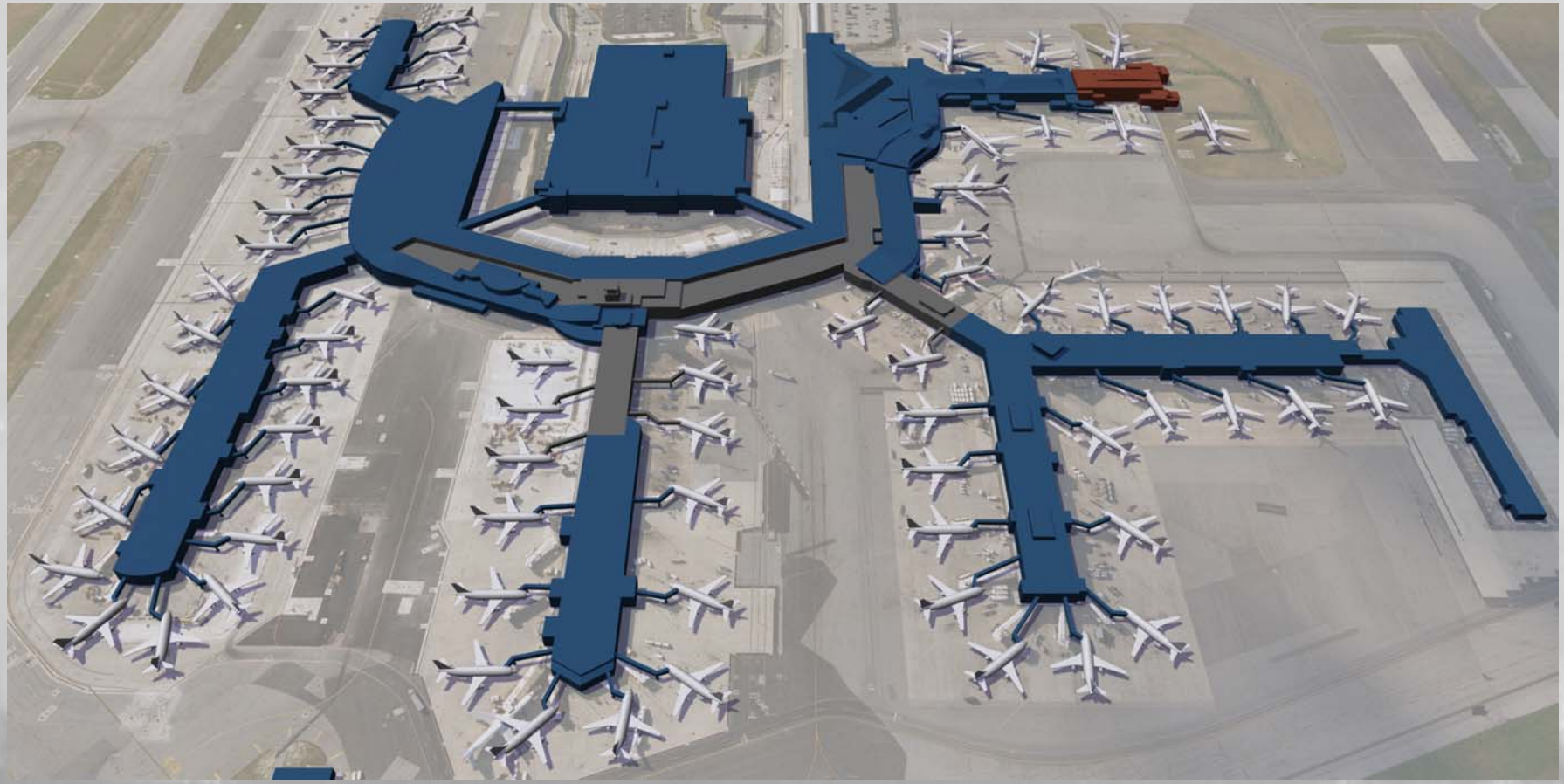
B/C Connector 2013
Substation ST-BC



D/E Connector 2016
Substation NT-D1

Concourse E Extension 2017

Substation E-3



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Substations DY-1 and DY-2

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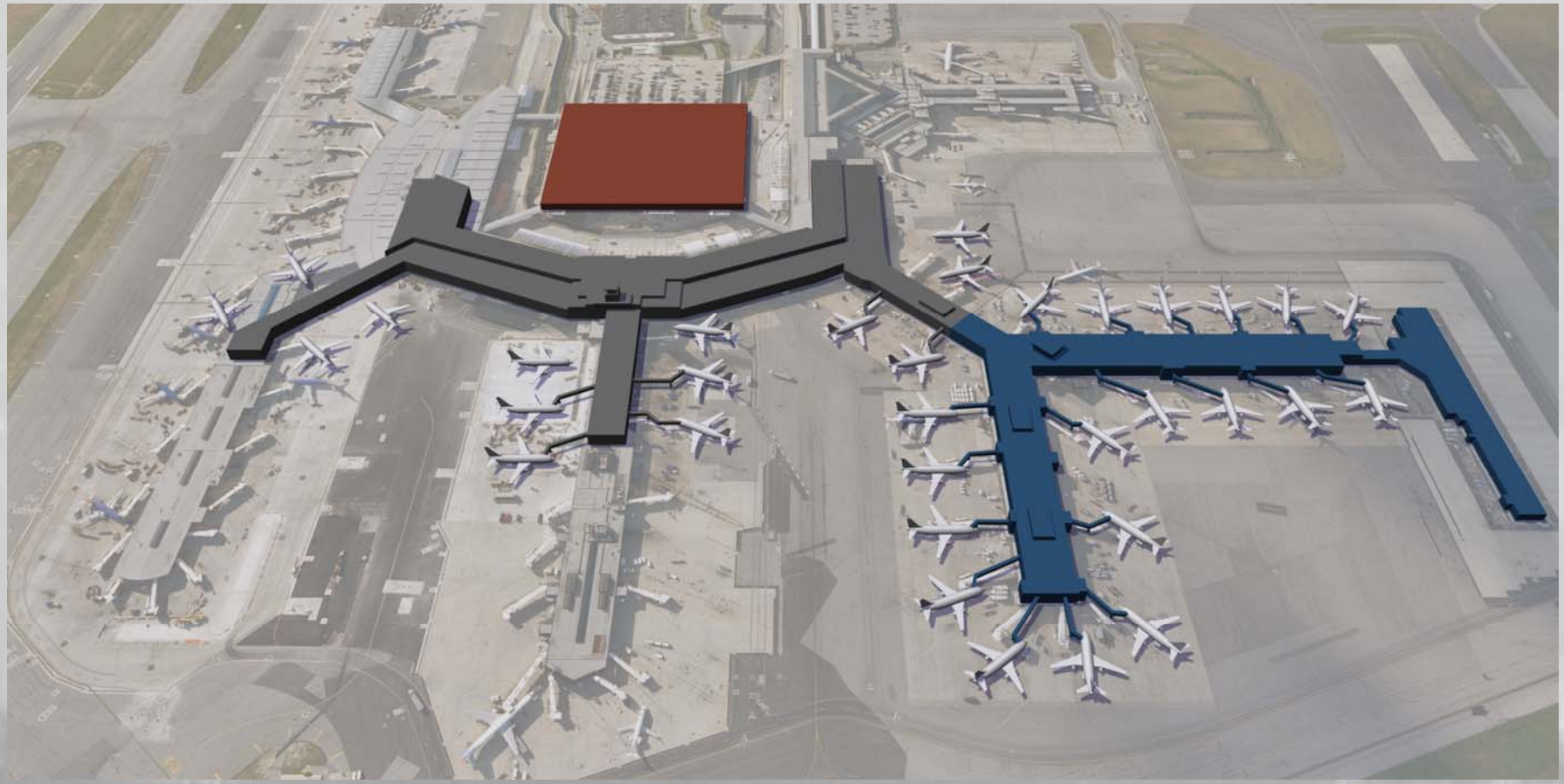

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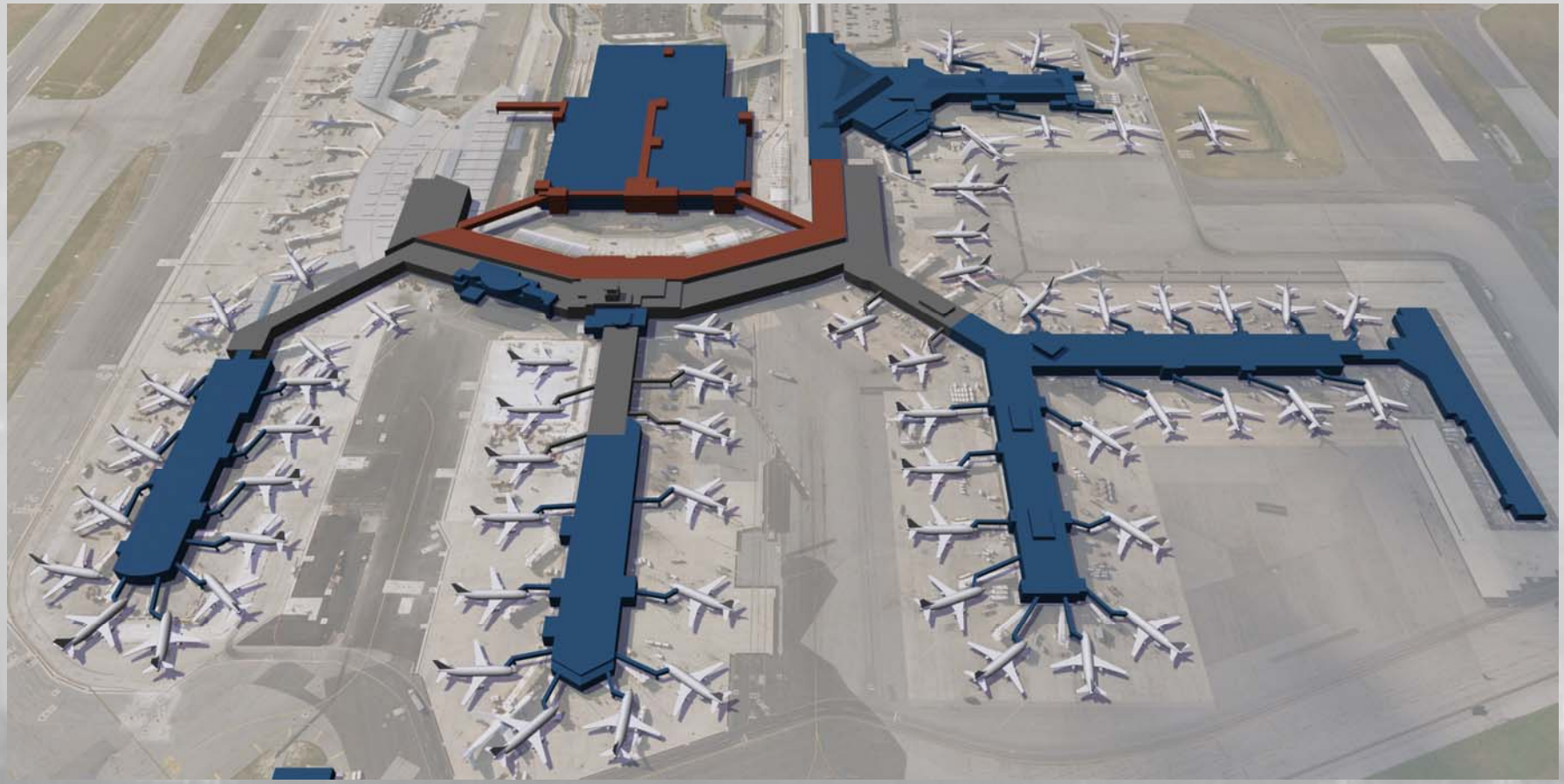


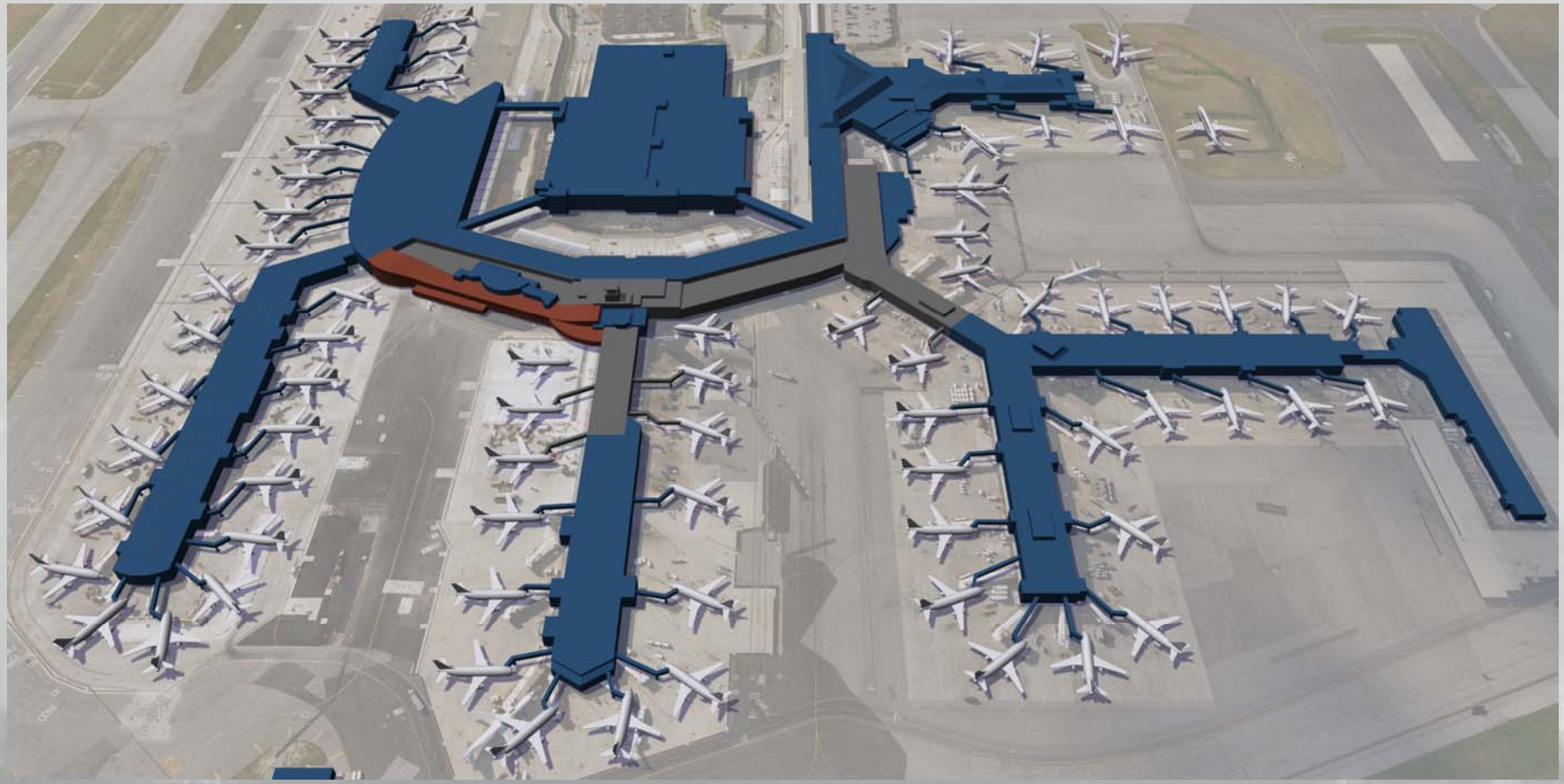
Terminal A/B Expansion 2005

Substations A-1, B-1, B-2

DE Baggage System Claim Improvement (DEBSCI) 2010

Major Modification to Substation E-2

B/C Connector 2013
Substation ST-BC



D/E Connector 2016
Substation NT-D1

Concourse E Extension 2017

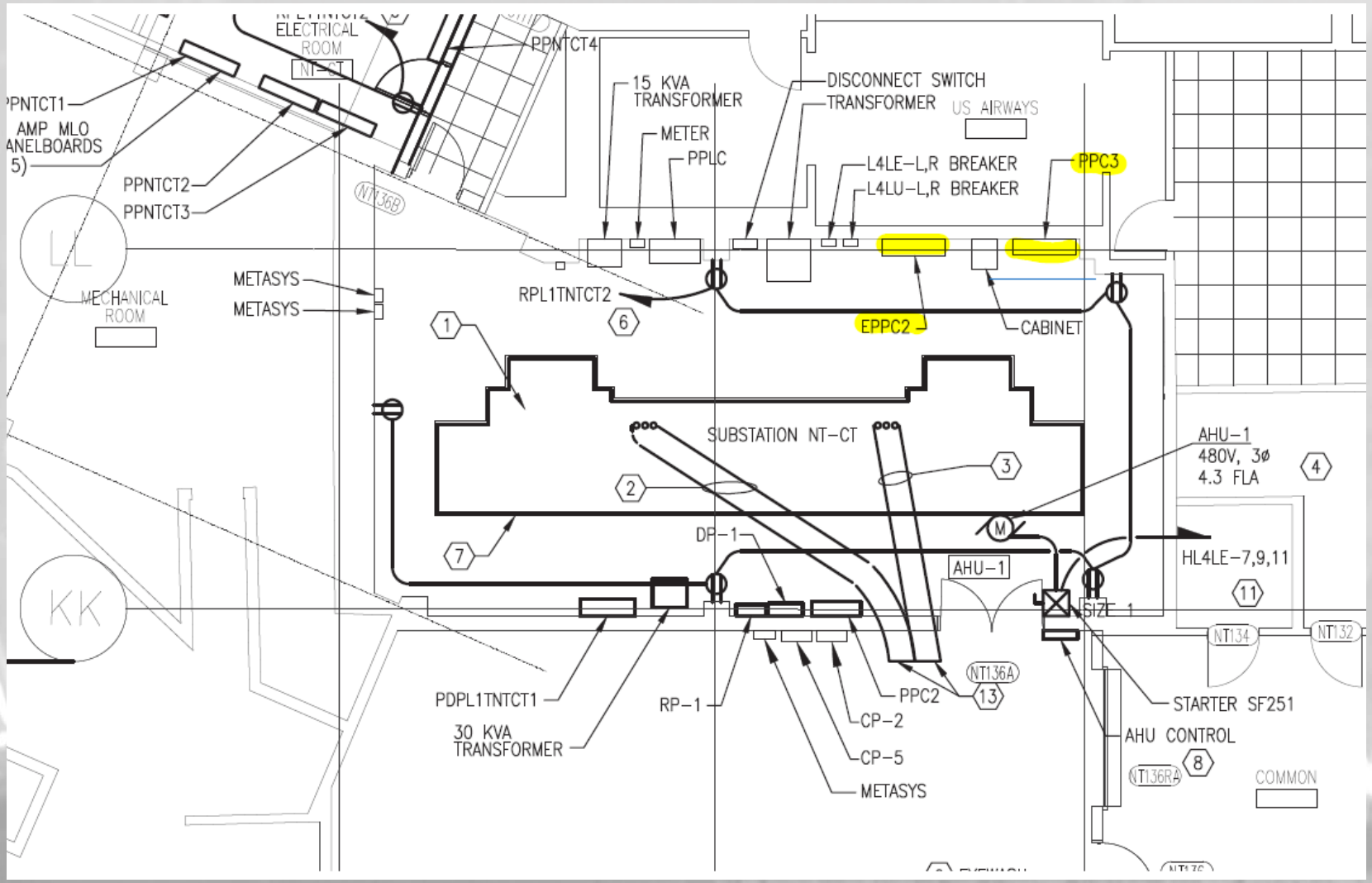
Substation E-3

Complexity of Electrical Distribution System

The electrical system was constructed, modified, replaced through the growth of the airport over more than 60 years.

- Service area of different substations are overlapping with each other.
- Some of the electrical equipment was fed from one substation before. Now they are fed from different substation.
- Electrical equipment in the same electrical room are fed from different substations.

Complexity of Electrical Distribution System




GIS

What is GIS?

GIS stands for Geographic Information System.

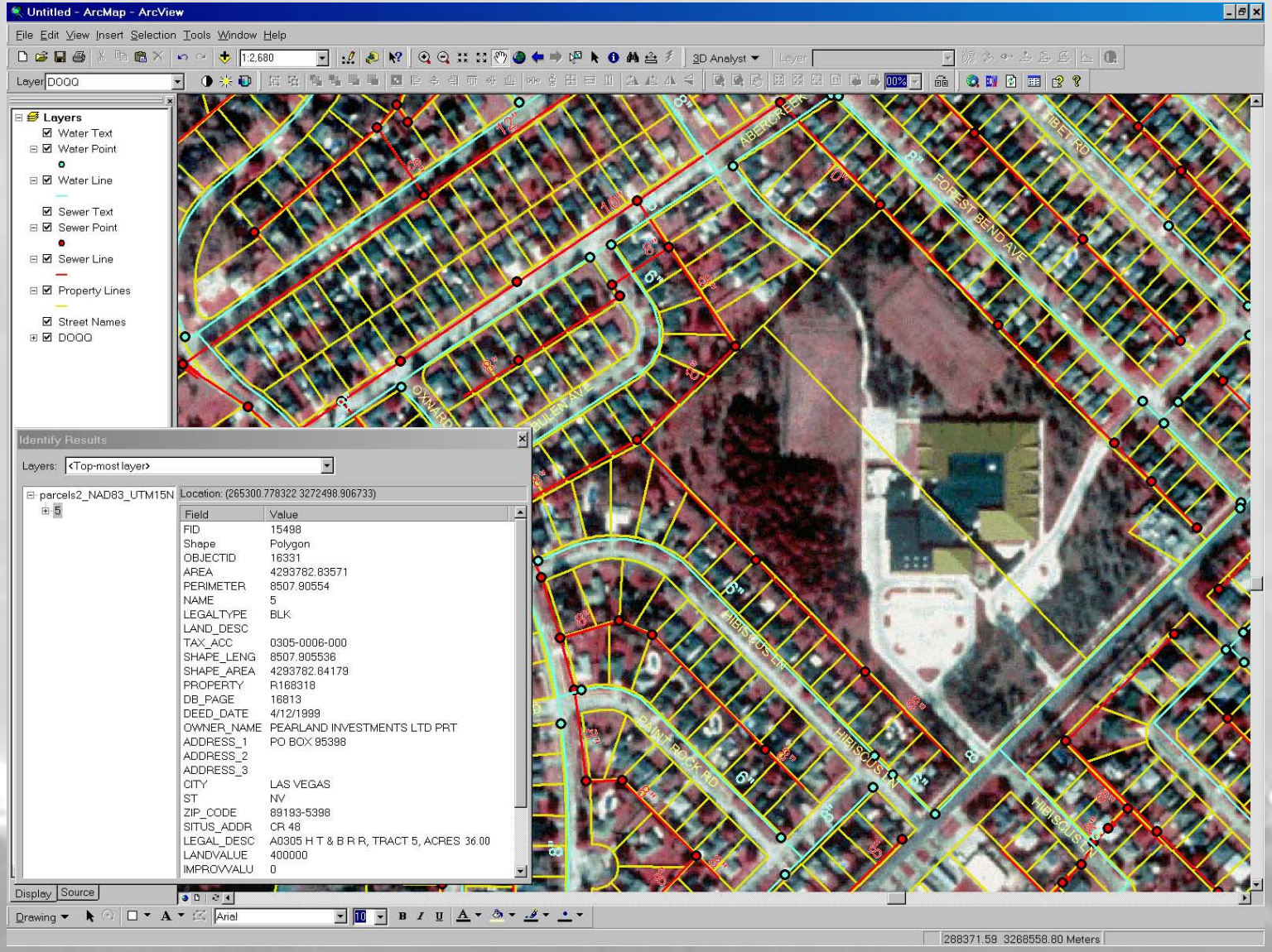
A geographic information system (GIS) is a computer system for capturing, storing, checking, analyze, and displaying data related to positions on Earth's surface. (National Geographic Society)

Geographic → Maps

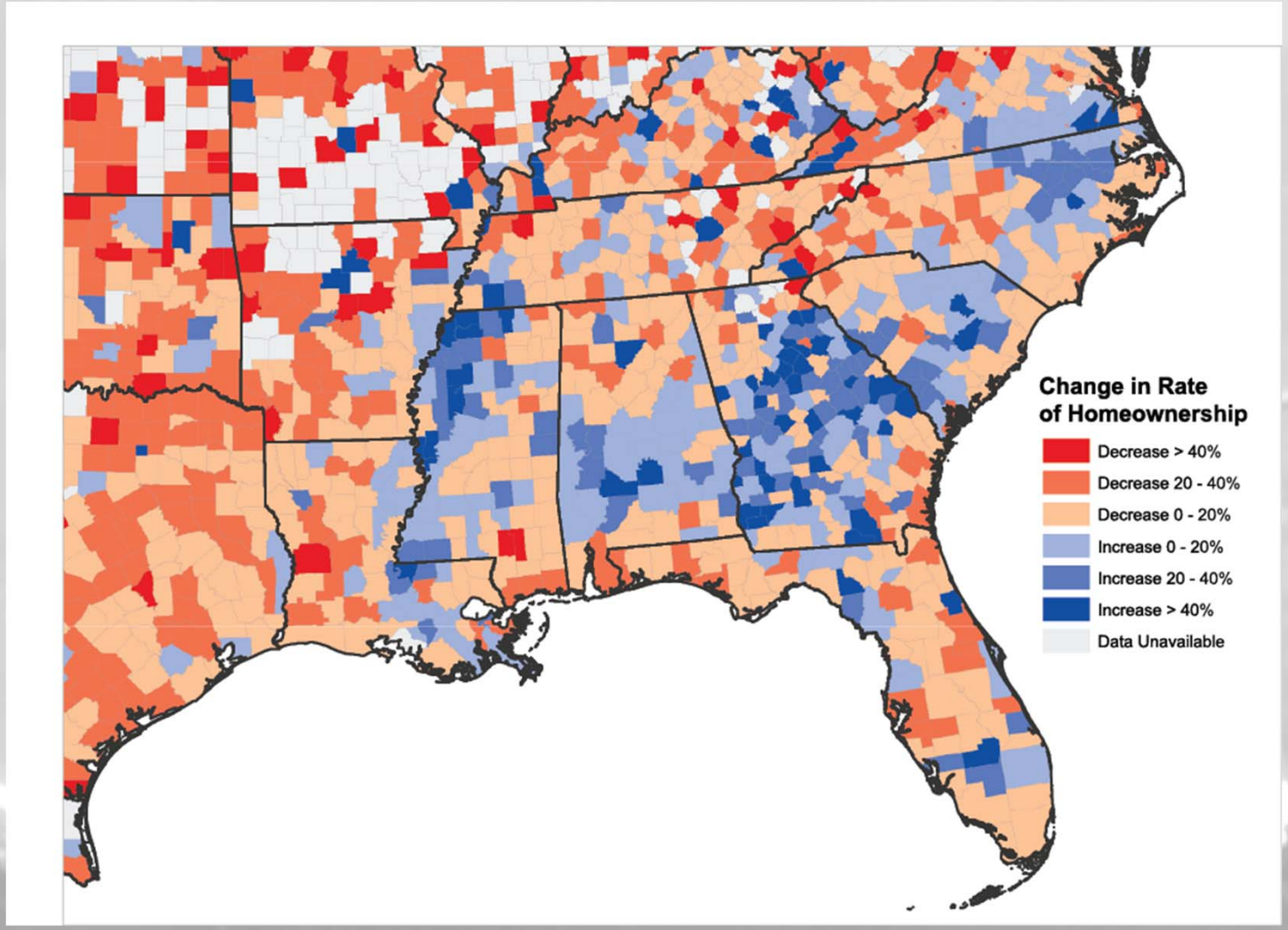
Information → Data

System → Computers

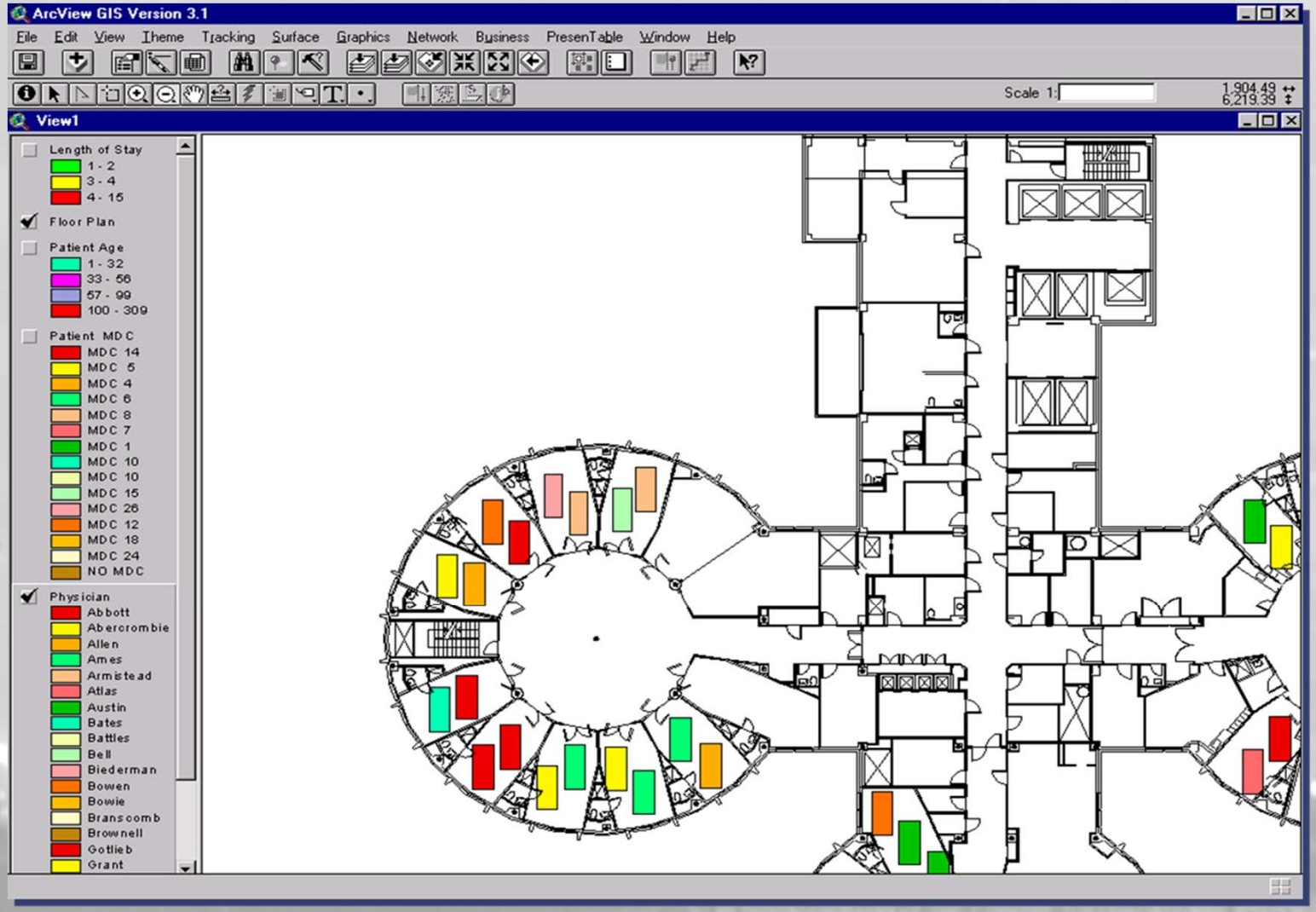
Typical GIS Application –water and sewer piping management



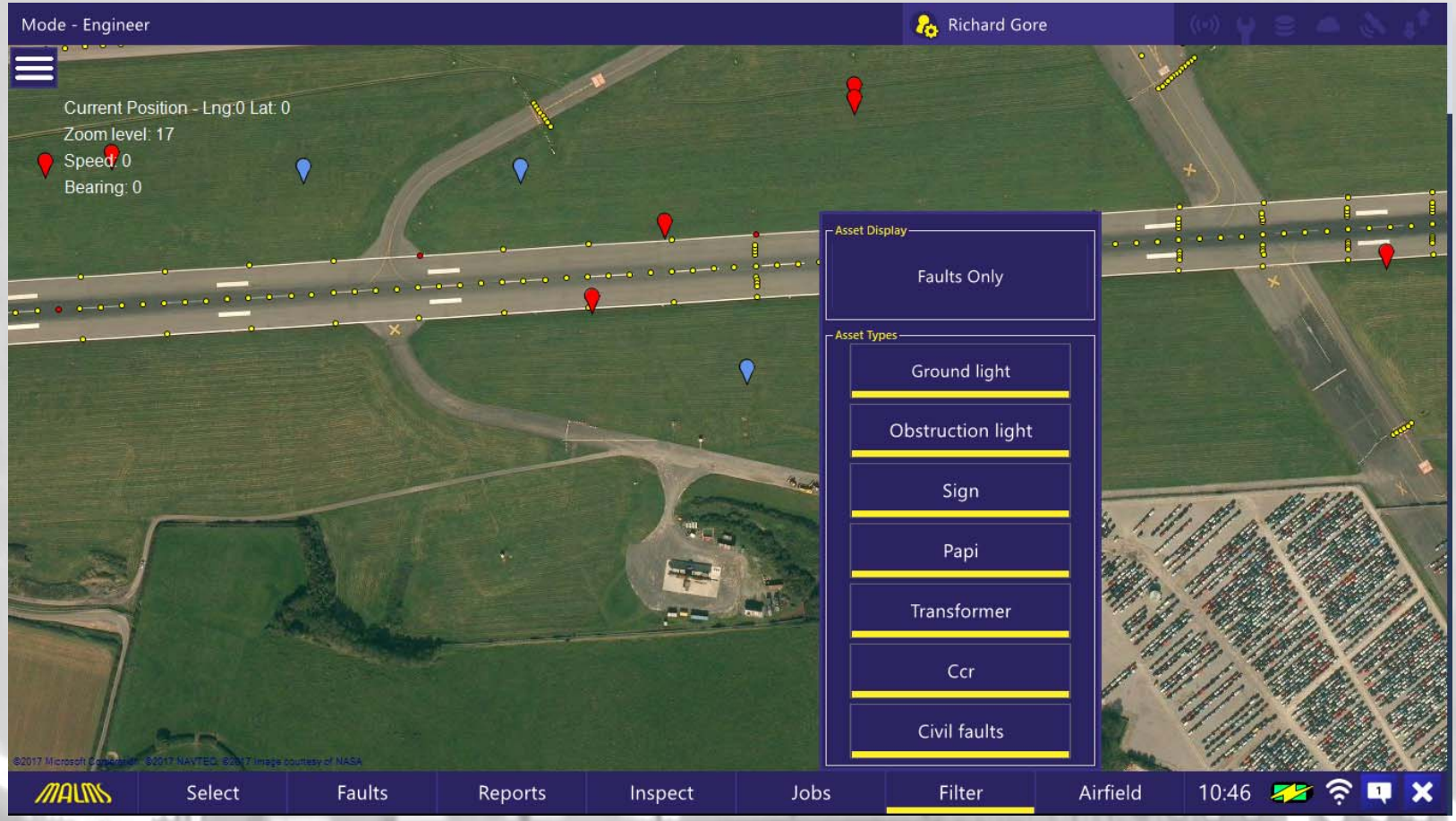
Typical GIS Application – Areas (Change in Rate of Homeownership)



Typical GIS Application – Hospital Facilities Management

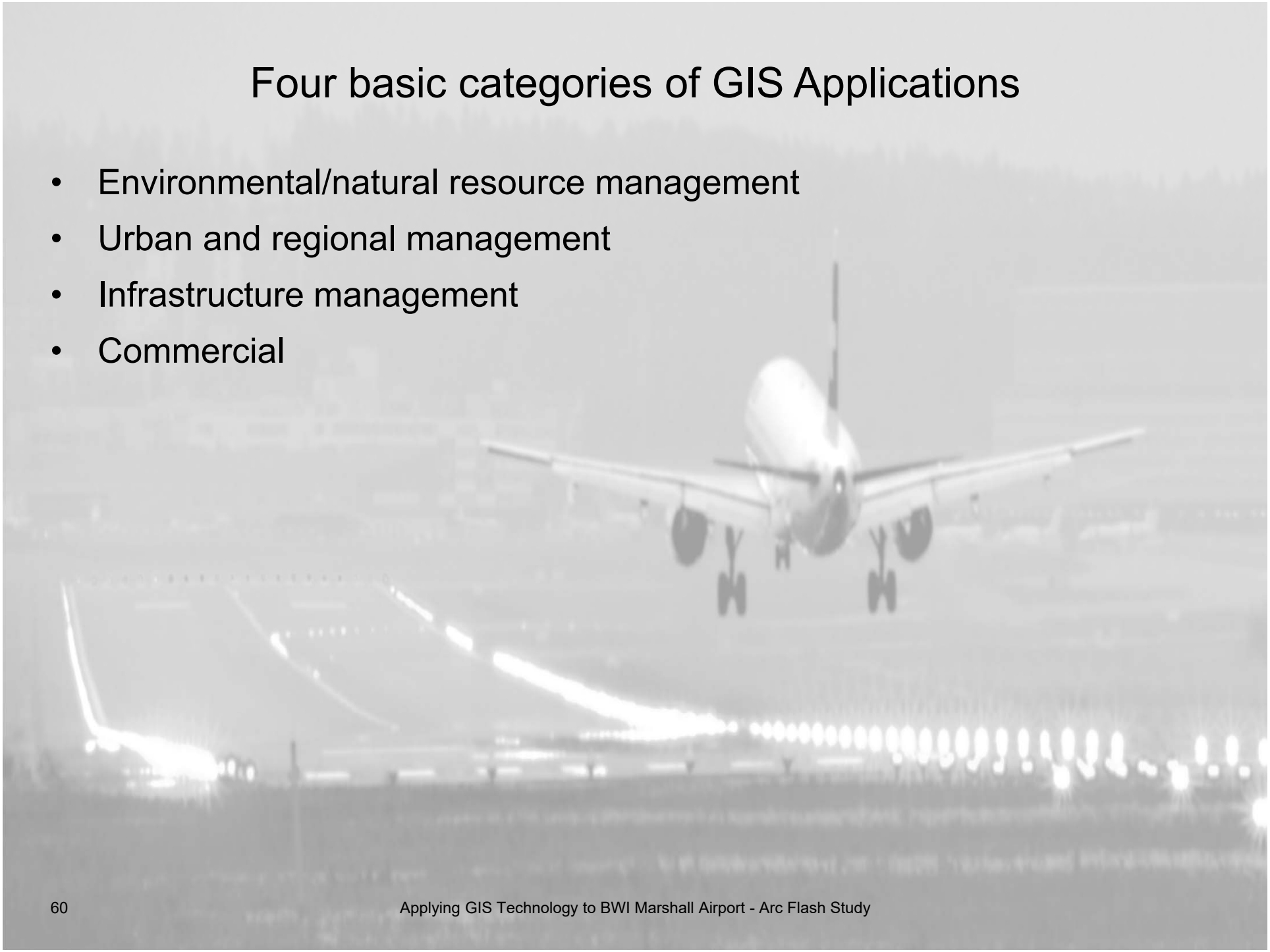


Typical GIS Application – Airfield Electrical Equipment Management



Four basic categories of GIS Applications

- Environmental/natural resource management
- Urban and regional management
- Infrastructure management
- Commercial



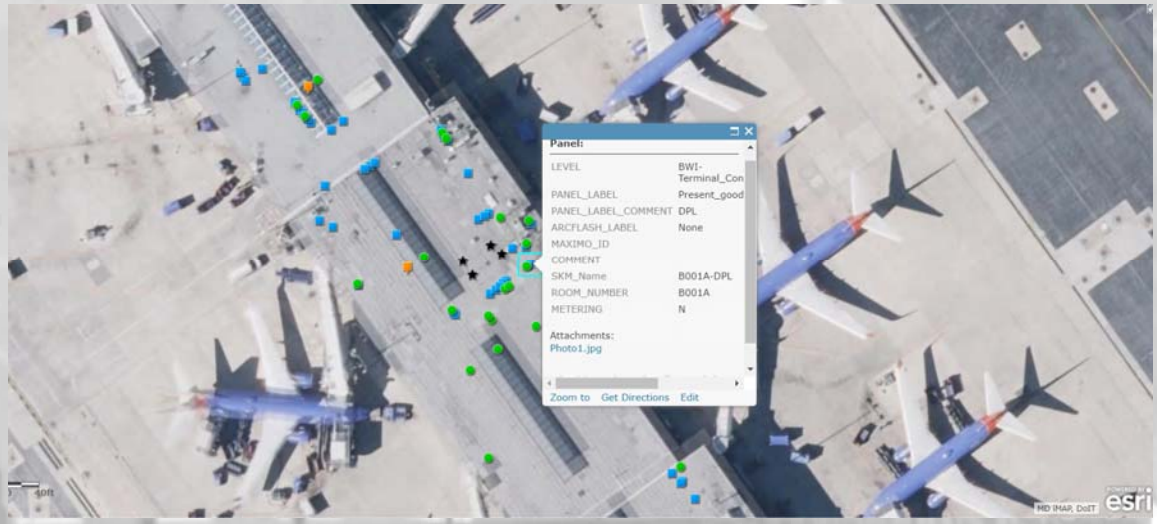
Components of GIS

- Hardware
- Software
- Data
- People
- Applications

Spatial Data and Attribute Data

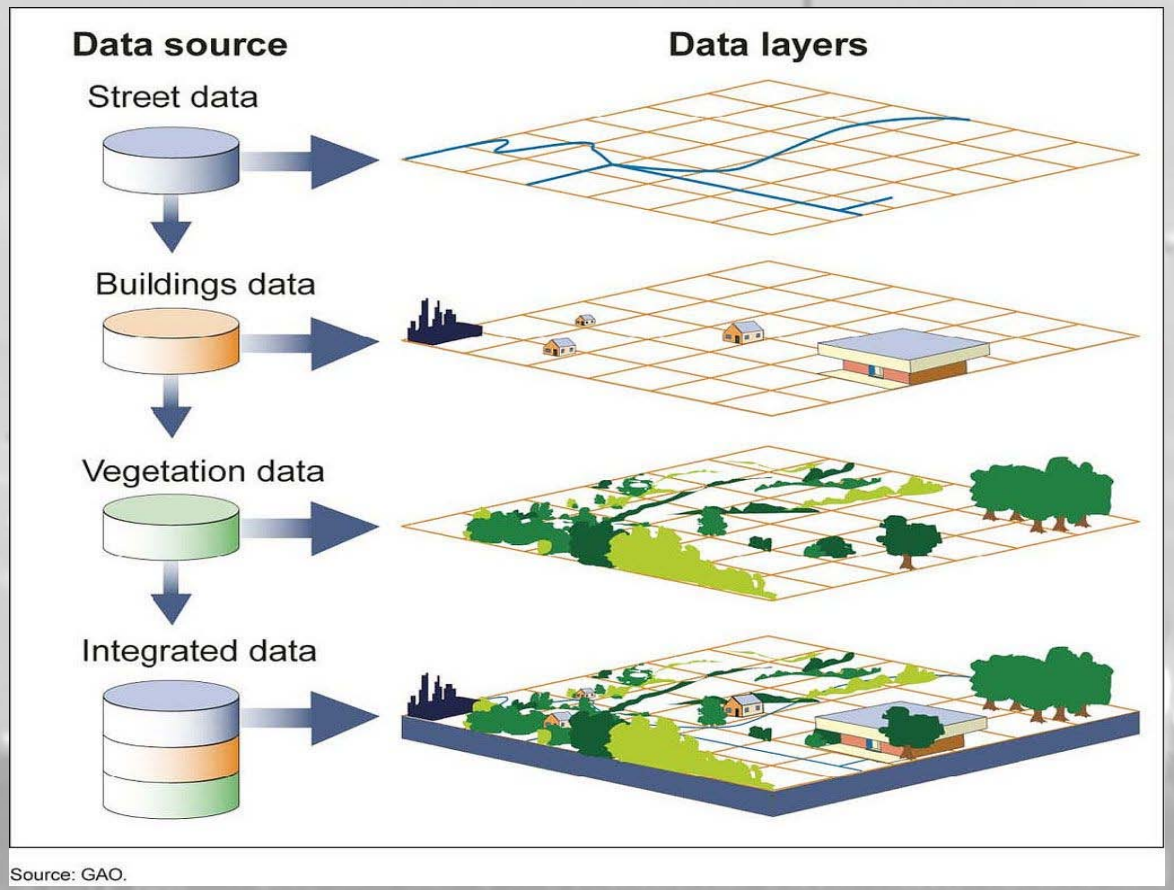
- Spatial data (location of an object)
  - Coordinate system
    - Latitude and Longitude

- Attribute data (information about an object)
  - Specifies characteristics at the location



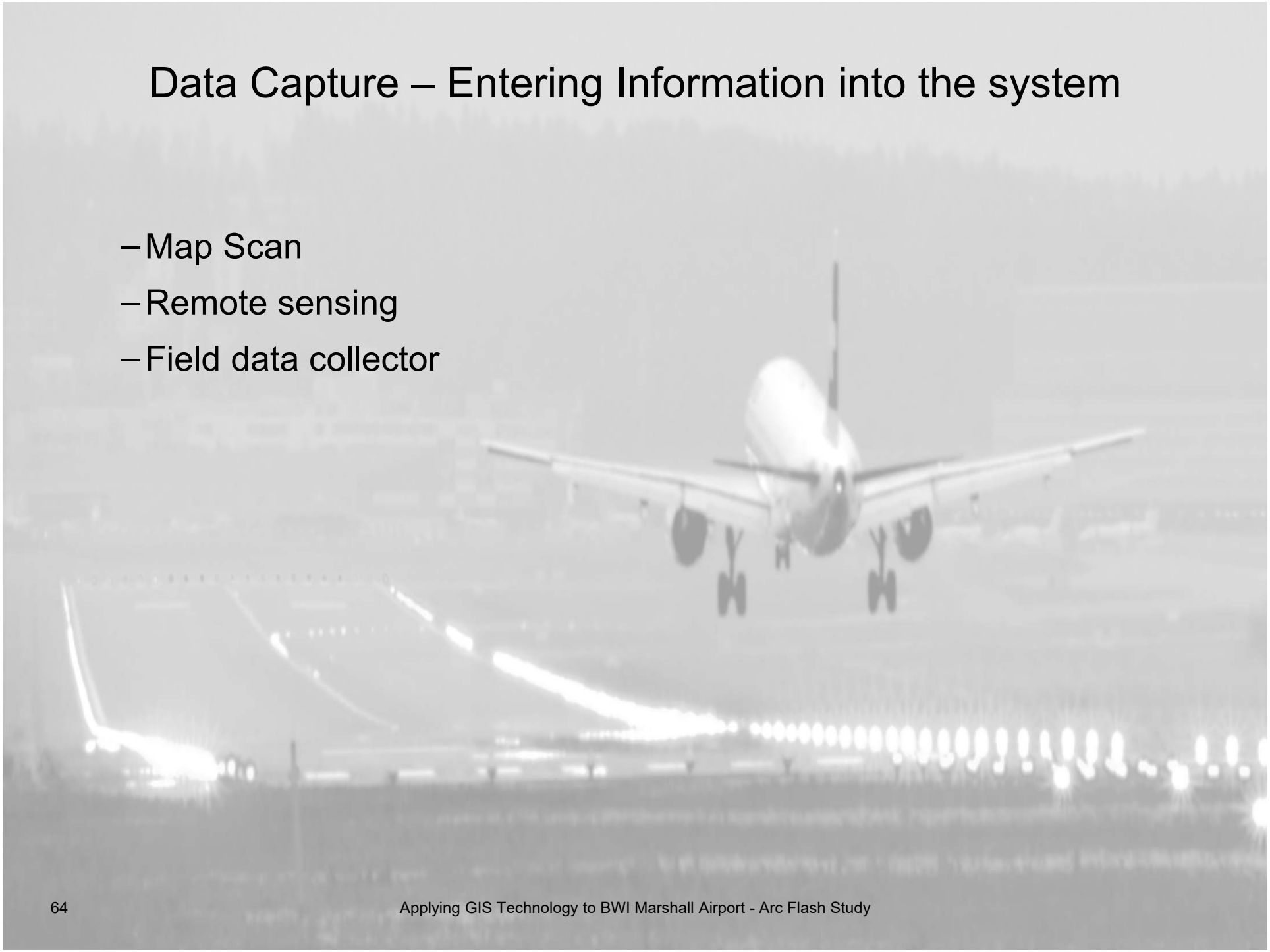
GIS Architecture

Spatial data are organized into layers. GIS can show many different kinds of data on one map through different layers, such as streets, buildings, and vegetation.

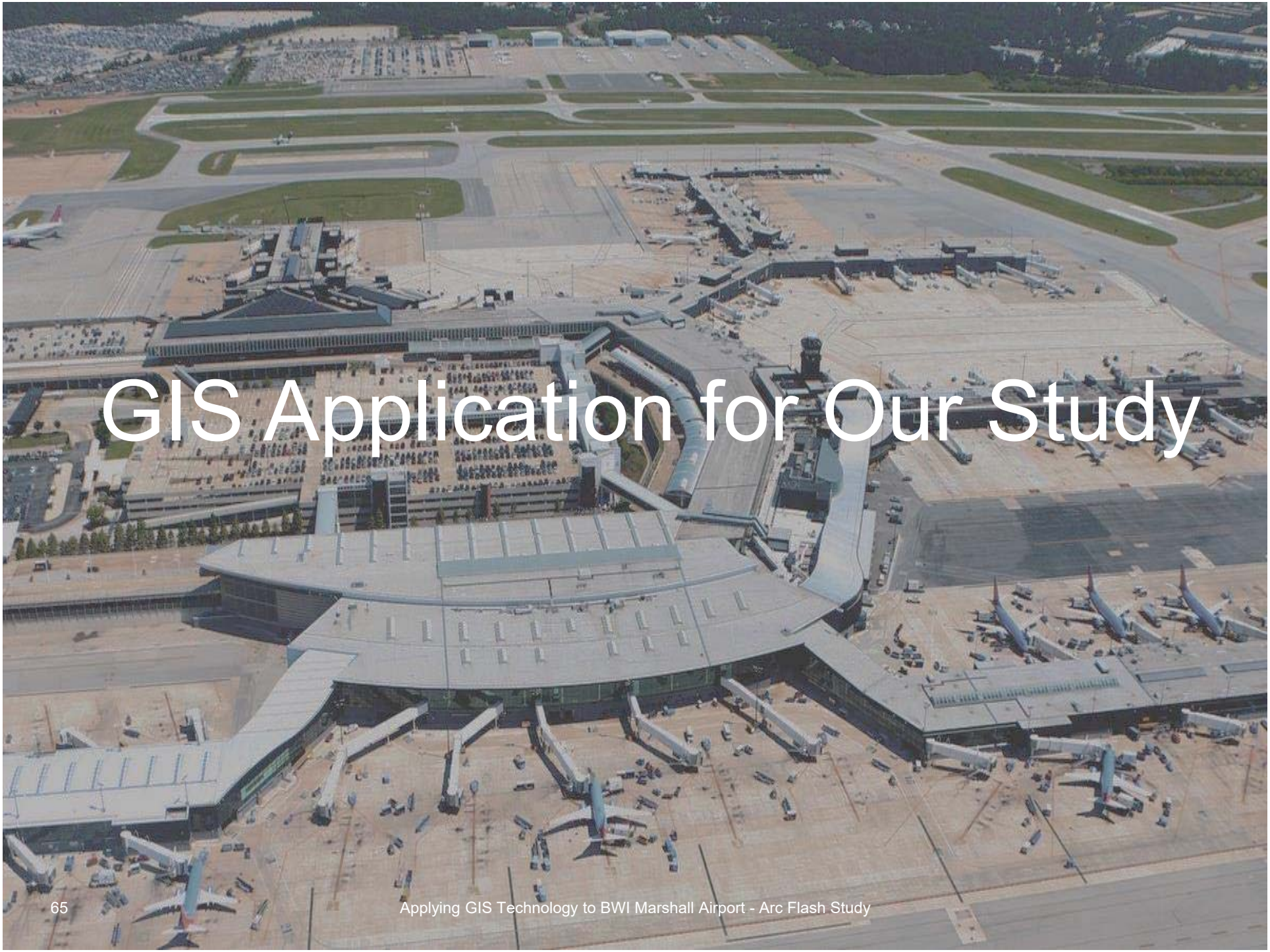


Source: GAO.

Data Capture – Entering Information into the system



- Map Scan
- Remote sensing
- Field data collector



GIS Application for Our Study

GIS Software – App for iPad

Legend

Transformer

Panel

MCC

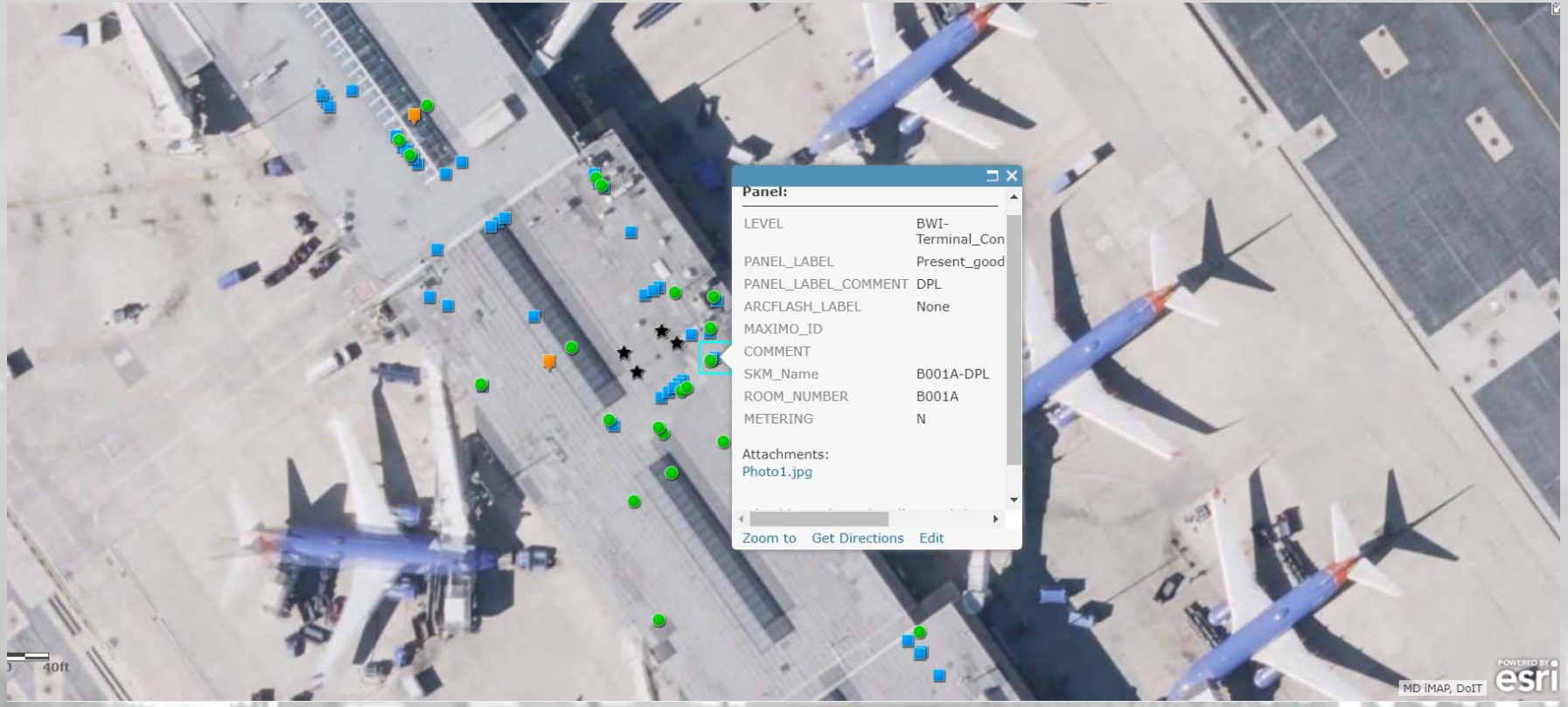
Switchboard

Switchgear

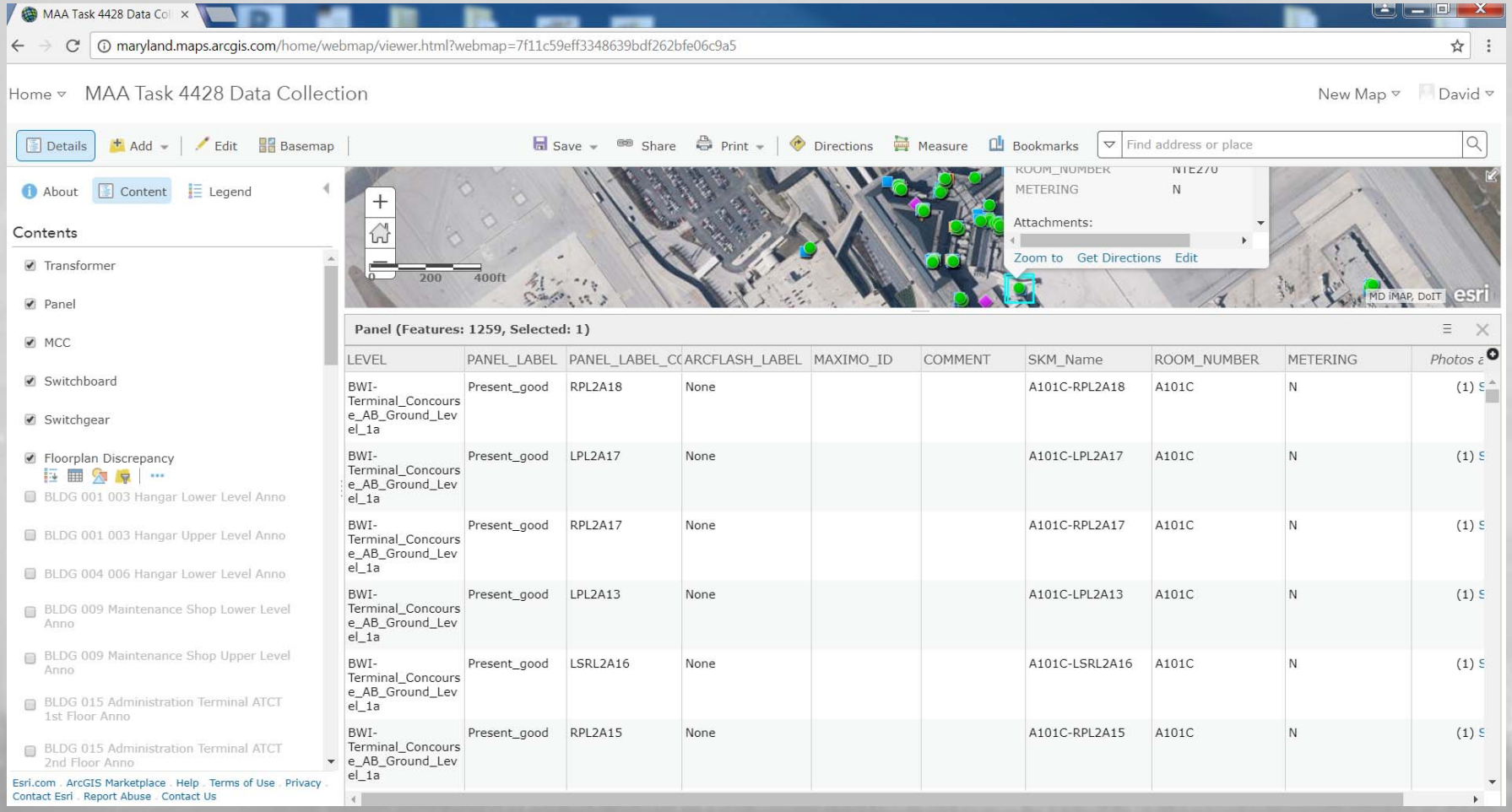
Floorplan Discrepancy

BWI GIS Map for Arc Flash Study on Desktop

Electrical Equipment Attribute Data



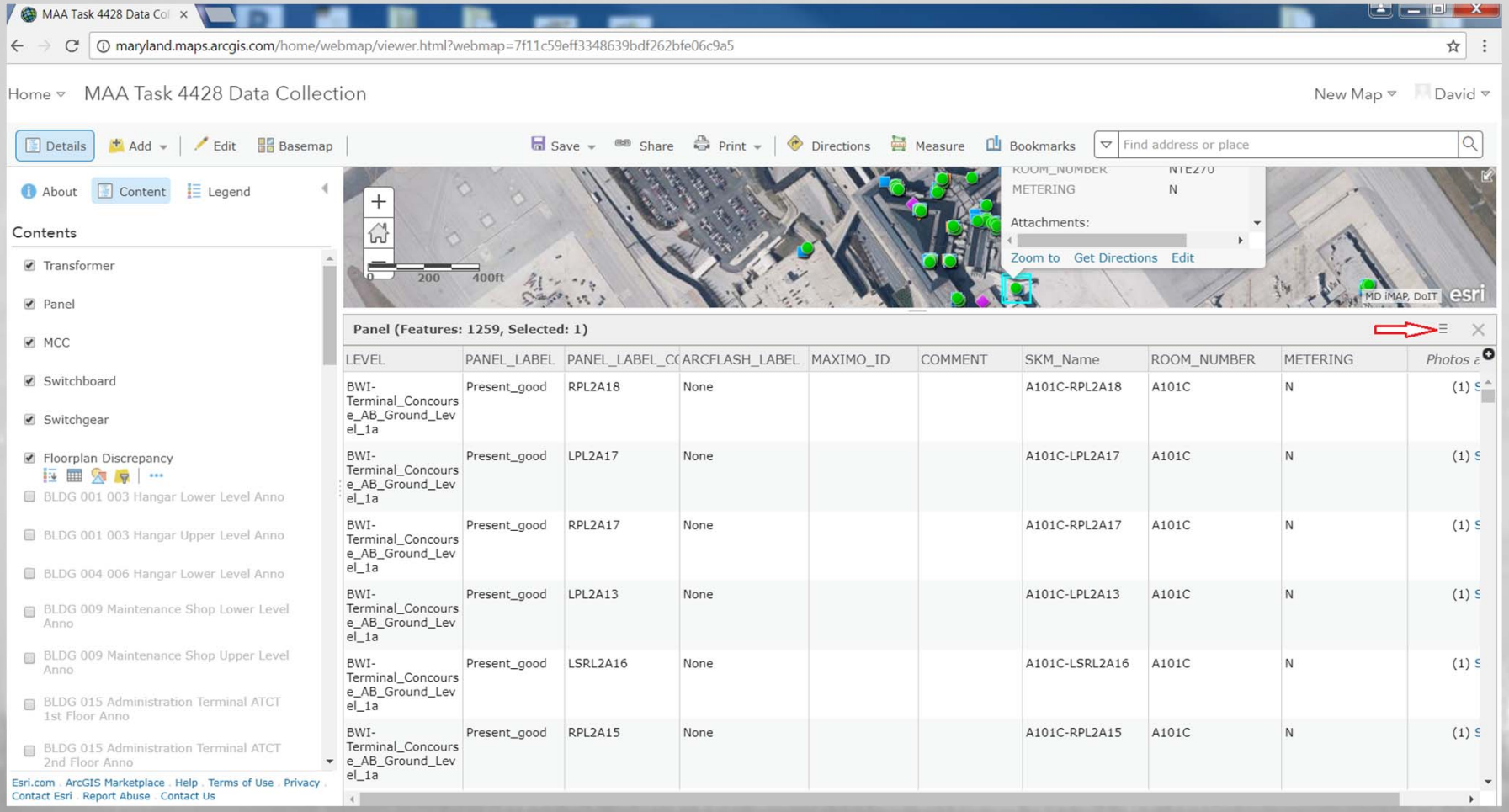
Electrical Equipment Attribute Data



LEVEL	PANEL_LABEL	PANEL_LABEL_CC	ARCFLASH_LABEL	MAXIMO_ID	COMMENT	SKM_Name	ROOM_NUMBER	METERING	Photos a
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	RPL2A18	None			A101C-RPL2A18	A101C	N	(1) S
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	LPL2A17	None			A101C-LPL2A17	A101C	N	(1) S
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	RPL2A17	None			A101C-RPL2A17	A101C	N	(1) S
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	LPL2A13	None			A101C-LPL2A13	A101C	N	(1) S
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	LSRL2A16	None			A101C-LSRL2A16	A101C	N	(1) S
BWI-Terminal_Concourse_AB_Ground_Level_1a	Present_good	RPL2A15	None			A101C-RPL2A15	A101C	N	(1) S

Substation ST-TU

Panel Attribute Data Table



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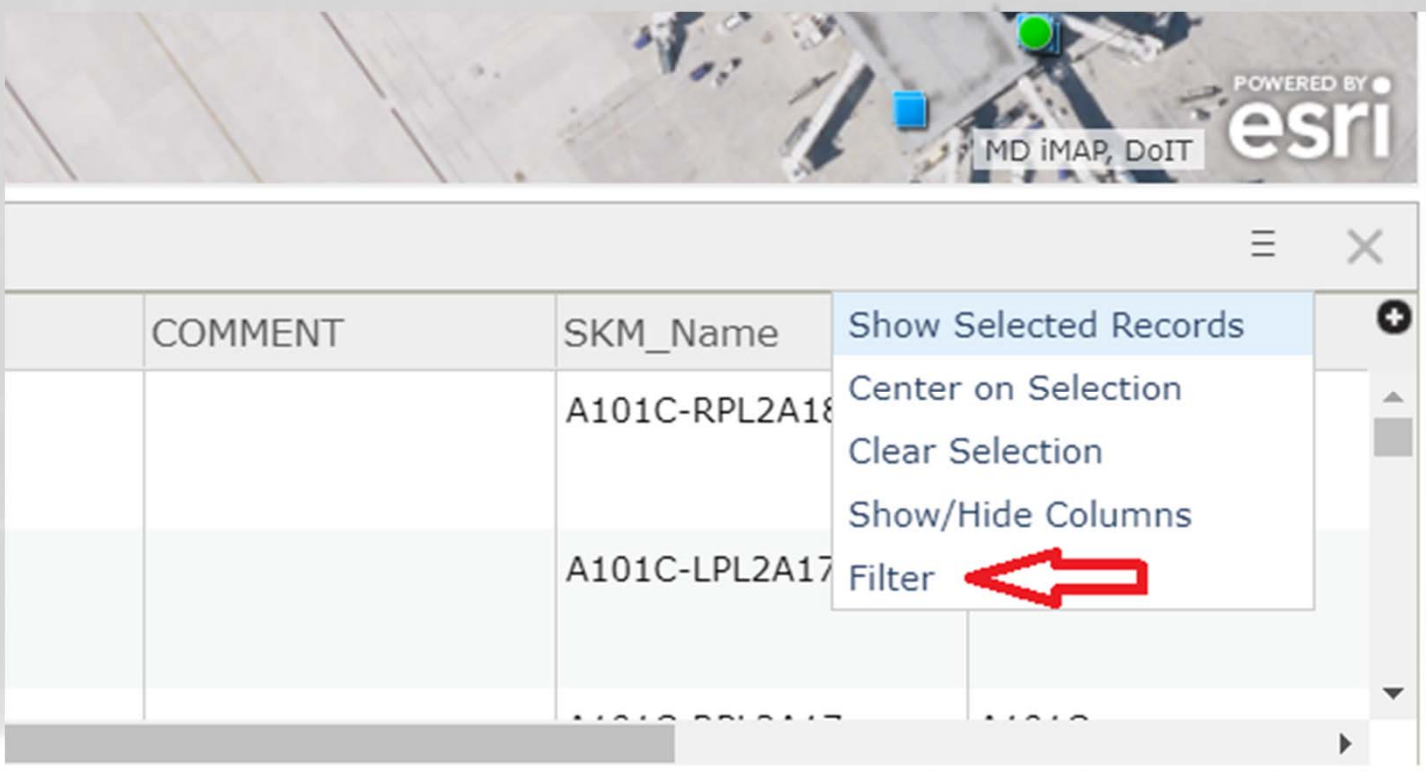

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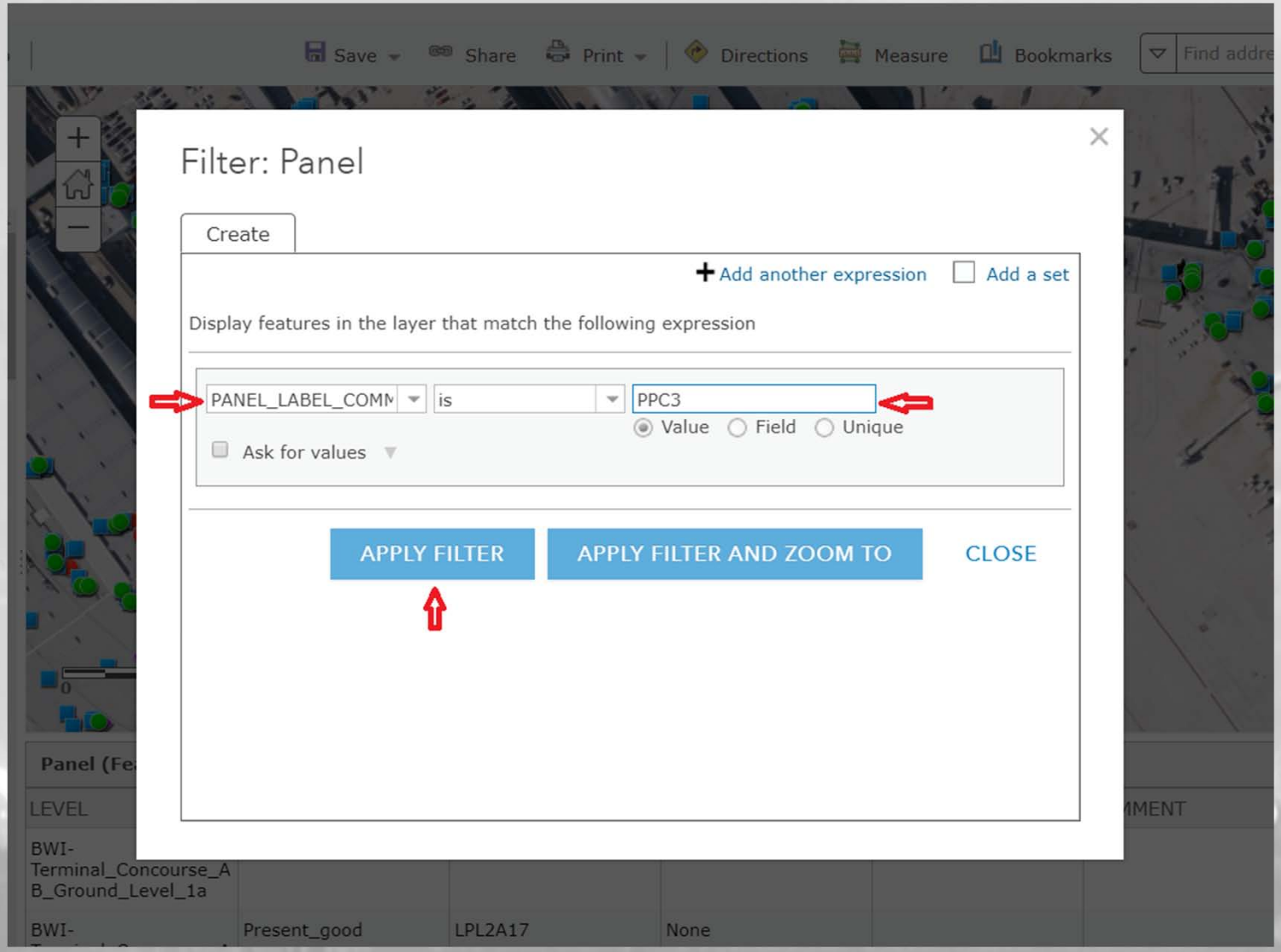

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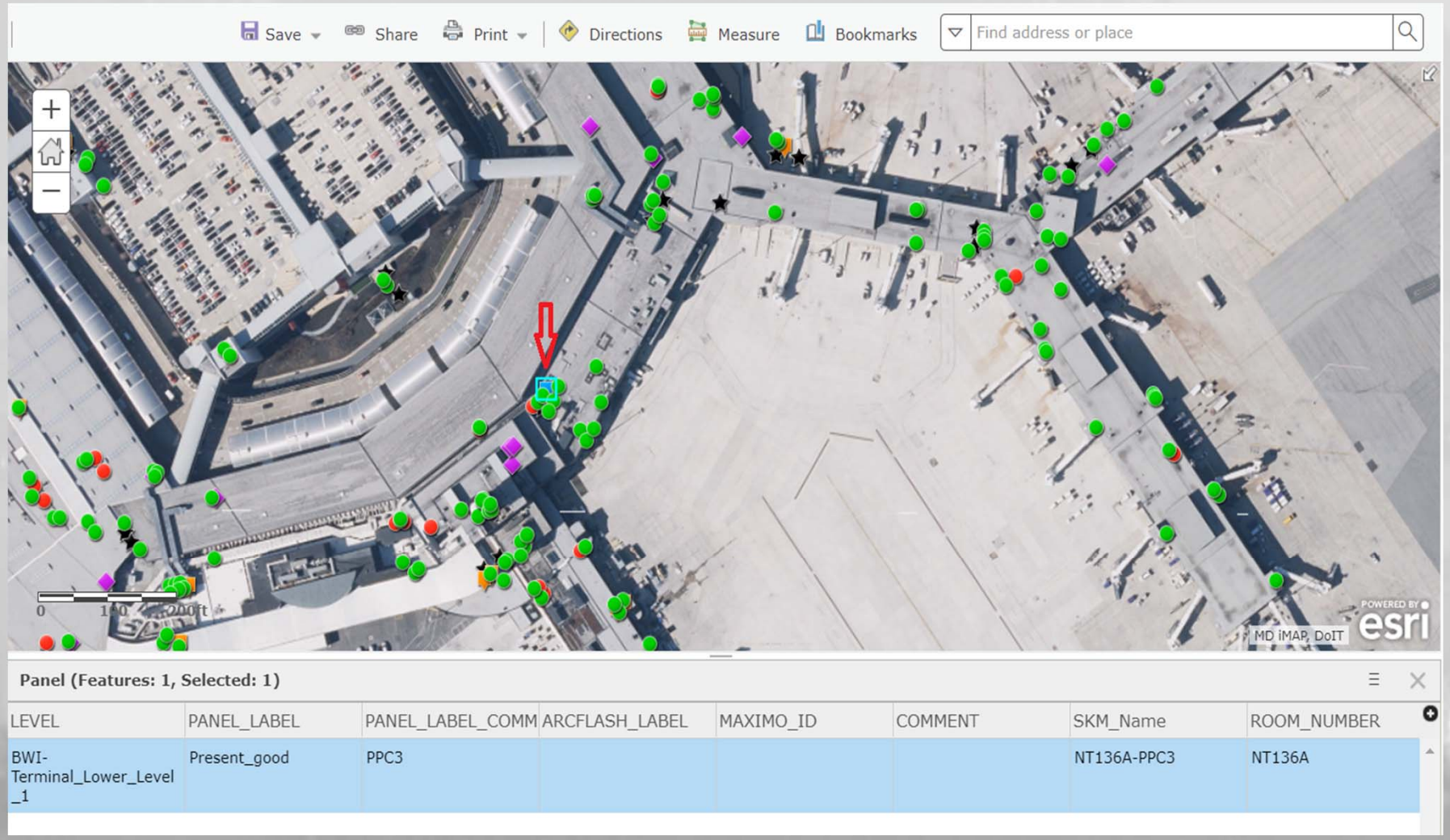

BWI Enterprise GIS Application


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