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Runway Status Light System Operational Concept

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Outline



- **Motivation**
- **Operational concept**
- **Requirements**
- **Operational scenarios**
- **Operational evaluation at Dallas Fort Worth Airport**
- **Summary**





The Problem: Airport Surface Accidents



Location	Fatalities	Date
Milan, Italy	118	2001
Tapei, Taiwan	83	2000
Quincy, Illinois	14	1996
Los Angeles, California	34	1991
Detroit, Michigan	12	1990
Omsk, Russia	174	1984
Madrid, Spain	93	1983
Guilin, China	11	1983
Tenerife, Canary Islands	583	1977

Runway incursions are accident precursors



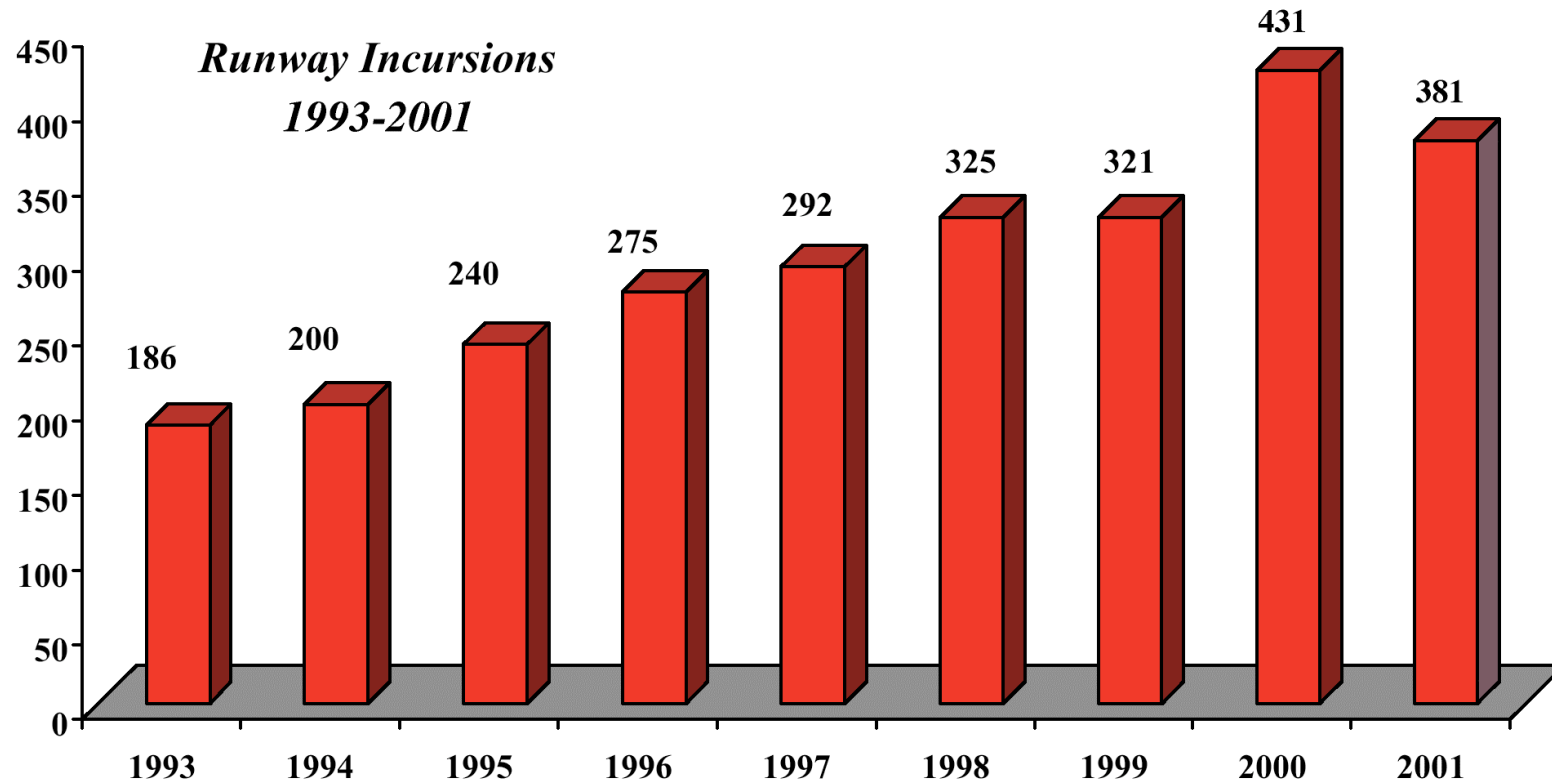
Definition of Runway Incursion



- **“A runway incursion is any occurrence on an airport runway involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land.”**
 - Source: FAA Runway Safety Office



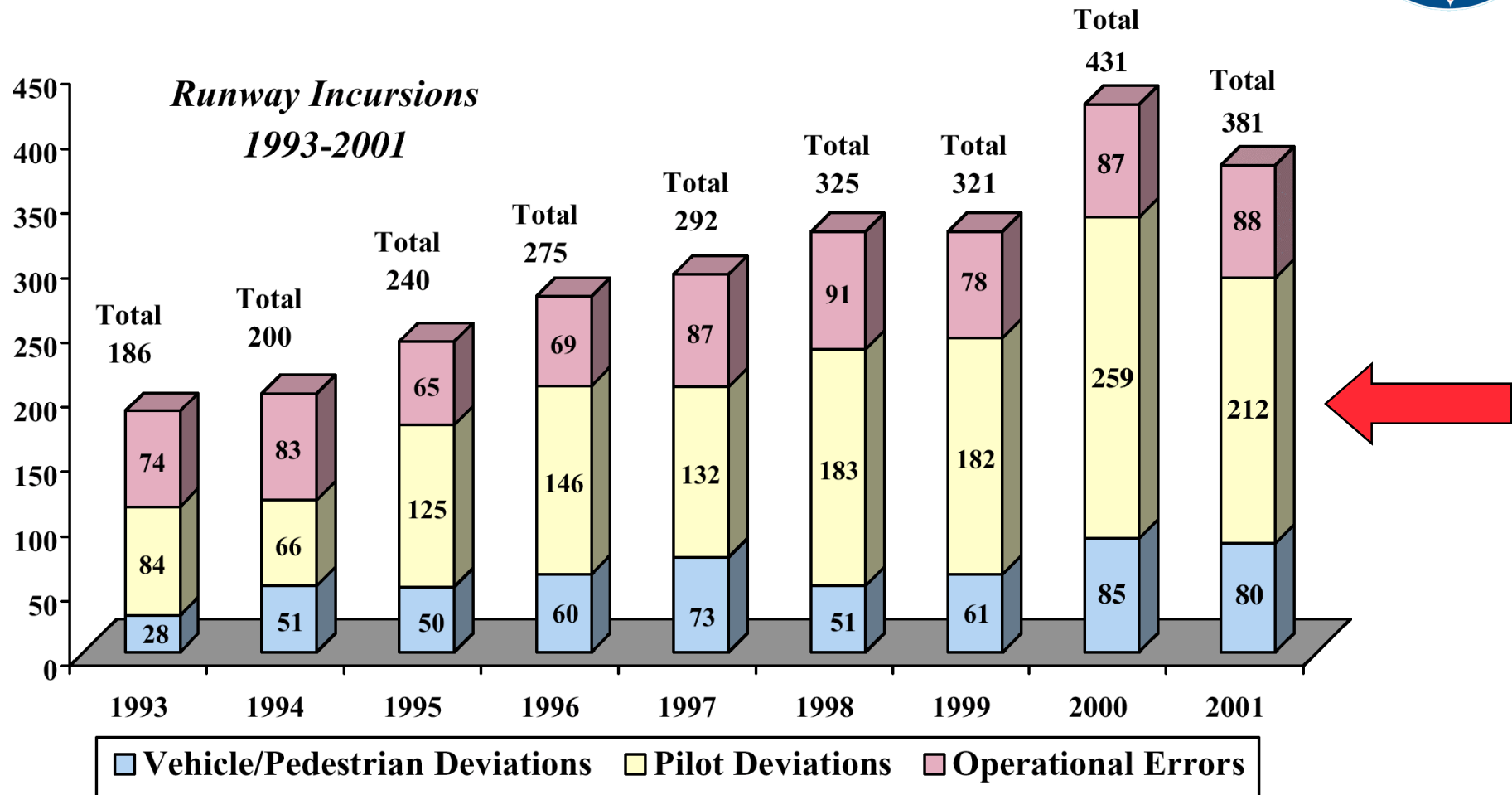
Runway Incursions 1993-2001



“Runway collisions at towered American airports could kill 700-800 ... over the next two decades” source: Prof. Arnold I. Barnett, MIT Sloan School



Runway Incursions 1993-2001



Pilot deviations and Operational Errors are root cause of runway incursions



Source of pilot confusion



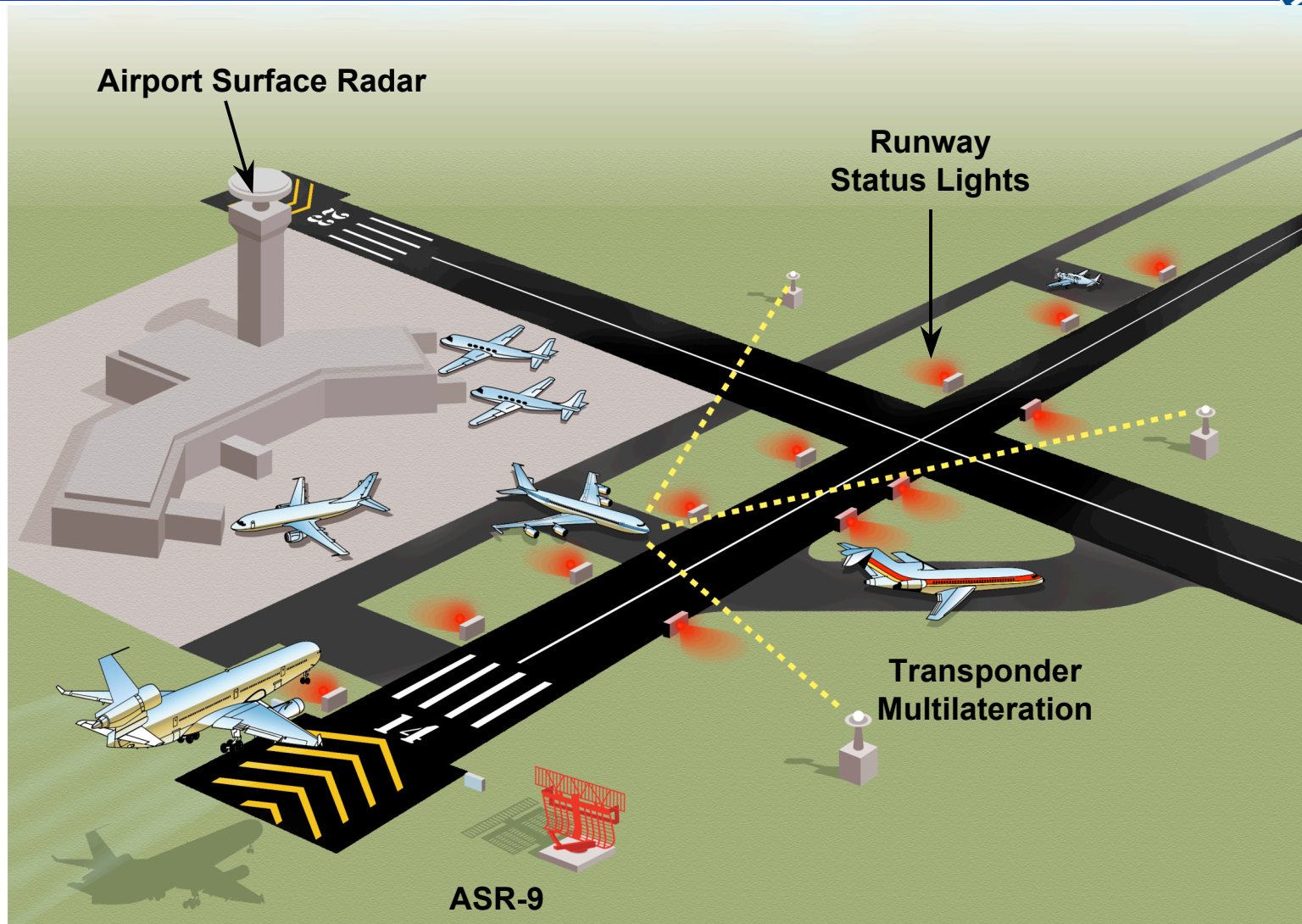
Dallas Fort Worth International Airport



- **Solution: increase situational awareness of pilots and vehicle drivers**



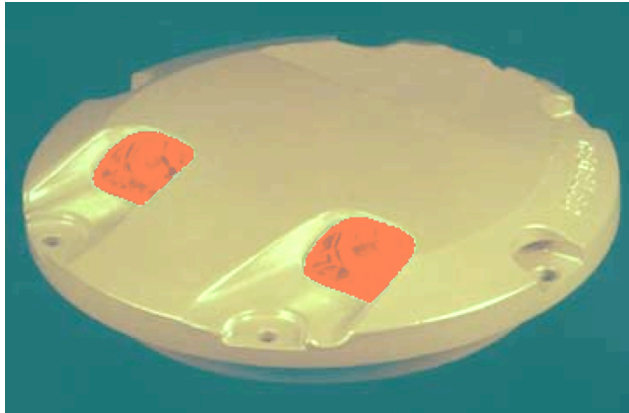
Runway Status Lights Concept



- Surveillance-driven lights provide situational awareness of runway status



Runway Status Lights Fixtures



In-pavement fixture



Elevated fixture

- Two types of fixtures
 - In-pavement &/or elevated
- Two types of lights
 - LED or incandescent
- Two states
 - Red or off
- Indicate status only, not clearance!



High level block diagram



Surveillance



Transponder
Multilateration



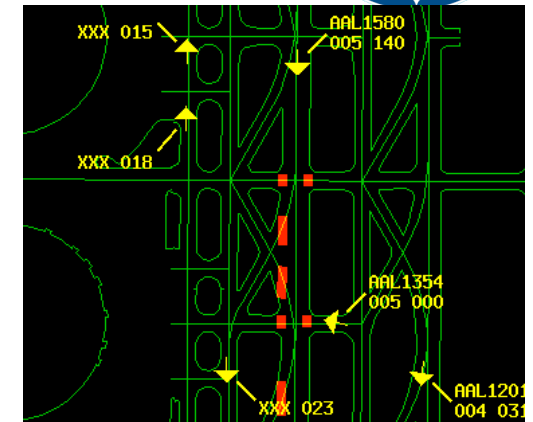
ASDE-3



ASR-9

MIT/LL

Light Control Logic



Controller Display



Field Lighting System



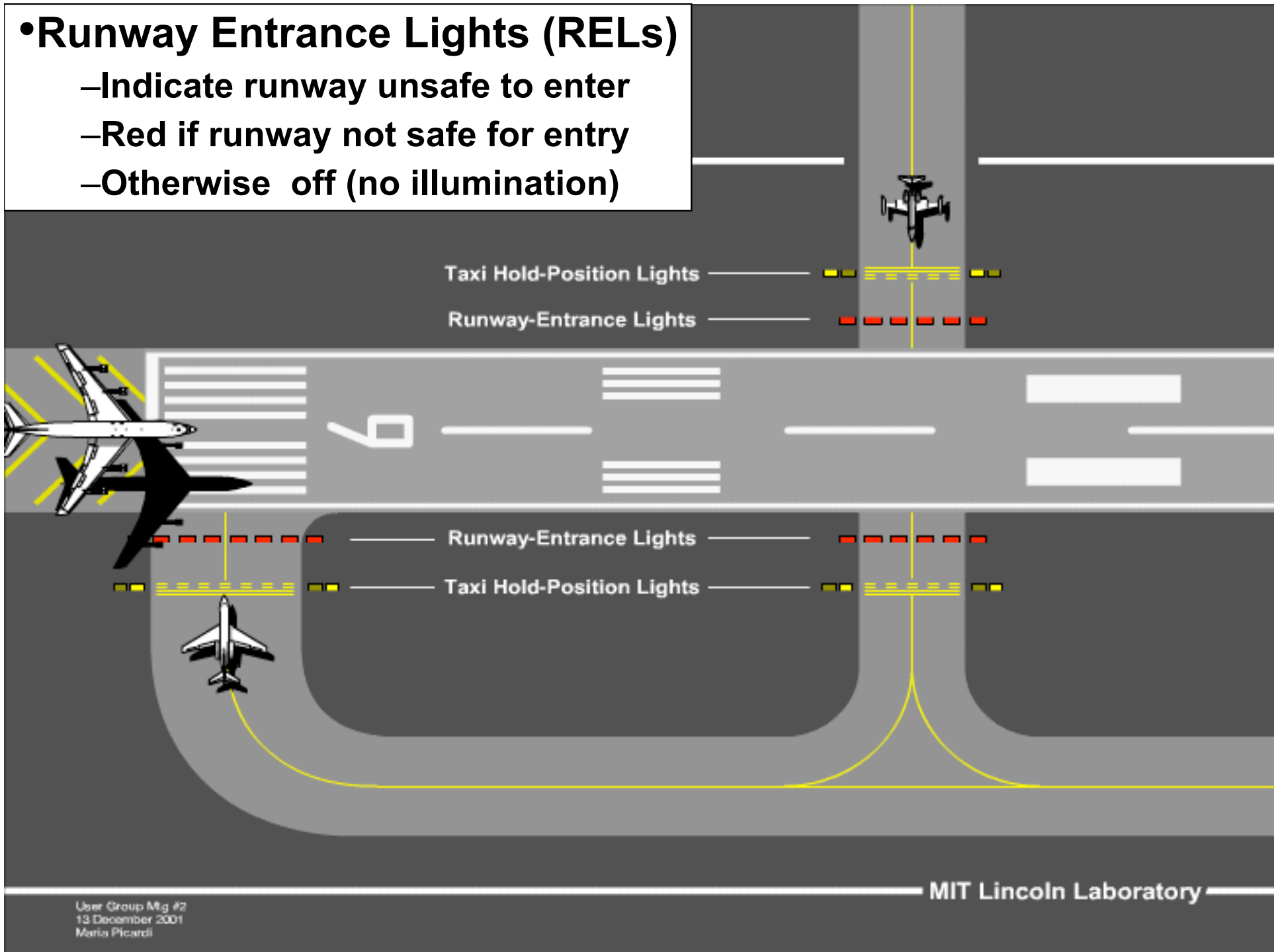
High level operational requirements



- **Runway status lights operate automatically**
 - No controller action required for operation
- **Lights must accurately depict runway status**
 - Lights must provide safety function
- **Lights must not interfere with normal safe surface operations**

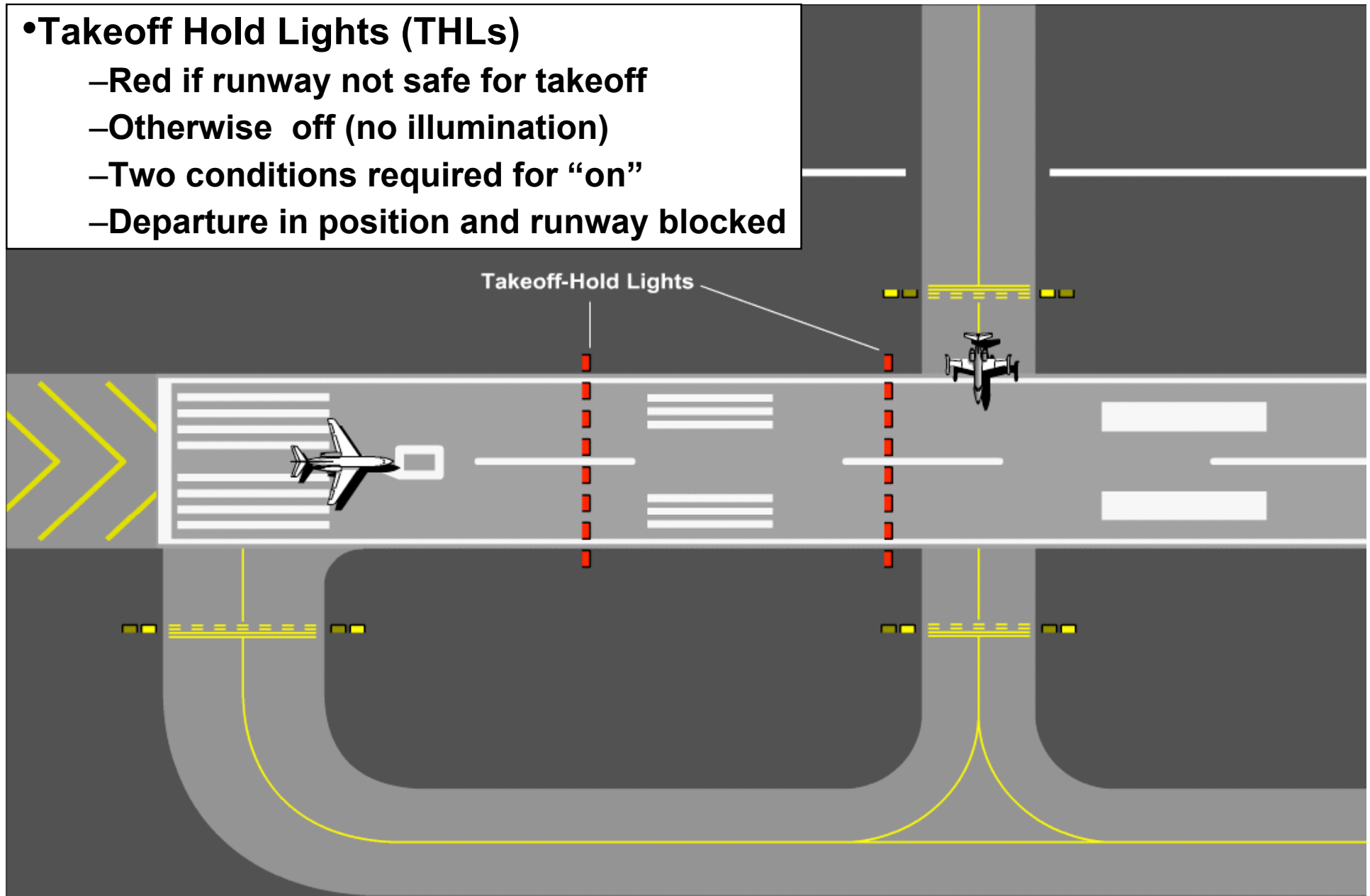
•Runway Entrance Lights (RELs)

- Indicate runway unsafe to enter
- Red if runway not safe for entry
- Otherwise off (no illumination)



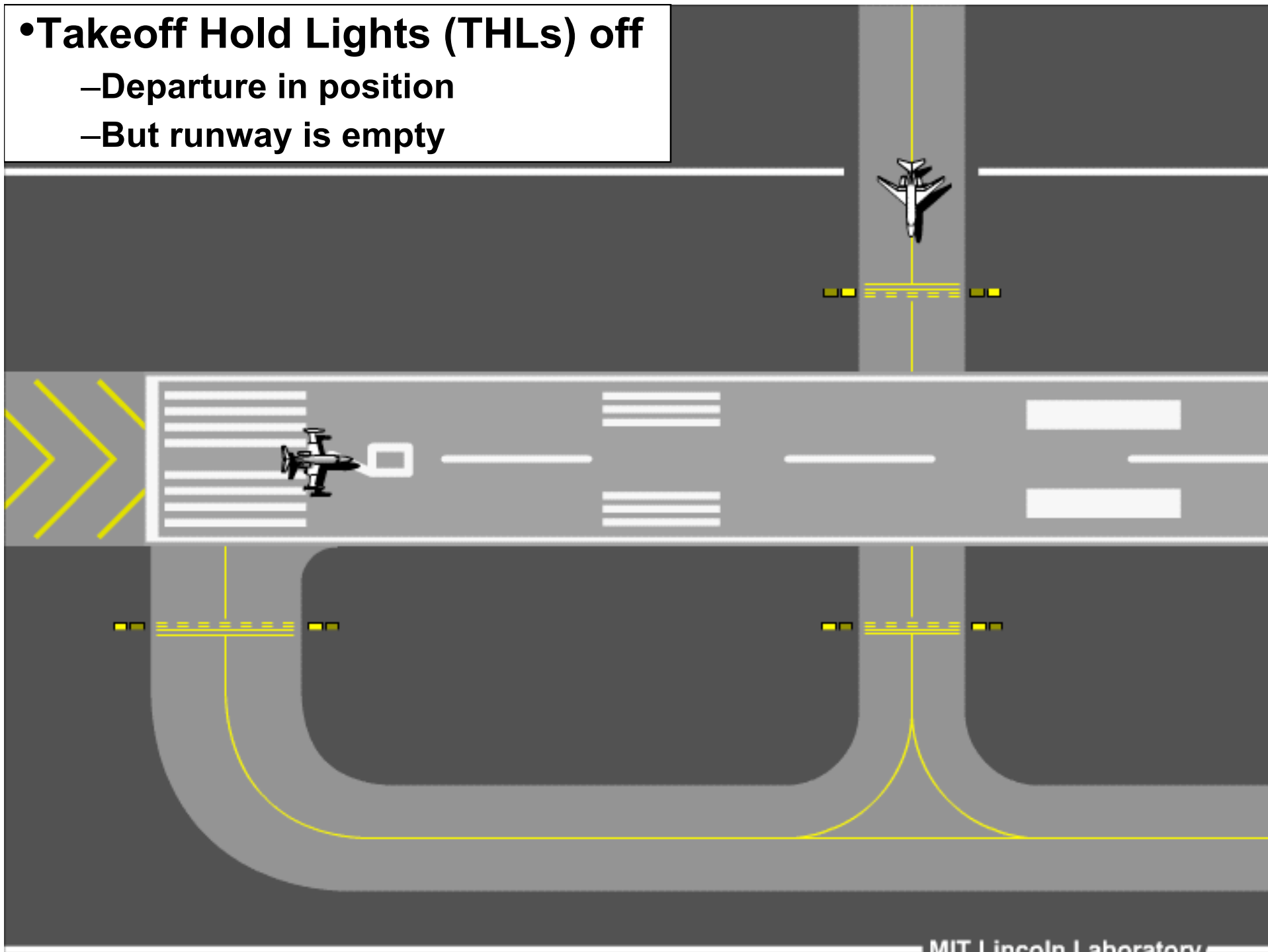
•Takeoff Hold Lights (THLs)

- Red if runway not safe for takeoff
- Otherwise off (no illumination)
- Two conditions required for “on”
- Departure in position and runway blocked



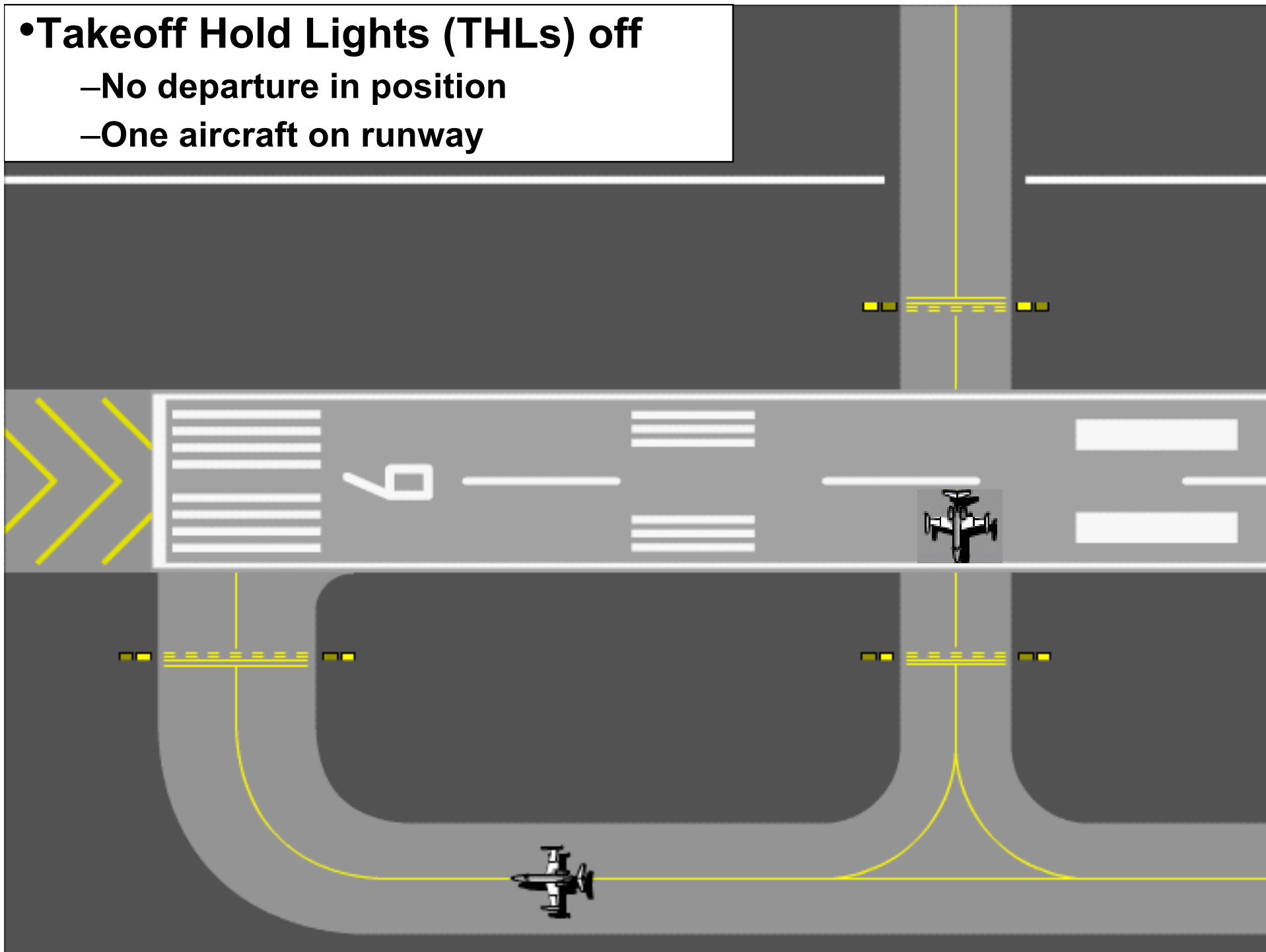
- **Takeoff Hold Lights (THLs) off**

- Departure in position
- But runway is empty



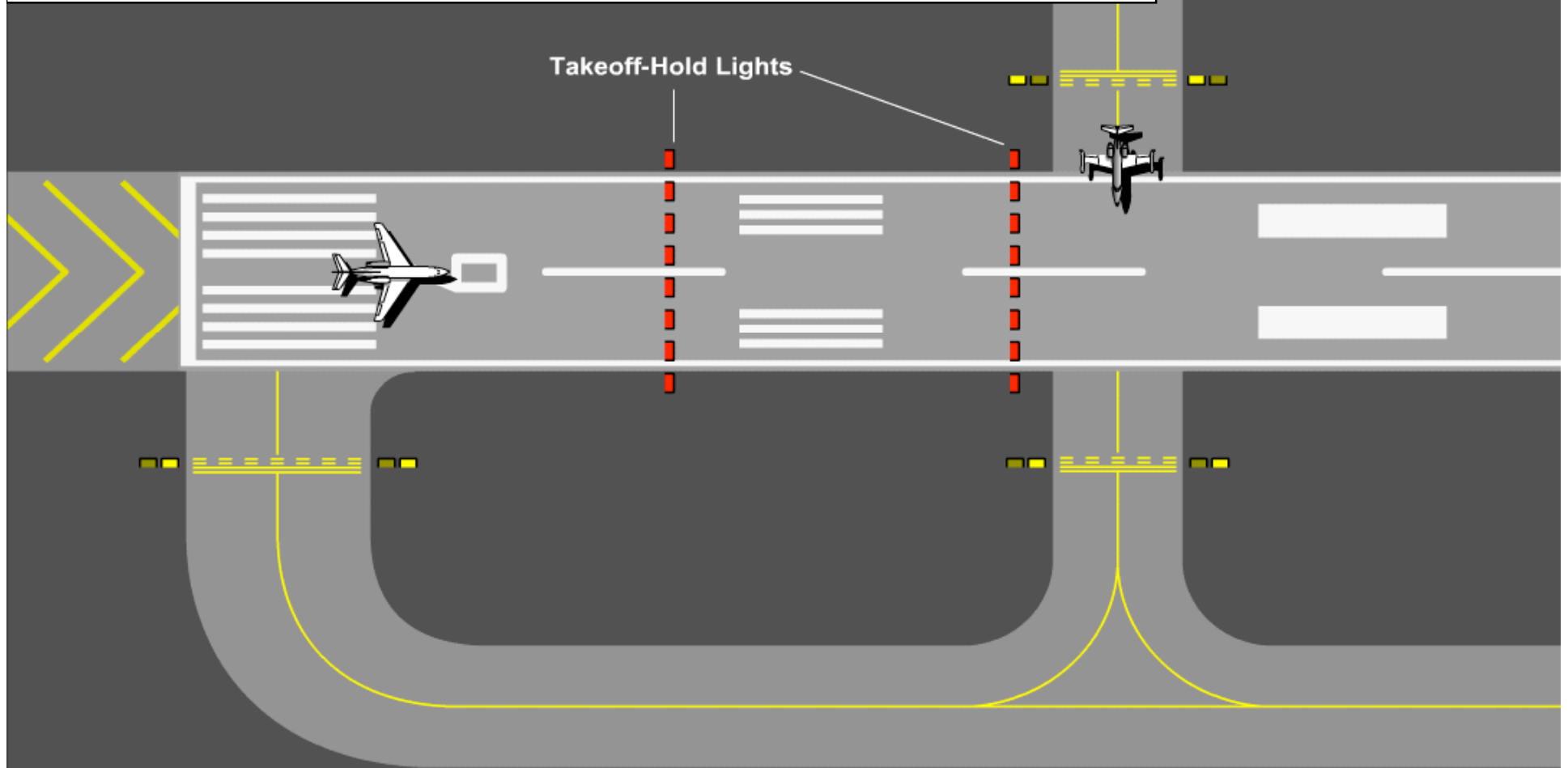
- **Takeoff Hold Lights (THLs) off**

- No departure in position
- One aircraft on runway



•Takeoff Hold Lights (THLs)

- Indicate runway occupied or soon to be occupied
- Red if runway not safe for takeoff
- Otherwise off (no illumination)



Runway Entrance and Takeoff Hold Lights

Taxi Hold-Position Lights ————

Runway-Entrance Lights ————

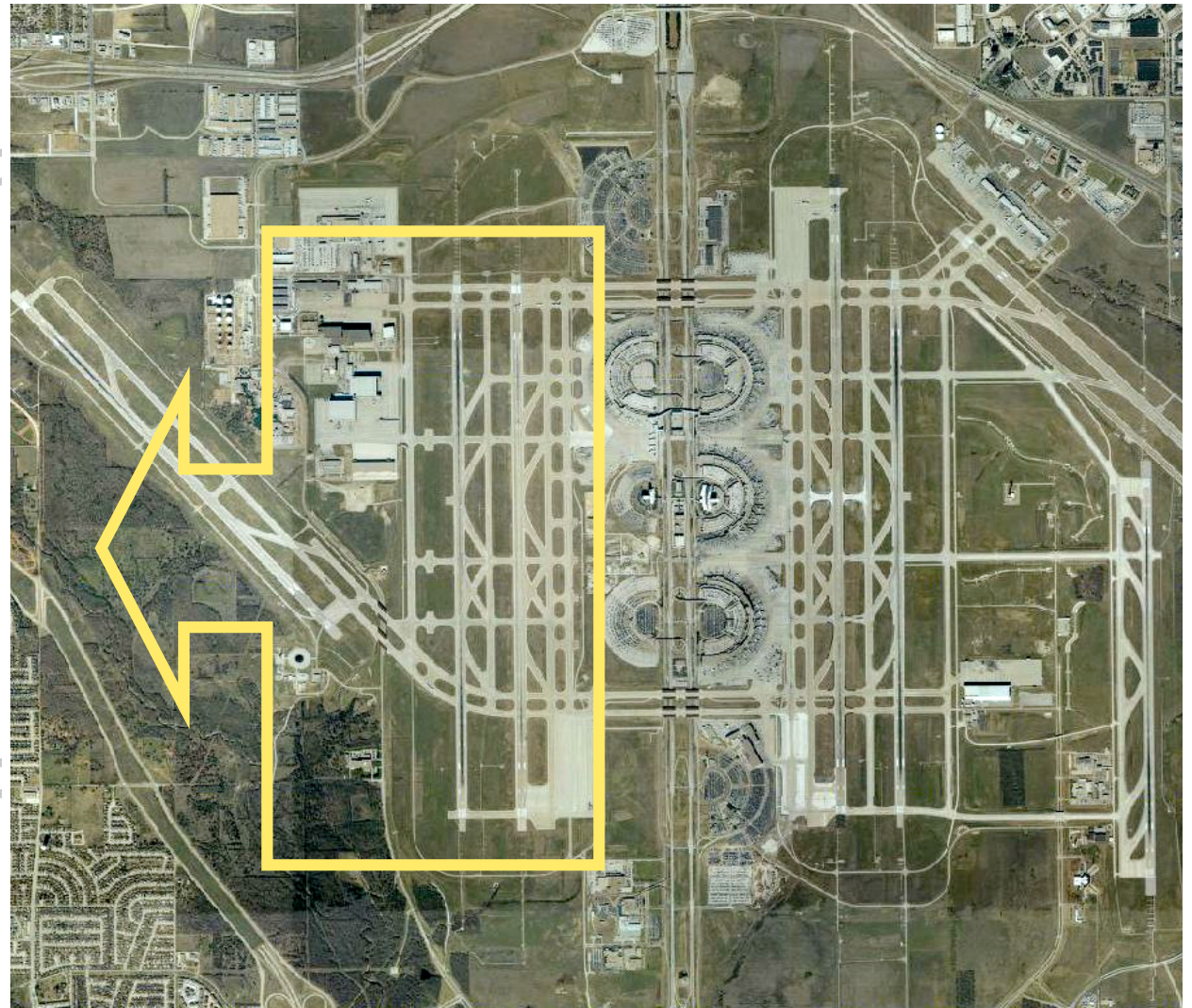
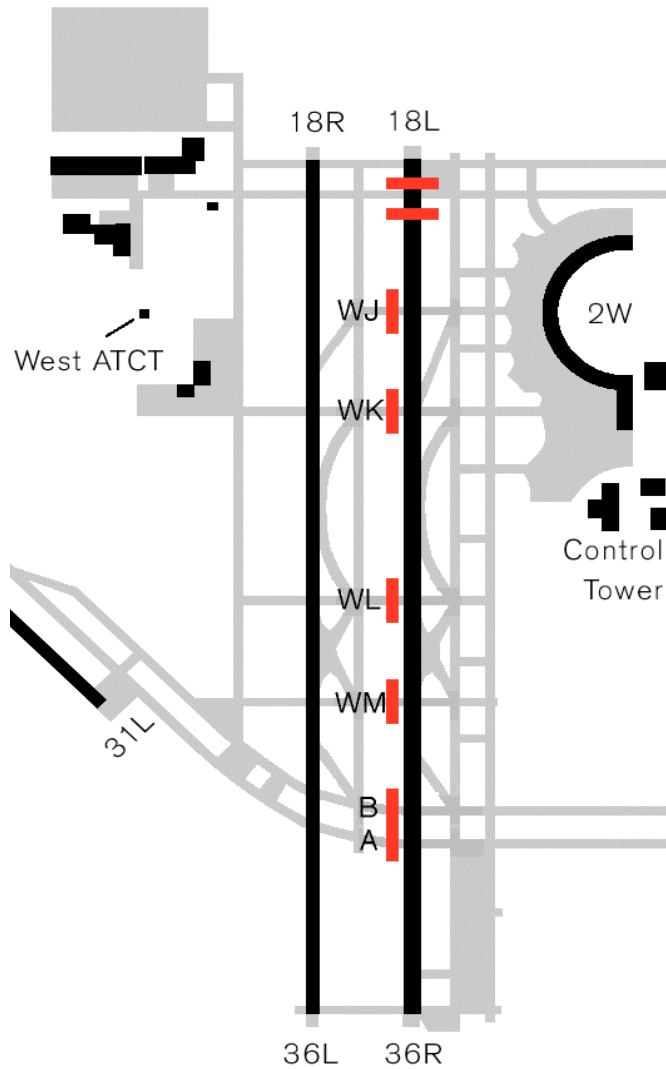
Runway-Entrance Lights ————

Taxi Hold-Position Lights ————





Operational Evaluation at DFW





Development Program on track



DFW Center Tower

- **Phase 1 (FY '01 - '02)
Engineering
Development**
- **Phase 2 (FY '02 - '03)
Shadow Operations**
- **Phase 3 (FY '03)
Operational
Evaluation at DFW**

Photo courtesy of NASA Ames



Key Human Factors Issues: Controllers



Air Traffic Controllers in Tower

- Tower display
- Workload
- Interference



Key Human Factors Issues: Pilots



Airline pilots



- **Status \neq clearance**
- **Status lights not at all intersections**
- **Trust and confidence in status depiction**



Summary



- **Concept**
 - Provide automatic depiction of runway status
 - Assure safety via increased pilots' situational awareness
- **Issues**
 - Pilot and controller acceptance
- **Accomplishments and Activities**
 - Animated scenarios demonstrated to User Group (including Unions) and FAA Air Traffic Management
 - Operational Concept Document published
 - Operational Evaluation Plan in progress
 - Shadow Operations at DFW center tower this year