Runway Incursion
Joint Safety Implementation Team

Implementation Plan
For
Visual Aids Enhancement & Automation Technology - Airports

DRAFT

Statement of Work:

The purpose of this project is to develop and install airport visual aids that provide clear guidance (taxi route, runway entrance, runway exit and construction area avoidance) for flight crews and other persons operating aircraft and vehicles on the movement area. It is intended that this project will provide unambiguous visual signals to convey runway occupancy clearances as well as to convey runway occupancy status to aircraft on final approach to a runway. Such visual aids are intended to prevent runway incursions and surface incidents and improve situational awareness. The systems will comply with appropriate aviation standards and visible under all meteorological conditions.

Configuration, installation and performance standards will be developed as a part of this statement of work. Final configuration and application of each safety enhancement is dependent upon the implementation of associated technologies, operational and workload factors, and benefit-cost analyses.

Lead Organization for Overall Coordination (LOOPC):

ARP-1

Safety Enhancement 1: (SE-42)
Variable Message Signs will change from "Mandatory" runway indicators to "Clearance" indicators providing a visual signal to aircraft and vehicle operators a safe access onto or across runways.

Accident Prevention Index: (To be completed by JIMDAT)

Total Resource Requirements:
Estimated at 5 Labor-years
Total Cost - $66,200,000

Completion Date: 60 months.

Output: Reduce the rate and number of Runway Incursion incident rate by providing clear and non-ambiguous runway occupancy clearance signals (variable message signs) for runway entrances at FAR Part 139 compliant runways serving FAR Part 121 operations.

Detailed Plan:

1) Validate control performance. ATS will validate and endorse the manual operation of the message signs before proceeding with the remainder of the safety enhancement.

- Resources: AAS-1 (LOOC), ATS, AAS-200, AND-500, AAR-400, IES, and Industry Producers
- Timeframe: 18 - 24 months
- Actions: Evaluate control and operation methods

2) Develop variable message sign design and performance criteria.

- Resources: AAS-1, AAS-200, AND-500, and AAR-400
- Timeframe: 6 months
- Actions: Form Project Group; Amend appropriate AC containing design & performance criteria

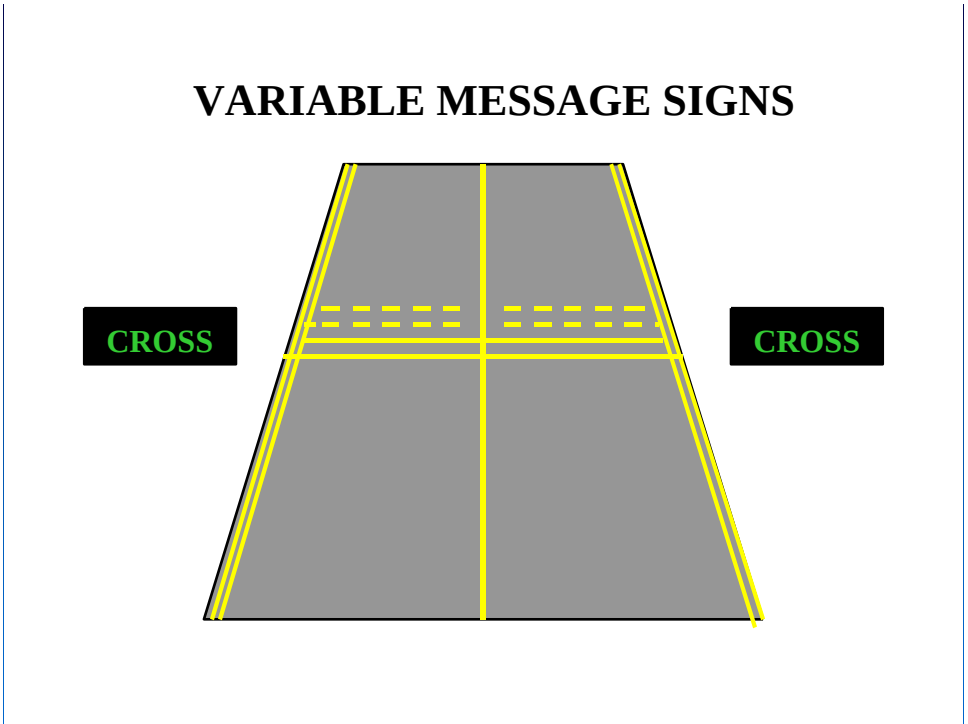
3) Validate design and performance.

- Resources: AAS-1, AAS-200, AND-500, AAR-400
- Timeframe: 6 months
- Actions: Conduct in-service evaluation

4) Develop control criteria.

- Resources: AAS-1, AAS-200, AND-500, AAR-400, Industry Producers
- Timeframe: Done
- Actions: None

5) Develop installation & maintenance criteria.



- Resources: AAS-1, AAS-200, IES, Industry Producers, Airport Representative Organizations
- Timeframe: 8 months
- Actions: Amend appropriate AC as necessary

6) Install and implement variable message signs.

- Resources: APP-1, AIP Funds, PFC Funds, Affected Airports
- Timeframe: 24 months
- Actions: Install and commence operation

Performance Goals & Indicators for Safety Enhancement/Outputs:

- **Goal:** Install variable message signs at towered Part 139 airports serving Part 121 operations based on traffic density and risk of incursions.
  Indicator: Number of runways with variable message signs installed

Safety Enhancement 2: (SE-43)
Holding position markings, signs and lights will improve visual awareness and all-weather conspicuity. This enhancement includes the evaluation of specific technologies (LED and fiber-optic) in order to establish performance standards that will improve all-weather conspicuity. Final implementation of this enhancement will not necessarily be limited to the evaluated technologies.

Accident Prevention Index: (To be completed by JIMDAT).

Total Resource Requirements:
Estimated at 4 Labor-years
Total Cost - $16,957,000

Completion Date: 48 months.

Output: Develop, evaluate and install taxi route and runway holding position markings, signs and lights to provide improved all-weather conspicuity of these visual aids.

Detailed Plan:

1) Develop improved runway holding position marking criteria.

- Resources: AAS-1 (LOOC), AAS-200, AAR-400, AND-500
- Timeframe: Completed
- Actions: Completed

2) Apply current runway holding position-marking criteria to taxiway centerline markings.

- Resources: AAS-1, AAS-200, AAR-400, and AND-500

- Timeframe: 24 months
- Actions: Amend AC 150/5340-1H

3) Develop design, performance and application criteria for fiber-optic technology fixed message signs.

Insert fiber-optic sign comparison graphic here

- Resources: AAS-1, AAS-200, AAR-400, AND-500
- Timeframe: 12 months
- Actions: Revise appropriate AC.

4) Install fiber-optic technology fixed message signs along SMGCS routings at airports conducting SMGCS operations.

- Resources: AAS-1, AAR-400, AAS-200, Affected Airports, Industry Producers & Contractors
- Timeframe: 48 months
- Actions: Install and initiate operational use.

5) Expand the LED research and development program to evaluate utilization of LED lighting to improve conspicuity of current taxiway edge lights, construction area lights and surface hazard boundary lighting.

Insert LED line graphics here

- Resources: AAS-1, AAS-200, AAR-400
- Timeframe: 24 months
- Actions: Expand evaluation of LED lighting for airside use and publish a technical report.

Performance Goals & Indicators for Safety Enhancement/Outputs:

- **Goal:** Install fiber-optic signs and LED taxiway lighting systems on SMGCS approved (approximately 75) airports.
  Indicator: Number of airports with LED and/or fiber-optic signs.

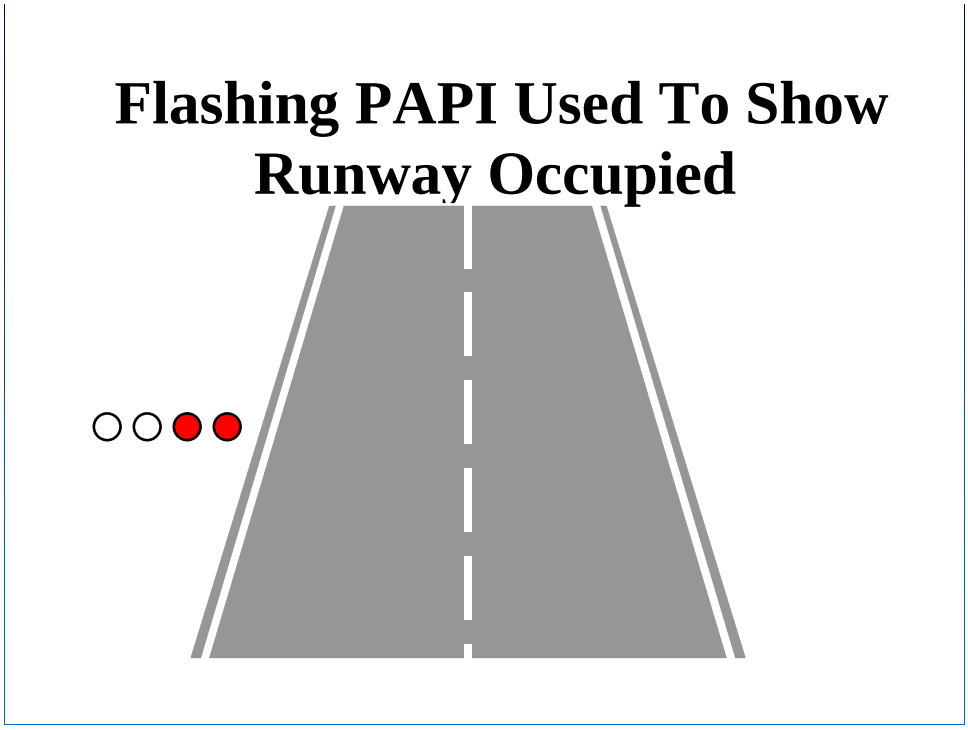
Safety Enhancement 3: (SE-44)
Visual signals will indicate runway occupancy to flight crews on final approach to that runway.

Accident Prevention Index: (To be completed by JIMDAT).

Total Resource Requirements:
Estimated at 5 Labor-years
Total Cost - $300,000 development, $60,000 per runway

Completion Date: 60 months.

Output: Develop, evaluate and install a visual signal to indicate runway occupancy to flight crews on final approach to that runway.



Detailed Plan:

1) Evaluate alternative visual signal solutions, including flashing PAPI.

- Resources: ATS-1 (LOOC), AAF-1, and AAS-200, AAR-400, AND-500
- Timeframe: 18 months
- Actions: Form project work group; conduct evaluation

2) Develop performance criteria.

- Resources: ATS-1, AAS-200, AAR-400, and AND-500
- Timeframe: 12 months
- Actions: Produce criteria document

3) Develop control criteria.

- Resources: ATS-1, AAS-200, AAR-400, and AND-500
- Timeframe: 12 months (concurrent with 2 above)
- Actions: Produce criteria document

4) Evaluate control and operational performance.

- Resources: ATS-1, AAS-200, AAR-400, AND-500, IES, and Industry Producers
- Timeframe: 6 months
- Actions: Install demo unit and complete evaluation

5) Determine appropriate locations and install operational units.

- Resources: ATS-1, AAS-200, AAR-400, AND-500, Affected Airports, and Industry Contractors
- Timeframe: 48 months
- Actions: Install operational units

Performance Goals & Indicators for Safety Enhancement/Outputs:

- **Goal:** Install a visual signal to indicate runway occupancy to flight crews on final approach at towered airports.
  Indicator: Number of runways with runway occupancy signals.

Safety Enhancement 4: (SE-45)
Smart lighting systems will indicate exact taxi routes and runway exists to landing and departing aircraft. Additionally these systems will monitor airfield traffic to prevent runway incursions and surface incidents as well as improve situational awareness.

Accident Prevention Index: (To be completed by JIMDAT).

Total Resource Requirements:
Estimated at 5 Labor-years
Total Cost - $900,100,000

Completion Date: 60 months.

Output: Develop, evaluate and install automated "Smart Lighting" systems to indicate taxi routes and runway exits for appropriate airports.

Detailed Plan:

1) Evaluate and validate the Smart Lighting system currently installed at Oslo, Norway with the intent to adopt system components for use to achieve the goal of this project.

- Resources: AAS-1 (LOOC), AAF-1, AAS-200, AAR-400, AND-500
- Timeframe: 9 months
- Actions: Form project work group; conduct evaluation

2) Upgrade the Smart Lighting system currently operational at Salt Lake City (SLC) to provide all capabilities present in the Oslo system.

- Resources: AAS-1, AAF-1, AAS-200, AAR-400, AND-500, Industy Providers & Contractors, SLC Airport Administration

- Timeframe: 36 months
- Actions: Upgrade system at Salt Lake City

3) Validate and publish system design and control criteria.

- Resources: AAS-1, AAF-1, AAS-200, AAR-400, AND-500, and Industry Providers
- Timeframe: 9 months
- Actions: Publish appropriate documents.

4) Install "Smart Lighting" systems at appropriate airports.

- Resources: APP-1, AIP/PFC funds, Industry Providers & Contractors
- Timeframe: 12 months
- Actions: Install systems at appropriate airports

Performance Goals & Indicators for Safety Enhancement/Outputs:

- **Goal:** Install smart lighting systems at approximately 60 airports with ground surveillance radar.
  Indicator: Number of airports with smart lighting systems

Relationship to Current Aviation Community Initiatives:

- Variable message signs have been utilized in other industries for a considerable time. Such signs have not been applied to airport movement areas at this time. Design and performance criteria must be developed for this application.

- Current sensing technology is employed for control purposes as follows: Loop sensing is employed at LGB, MCI & ORD; microwave sensing is employed at BOS, SEA& SLC. Control methods currently in use are computer or PLC activated using fiber-optic, power line carrier signal or hard wired technology.

- Variable message signs will replace mandatory signs currently in place.

- Revised AC 150/5340-1H was issued in January 2001. Markings are to be in compliance by 12/31/01.

- Taxiway centerline markings for SMGCS operations currently meet the criteria for runway holding position markings with the exception of a requirement for glass beads.

- FAA has scheduled R&D evaluation completion in May 2001.

- Optic-optic signs have been installed at test locations for in-service evaluation.

- The FAA Technical Center has conducted some evaluations of limited LED lighting applications.

- An operational "Smart Lighting" taxi guidance system is currently installed at Oslo, Norway. A similar, limited capability system is currently installed at Salt Lake City. A manually operated and monitored taxi guidance system utilizing sequential illumination of taxiway centerline light segments has been operational at London's Heathrow for almost 40 years and similar systems are installed at other United Kingdom airports.

- Link National Blueprint for Runway Safety to JSIT initiatives.

Project Schedule

Outputs	*Months* 6	12	18	24	30	36	42	48	54	60
Output 1. Variable Message Signs										
Develop design & performance criteria										
Validate design and performance										
Develop control criteria	Use existing ATCT lighting control systems									
Validate control performance										
Develop installation & maintenance criteria										
Install & implement										
Output 2. Taxi Route and Runway Holding Position Markings, Signs and Lights										
Develop improved runway hold position marking criteria	AC 150/5340-1H issued January, 2001									
Apply hold position marking criteria to taxiway centerline marking.										
Develop fiber-optic fixed message signs.										
Install fiber-optic signs at SMGCS locations										
LED technology for taxiway edge marking										
Output 3. Visual Signal to Indicate Runway Occupancy to Flight Crews on Final Approach										
Evaluate & validate a modified PAPI (pulsing) visual signal										
Development criteria for PAPI modification										
Develop control criteria										
Evaluate control and operational performance.										
Select locations and install										
Output 4. Develop and install taxi route smart lighting systems										
Evaluate and validate Oslo Norway smart lighting system										
Upgrade SLC system to applicable Oslo functionality										
Validate and publish system design and control criteria.										
Install smart lighting systems at appropriate airports										

Legend:

Planned

Tentative Plan

Jan 02

Completed
Underway

Programmatic Approach

Product Development

Each of the outputs requires validation that it will be compatible with the NAS and that they will effectively contribute to reduced runway incursions. Human performance factors evaluation will be an important part of the development process.

Implementation Strategy

Logistical constraints, whether funds are available or not, will prevent installation at all locations with a potential for runway incursions during the project time frame. Product availability, product knowledge and capital planning issues are some of the logistical factors that will limit rapid deployment to all applicable airports. Therefore, the project plan assumes a limited deployment of these technologies based on the following:

- Variable guidance sign installations are based on the number of runway entrances at commercial service runways at locations serviced by an airport traffic control tower (approximately 396 airports). Towered airports are the only locations capable of operating variable message guidance signs until automatic technology becomes available. Need for installation should be based on airport traffic density and risk of incursions.

- Fiber-optic fixed message sign installations are based on existing SMGCS locations. These locations have a need for increased conspicuity during poor visibility weather.
- Smart lighting system installations are based on locations that are expected to receive ground surveillance radar during the project timeframe. Smart lighting systems maximize the capability of the proposed ground surveillance radar system.

Specific benefits and costs will be evaluated as each safety enhancement is developed and the implementation strategy will be revised accordingly. In addition, regional Runway Incursion Action Teams (RIAT) will be employed to examine each location and determine whether enhancements are warranted and appropriate.

Organizational Strategy

The Runway Incursion JSIT identified Ken Jacobs (FAA AAS-100 202.267.8824) as the JSIT project lead for Visual Aids Enhancement and Automation Technology for Airports. The project lead will help coordinate the various FAA lines of business related to the project. Implementation of these four outputs will be through combined efforts of FAA, Airports and Industry.

Implementation Activities

In collaboration with industry FAA will evaluate and certify:

- Variable message signs for runway entrances (and other applications as needed).
- Improved conspicuity markings, signs and lights to be visible in all meteorological conditions.

In addition, development of "smart" electrical systems to indicate runway occupancy and taxi routing will be coordinated with industry. Once developed, these outputs will be installed at appropriate airports.

Key Products & Milestones:

Safety Enhancement 1: Variable Message Signs

- completion of in-service evaluation
- publication of appropriate AC
- initial operational installation of variable message signs
- all specified signs in operational use

Safety Enhancement 2: Taxi Route and Runway Holding Position Markings, Signs and Lights

a) Taxiway Markings

- completion of in-service evaluation
- publication of appropriate AC

b) Fiber-optic fixed message signs

- completion of in-service evaluation
- publication of appropriate technical report
- all specified signs in operational use

c) LED taxiway edge and construction area lighting.

- Continue and expand LED R&D program
- publication of appropriate technical report

Safety Enhancement 3: Visual Signal to Indicate Runway Occupancy to Flight Crews on Final Approach

- conduct in-service evaluation of alternative solutions (including flashing PAPI)
- develop installation/modification criteria
- develop control criteria
- publish specifications
- Install or modify units where appropriate.

Safety Enhancement 4: Automated "Smart Lighting" Systems to Indicate Taxi Routes and Runway Exits

- Evaluation and validation of Oslo smart lighting system.
- Upgrade SLC system to applicable Oslo functionality.
- Publish design and control criteria.
- Installations at appropriate airports.

Risk Description

Each project output has needs to be developed and validated for use in the US national system before implementation. The risks listed below are potential risks that may be encountered as the outputs are developed.

Technical:

- Unforeseen problems associated with interfacing newly developed systems with existing electrical infrastructure.
- Impact on and compatibility with existing equipment.
- Impact on airport capacity operations.
- Impact on control tower workload.

Cost:
Failure to secure adequate funding for development and implementation could develop as a risk factor. Failure to plan for and approve AIP and/or PFC funding for these projects will exacerbate funding problems. Implementation costs will be an economical burden for low end users (small airports).

Budget Estimate:

Output	FTE	Development	Unit	Quantity	Total
1	3/4 labor - year	$400,000	$6,000	11,000	$66,200,000
2a	1/2 labor - year	$200,000	$3,000	5,625	$16,957,000
2b			$40,000	1,200	$48,000,000
3	1 labor - year	$600,000	$60,000	Unknown	Unknown
4	3 labor - year	$200,000	$15,000,000	60	$900,100,000

2a = Fiber Optic Signs.
2b = Taxiway Centerline Markings.
4 = Includes installation of centerline lights.

Schedule:
Schedules may be delayed resulting from:

- failure to allocate adequate personnel (including their time) and funding
- unforeseen weather conditions during the installation phase
- unknown or undesignated installation locations

Risk Mitigation Plan

- Define specific airports for visual aid upgrades early in the implementation process.
- Estimate total program cost and include in fiscal year (FY) -03, -04, -05, and -06 budget requests for AIP and F&E.
- Begin capital improvement planning with airport sponsors and NAS implementation organizations.
- Obtain performance agreement with AAS, ATS, AAR, AND to ensure proper coordination and specific outcomes that support the overall project.

Impact on non-Part 121 or International Applications

Benefits could accrue to non-Part 121 airports and operations if these systems were installed. International operators are already deriving benefits from these airport visual aids.