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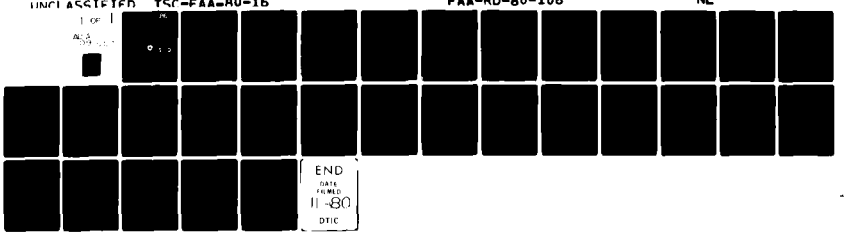

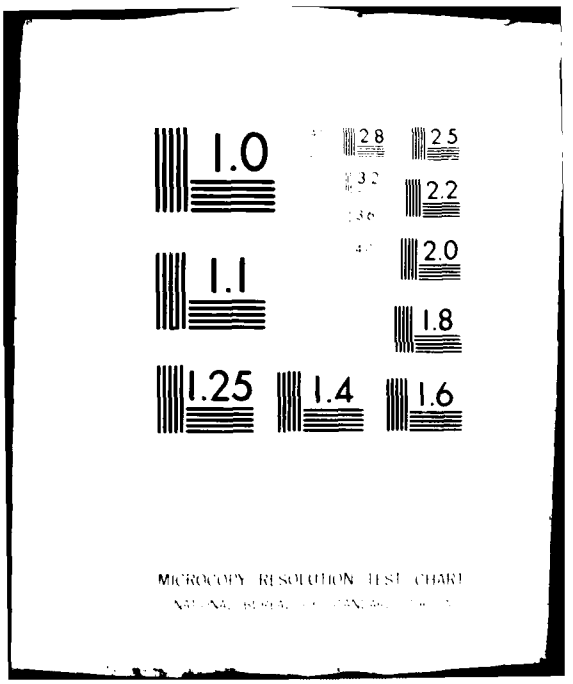
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(13) LEVEL II

REPORT NO. FAA-RD-80-108

VISUAL CONFIRMATION (VICON) OF VOICE TAKE-OFF CLEARANCE OF COST-AND-DEPLOYMENT ANALYSES AND STRATEGIES

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U.S. DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
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Cambridge MA 02142

SEPTEMBER 1980

FINAL REPORT

Prepared for

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16. Abstract

This report presents the final results of a program undertaken by the Transportation Systems Center (TSC), to study cost-and-deployment strategies of VICON installations over a four-year period.

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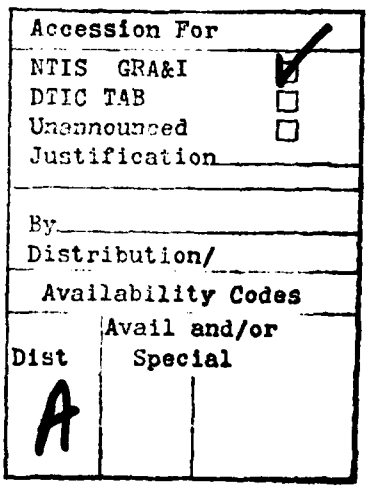
PREFACE

This VICON program which has been undertaken by the Transportation Systems Center for the Federal Aviation Administration's System Research and Development Service, will study cost and deployment strategies of installation over a four-year period. More data will be available after the completion of the VICON test at Bradley International Airport, Windsor Locks, CT, and will be issued subsequently.



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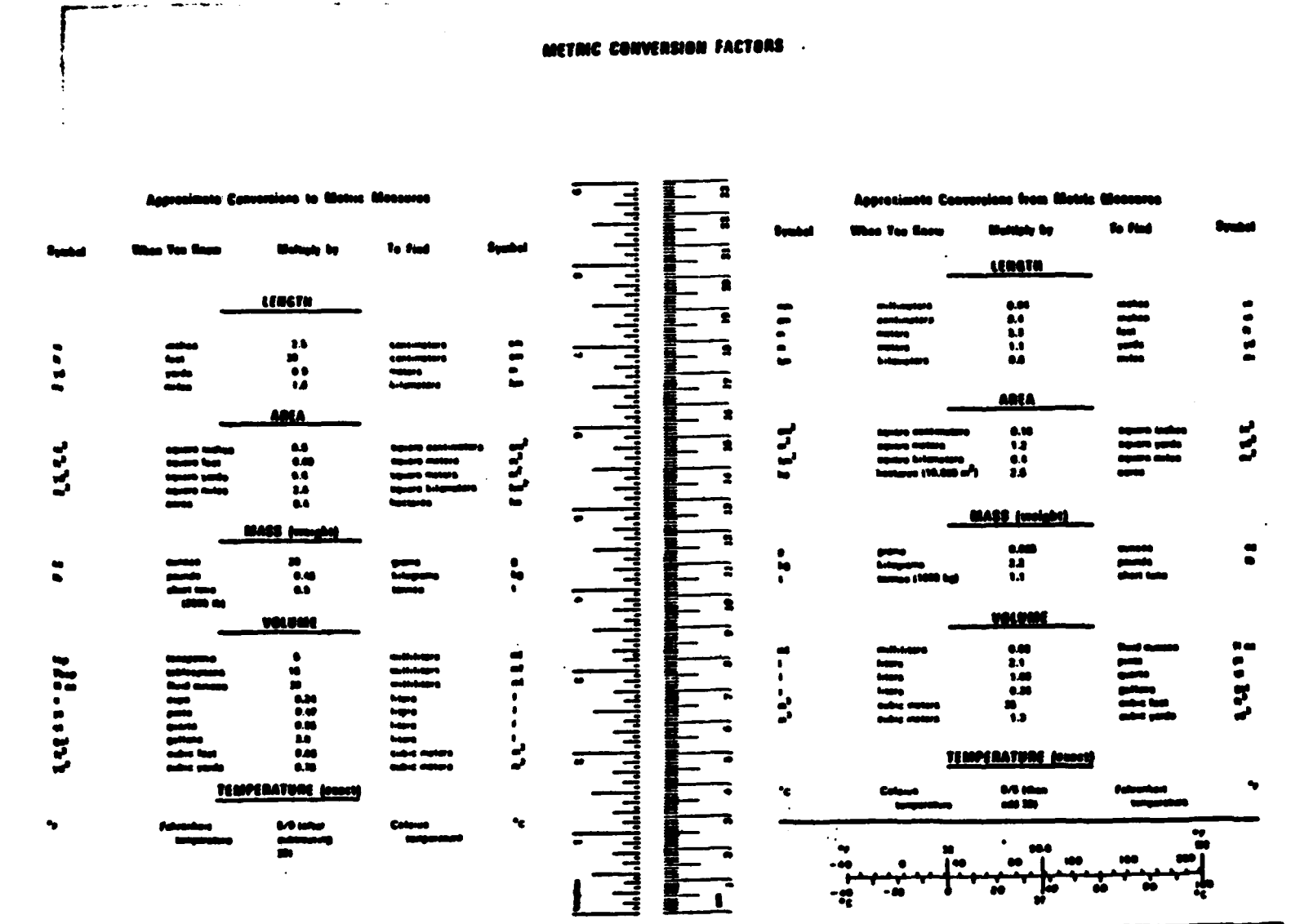

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

On March 27, 1977, one of the most tragic airport accidents in the history of aviation occurred on Tenerife Island, Spain, in which 583 people were killed. The cause of the accident was an unauthorized takeoff by a foreign-flag carrier. The FAA program to be discussed in this report addresses a safety system in which a visual signal is used to complement or verify the air traffic controller's verbal departure instructions, namely, VIsual CONfirmation of Voice Takeoff Clearance, and called VICON.

2. BACKGROUND

A two-phase development and evaluation program was devised to determine if visual signals, which are located adjacent to the departure points on the runway and activated by the tower controller, are operationally acceptable and technically feasible. Phase I conducted in 1978, at the National Aviation Facilities Experimental Center, Atlantic City NJ, (now known as the FAA Technical Center), was designed to provide preliminary system development and initial operational and technical testing; Phase II includes the procurement, installation, testing, and evaluation of a complete VICON system at the Bradley International Airport, Windsor Locks CT. The Phase II field appraisal commenced in October 1979, and was completed in March 1980. This field testing was conducted to evaluate the VICON principle and to provide pilot and controller response to the technique.

OBJECTIVE

The overall objective of this project is to evaluate the feasibility of a VICON system in an operational enviroment. There is the requirement to answer the follcwing questions:

a. Is the visual confirmation of a controller's voice instruction feasible?

b. Can VICON be integrated into the present ATC system?

c. If integrated, would it provide an added measure of safety?

d. What is the cost to deploy this system?

e. How should VICON be deployed among the towered airports (priorities)?

For the purpose of this report the answers to questions a, b, and c above are assumed to be affirmative. Only questions d and e will discussed here.

3. SYSTEM DESCRIPTION

In brief, the VICON system is a cluster of three green lights which flash when "on" and are located adjacent to the left side of the runway approximately 400 feet down the runway, in line with the runway edge lights. The light is installed at all takeoff locations on the airport. A system selector panel for activating the lights is located in the tower cab, at or near the local controller's operating position. These two components are connected by hardwire.

VICON is simply a departure clearance configuration system. The system exercises a second independent human stimulus (sight) to complement the verbal departure instruction. By itself, the display of the VICON light does not constitute a clearance for takeoff. The controllers verbal clearance remains a mandatory ATC requirement. The VICON signal only confirms the issuance of a verbal takeoff clearance. Compliance with VICON during the field tests at Bradley International will be on a voluntary basis. As part of the field trial and as a measure of pilot acceptance, takeoffs with a concurrent flashing green VICON confirmation signal from the appropriate light cluster will be supported and encouraged by various means of publicity, and indoctrination, and briefing.

4. APPROACH

It was determined that the best source of information was at the FAA Regional Offices. Each Region was visited by one of the two VICON Briefing Teams, composed of FAA/ARD and TSC (Transportation Systems Center) personnel during the month of May 1979. A summary of that briefing follows.

4.1 PURPOSE OF THE BRIEFING

In October 1980 a decision will be made whether or not to deploy the VICON system nationwide, and to aid in making that decision the following information is required:

a. Is the technique feasible?

b. Does it improve safety?

c. Can it be integrated into the present ATC system?

d. What would be the impact if the system was deployed?

Item d includes the cost impact to install the system nationwide. This data is best collected from the regions and integrated at Headquarters.

4.2 AIRPORT LAYOUTS

A layout of the taxiway runway system is requested from each towered airport. Each takeoff location used at the airport should be indicated. On the same airport layout indicate the number of local control positions which would need a selector panel.

4.3 REGIONAL COST ESTIMATE

Based on the airport layout charts, indicate the light cluster locations. Estimate the cost to provide power and control cables to each light cluster.

4.4 REGIONAL DEPLOYMENT STRATEGY

Recommend a strategy to install the VICON system for your region. Use the following constraints.

a. All takeoff locations will be instrumented.

b. All towered airports (present and future) will have a VICON system.

c. The system will be fully deployed in four years.

The strategy could be to install the system in the most active airport first and follow down the list or it could be a random selection of airports based on regional characteristics. Indicate your recommendation.

4.5 ATC INTERVIEW FORMAT

In addition to the cost information and the recommendation for a deployment strategy, additional data is needed. This data is not associated with deployment or its cost, but will be used in connection with a briefing given to the users of the system if it is decided to deploy VICON nationwide. It is requested that each towered airport be given an interview form to fill out and return to the region. Each region will send all the data to headquarters.

5. DATA REPORTED BY REGIONS

5.1 BACKGROUND

As requested, each region furnished a layout of the runway and taxiway system and indicated where VICON light clusters were needed at their towered airports. Each also reported on the number of local control positions that would require a selection panel.

5.2 FIELD INSTALLATION COST FACTORS

Field installation cost factors included engineering, overhead, site survey, site preparation, cable installation, trenching, grading and connecting all the light clusters to the control panel equipment. In addition each region was required to report any unusual costs peculiar to its individual airports. This was all accomplished by 30 July 1979 and forwarded to FAA Headquarters as directed.

5.3 ESTIMATED VICON TOTAL COSTS

Table 5-1 is a summary of the total costs by Region. The Washington Office costs included cable costs as well as all the VICON equipment.

TABLE 5-1. ESTIMATE OF VICON COSTS FY79

Region	Number of Airports	Regional Cost	Washington Office Cost	Total Cost
New England	23	$ 4,735,300	$ 1,799,060	$ 6,534,360
Eastern	52	9,708,500	4,747,110	14,465,610
Southern	83	13,041,500	6,014,720	19,056,220
Central	28	8,316,600	2,354,140	10,670,740
Southwest	59	10,979,000	4,523,870	15,502,870
Northwest	23	5,455,700	2,042,700	7,498,400
Rocky Mountain	21	4,913,500	1,854,860	6,768,360
Western	63	19,726,400	4,530,800	24,251,200
Great Lakes	68	10,539,820	5,947,470	16,487,290
Total	420	87,416,320	33,824,730	121,241,050

Note:

Washington Office Cost
Visual Light Clusters

7-10	units	$ 64,450
11-15	"	79,550
16-19	"	108,730
20-23	"	120,000
24-30	"	158,000
31-32	"	170,000
33-38	"	212,000
38-44	"	250,000

It might be well to point out at this time that equipment costs are based on NAFEC's estimate of what it cost them to procure or fabricate the equipment now installed at Bradley International Airport for the field test. If no major changes to the current equipment are made, equipment costs could be reduced by sole-source, bulk-buying. This possible saving could be off-set by inflation costs, since it is estimated to be a four-year installation effort commencing in FY82.

Table 5-2 is an estimate of inflation factors and costs for the procurement cycle. Since the 121.2 million for 1979 did not include all of the inflation costs, it was rounded out to 122 million. Based on recent econometric reports a 25% inflation factor was used for the years 1980-81. This increased the estimated cost to 152.5 million. Assuming incremental funding of 40 million for the first three years and 32.5 million for the fourth year, an estimated 10% inflation factor was added for each year. This increased the estimate to 189.2 million.

TABLE 5-2. BUDGET COST PLUS INFLATION FACTORS

1979 ESTIMATE $122,000,000

1980-1981 ESTIMATE (INCLUDES 25% IF) 152,500,000

BUDGET SCHEDULE	REVISED
1982 40M PLUS 10% IF	44.0
1983 44M PLUS 10% IF	48.4
1984 48.4M PLUS 10% IF	52.8
1985 40M PLUS 10% IF	44.0
Total	189.2

Another cost factor that must be considered is personnel resources at the Regional level. Airways Facilities Division personnel at each Region were quick to point out that a four year VICON installation program supervised by the Regions would utilize all of their engineering and installation resources for that period and curtail any other engineering and installation activity. The Northwest Region stated that it could cope with 3 installations per year. Since they have 23 towered airports, it would take eight years to complete the VICON requirement. If a decision is made to implement VICON, consideration should be given to a contractual turn-key type approach. This method could be more expensive.

Regional Air Traffic Services division personnel were strongly opposed to the VICON principle from both a personnel-resources as well as an operational viewpoint. They stated that the control and switching of the VICON lights would be distracting to the local controller(s) and that at busy terminals the requirement for additional controller authorizations would be necessary to assist the local controller in the performance of the VICON function.

In Section 4.5 ATC Interview Format, an additional requirement was imposed on all towered airports. At that time it was thought that the collected data would not be used for this report. However, the data collected indicated that 87% of the replies from the 420 towers supported the FAA Regions' position and were strongly opposed to the VICON principle and offered other solutions to the unauthorized takeoff problem. This resulted in Option 5 which will be discussed in Section 7, Strategy Options.

6. REGION DEPLOYMENT STRATEGY

Each Region was requested to recommend a priority listing of VICON installations and the rationale for their recommendations. Since the test at Bradley International Airport will not be completed until March 1980, and since some of the test findings and recommendations may have an influence on deployment, each plan or group of similar plans will be presented as options at this time. The final report will contain any data that provides additional options or support to these stated options.

6.1 EASTERN REGION

Priority Listing

1	Newark NJ	27	Allegheny PA
2	LaGuardia NY	28	Caldwell NJ
3	Washington DC	29	Wilmington DE
4	Philadelphia PA	30	Trenton NJ
5	New York, JFK, NY	31.	Newport News VA
6	Pittsburgh PA	32	Atlantic City NJ
7	Baltimore MD	33	Harrisburg PA
8	Rochester NY	34	Lancaster PA
9	Syracuse NY	35	Poughkeepsie NY
10	Chantilly VA	36	Reading PA
11	Norfolk VA	37	Wilkes-Barre PA
12	Buffalo NY	38	Elmira NY
13	Richmond VA	39	Williamsport PA
14	Albany NY	40	Erie PA
15	Charleston WV	41	Utica NY
16	Andrews MD	42	Huntington WV
17	Niagara Falls NY	43	Parkersburg WV
18	Middletown PA	44	Binghamton NY
19	Roanoke VA	45	Lynchburg VA
20	Allentown PA	46	Ithaca NY
21	Islip NY	47	Clarksburg WV
22	Farmingdale NY	48	Hagerstown MD
23	Teterboro NY	49	Charlottsville VA
24	Morristown NY	50	Morgantown WV
25	White Plains NY	51	Wheeling WV
26	North Philadelphia PA	52	Lewisburg WV

Although no rationale was presented it is obvious that the first priority was given to the busiest air-carrier airports followed in descending order by the busiest itinerant airport.

6.2 CENTRAL REGION

Priority Listing

Priority	Location	Remarks
1	St. Louis MO	
2	Kansas City (MCI) MO	
3	Omaha NE	
4	Kansas City (IMKC) MO	
5	Wichita KS	
6	Des Moines IA	
7	Lincoln NE	
8	Chesterfield MO	
9	Johnson County (Exec) KS	
10	Cedar Rapids IA	
11	Springfield MO	
12	Topeka (FOE) KS	
13	Salina KS	
14	Waterloo IA	
15	Sioux City IA	
16	Dansas City (Fairfax) KS	
17	Hutchinson KS	
18	Grand Island NE	
19	St. Joseph MO	
20	Topeka (TOP) KS	
21	Joplin MO	
22	Dubuque IA	
23	Cape Girardeau MO	
24	Columbia MO	
25	Jefferson City MO	Non-Fed ATCT
26	Ft. Leonard Wood MO	Non-Fed ATCT
27	Davenport IA	Non-Fed ATCT
28	Olathe (IND) KS	Non-Fed ATCT

Although no rationale was given, it looks as though they followed the same priority as the Eastern Regional.

6.3 NORTHWEST REGION

They recommended the following for installation within the Region:

a. A schedule that would require installation at preferably two but not to exceed three locations per year unless additional F&E personnel resources are made available for accomplishment.

b. Install first at airports with approved CAT III approaches, followed by:

c. Installation at airport with approved CAT II approaches, followed by:

d. Installation at all locations in priority order based on total airport operations until project completion.

6.4 WESTERN REGION

The following is the Western Region's rationale and priority order for installation. A team consisting of representatives from the Air Traffic Airway Facilities, Airports, and Flight Standards Divisions determined what the rationale for priority would be:

a. Start with airports which would not be too difficult to equip and where activity was not so heavy that operations would be adversely affected. These airports have air-carrier activity and crossing runway complexity. This initial group would be followed by similar air-carrier airports but without crossing runways. Palmdale is included in this group because of the carrier certification and training activity.

b. The next group consisted of busier air-carrier airports but without crossing runways. We assumed that by this time we would have gained sufficient experience in installing and utilizing the system and would be ready to install the system at busier locations.

c. The third group includes busy general aviation airports, some with crossing runways, listed in priority by activity.

d. The last group would be those where activity does not warrant a higher priority and should probably be subjected to a cost/benefit study before installation. Visalia is included in this group since we have sumbitted this location for an ATCT in the FY-81 budget.

Priority Listing

Group 1A	Not too busy Crossing Runways Air-Carrier Airports
Santa Barbara	
San Diego (Lindbergh)	
Reno	
Monterey	
Group 1B	Same as 1A except no crossing runways
Fresno (Air Terminal)	
Ontario	
Sacramento (Metro)	
Stockton	
Bakersfield	
Modesto	
Palm Springs	
Redding	
Palmdale	
Lake Tahoe	
Grand Canyon	
Flagstaff	
Group 2A	Busy, air-carrier, crossing runways
San Francisco	
Las Vegas	
Long Beach	
Burbank	
Tucson	

Priority Listing for Western Region (Continued)

Group 2B	Same as 2A except no crossing runways
Los Angeles	
Oakland (2 Towers)	
Santa Ana	
San Jose	
Phoenix	
Group 3A	Busy non-air-carrier airports
Van Nuys	
Torrance	
San Jose	
Reid-Hillview	
Concord	
San Diego (Montgomery)	
Hayward	
Deer Valley	
San Diego (Gillespie)	
San Carlos	
Fullerton	
Palo Alto	
San Diego (Brown)	
Carlsbad (Palomar)	
Santa Monica	
Scottsdale	
La Verne (Brackett)	
El Monte	
Sacramento (Exec.)	
Chino	
Oxnard	
Livermore	
Hawthorne	
Santa Rosa	
North Las Vegas	
Napa	
Group 3B	Others
Riverside	
Goodyear (Litchfield)	
Lancaster	
Salinas	
Merced	
Chico	
Santa Maria	
Fresno (Chandler)	
Marysville	
Imperial	
Visalia (Proposed ATCT)	

6.5 SOUTHWEST REGION

They recommended the VICON, if adopted, be first installed in lower activity towers and progress to the busier locations. They believe this deployment strategy would allow the bugs to be worked out of the system before being installed at the busier towers.

6.6 GREAT LAKES REGION

They recommended the VICON, if adopted, be first installed in lower activity towers and progress to the busier locations. They believe this deployment strategy would allow bugs to be worked out of the system before being installed at the busier towers.

6.7 NEW ENGLAND REGION

They recommended that first priority be given to airports with air-carrier operations in descending order and that overall operations count in descending order for all others.

6.8 ROCKY MOUNTAIN REGION

Enclosed is the list of airports in priority order for VICON implementation. The rationale in determining the priorities is based on runway complexity and air traffic volume at each airport.

Runway configuration complexity was considered with regard to availability of parallel taxiways, crossing runways when taxiing for takeoff or after landing, the need to taxi on the runway to get into position for takeoff, intersecting runways, and any unique surface arrangements that may be misleading or confusing to the pilot. Also considered was the possibility of using a taxiway for takeoff and the visibility of traffic from the tower cab, especially at locations that have mixture of large and small aircraft.

Traffic volume was considered with respect to the overall airport traffic and for the primary runway(s) at each location.

If the program is assigned and conducted in the priority shown, experience in engineering, procurement, implementation and operation will be gained at less active (but critical) locations before undertaking large, complex, and highly utilized locations. We anticipate that this will enhance the acceptance and utilization of the system while allowing us to take advantage of any cost-effective developments during early engineering efforts.

Priority Listing

Priority	Airport
1	Billings MT
2	Pueblo CO
3	Grand Forks ND
4	Ogden UT
5	Bismarck ND
6	Casper WY
7	Helena MT
8	Colorado Springs CO
9	Denver CO
10	Missoula MT
11	Great Falls MT
12	Fargo ND
13	Sioux Falls SD
14	Arapahoe CO

Priority Listing (Continued)

Priority	Airport
15	Broomfield CO
16	Cheyenne WY
17	Salt Lake City UT
18	Grand Junction CO
19	Rapid City SD
20	Minot ND
21	Aspen CO

6.9 SOUTHERN REGION

The Southern Region's rationale was based on total airport operations, starting with the busiest and down the line of 83 Airports to the least busy. Their priority listing is as follows.

Priority Listing

1. Atlanta GA (Hartsfield)
2. Miami FL (Opa-Locka)
3. Miami FL (Tamiami)
4. Miami FL (International)
5. Memphis TN
6. Fort Lauderdale FL (International)
7. Daytona Beach FL
8. Melbourne FL
9. West Palm Beach FL
10. Hollywood FL (North Perry)
11. Atlanta GA (Fulton County-Charlie Brown)
12. Atlanta GA (Peachtree-Dekalb)
13. Tampa FL
14. St. Petersburg FL (Clearwater)
15. Nashville TN
16. Charlotte NC
17. Vero Beach FL
18. Fort Lauderdale FL (Executive)
19. Asheville NC
20. Birmingham AL
21. Raleigh NC
22. Louisville KY (Bowman)
23. San Juan PR (Isla Verde)
24. Orlando FL (Herndon)
25. Greensboro NC
26. Pompano Beach FL
27. Sarasota FL
28. Charleston SC
29. Columbia SC
30. Panama City FL

Priority Listing (Continued)

31 Fort Meyers FL
32 Knoxville TN
33 Savannah GA
34 Louisville KY (Standiford)
35 Orlando FL (McCoy)
36 Jacksonville FL (International)
37 Covington OH (Greater Cincinnati)
38 San Juan PR (Isla Grande)
39 Greenville SC (Downtown)
40 Gainsville FL
41 St. Thomas VI
42 Lexington KY
43 Chattanooga TN
44 Mobile AL
45 Jacksonville FL (Craig)
46 Pensacola FL
47 Tri-City TN (Bristol)
48 Montgomery AL
49 Tallahassee FL
50 Albany GA
51 St. Petersburg FL (Albert Whitted)
52 Winston-Salem NC
53 Dothan AL
54 Jackson MS (Thompson)
55 Jackson MS (Hawkins)
56 Wilmington NC
57 St. Croix VI
58 Huntsville AL
59 Fayetteville NC
60 Augusta GA
61 Columbia GA
62 Gulfport MS
63 Key West FL
64 Tuscaloosa AL
65 Spartanburg SC
66 Florence SC
67 Knoxville TN (Downtown)
68 Myrtle Beach SC
69 Greenville MS
70 Owensboro KY
71 Athens GA
72 Grear SC
73 Macon GA
74 Meridian MS (Key)
75 Hickory NC
76 Valdosta GA

Priority Listing (Continued)

77 Kinston NC
78 Paducah KY
79 New Bern NC
80 Miami FL (Dade-Collier)
81 Ponce PR
82 Brunswick GA
83 Mayaguez PR

7. STRATEGY OPTIONS

Despite the strong opposition to the VICON principle by both the FAA Regions and the towered airports, the Regions did furnish priority listings that resulted in the following options:

Option 1 - Follow the Regions' recommendations and at the rate of 105 deployments per year, allocate to each region 25 percent of their towered airports.

Option 2 - Start with the lower activity airports as recommended by some Regions and work up to the busier airports.

Option 3 - Start with the highest activity airports and work down to the lowest.

Option 4 - Assuming that the test at Bradley International Airport is successful, deploy up and down from Bradley's ranking in overall operations. The FY78 Air Traffic Activity listed Bradley as ranking 181 out of 420 airports.

As stated in Section 4, each FAA tower was briefed on the VICON principle and requested to complete an Air Traffic Controller Interview form, Attachment I. No restriction was placed on the number of forms each tower could submit and many towers submitted more than one. However, the majority elected to submit a single composite report. A total of 545 responses were received from the 420 towers. Statistical information pertinent to this report is contained in Attachment 1.

A similar survey for pilots was performed and upon approval of the Office of Management and Budget (OMB), the pilot interview form, Attachment 2, was distributed to airline pilots in coordination with the Airline Pilots Association (ALPA), general aviation pilots in coordination with the Air Safety Foundation of the Aircraft Owners and Pilots Association (AOPA), the FAA pilots in the early fall of 1979. In addition, Air National Guard pilots at NAFEC and Bradley Field, Hartford, Connecticut were included in this survey since both groups participated in the operational testing of the VICON concept at Bradley Field. Pilot response was very limited - only 178 completed forms were received; 48 from air carrier pilots, 55 from GA pilots, 51 from FAA pilots, and 24 from military pilots. Statistical information pertinent to this report is contained in Attachment 2. Both FAA controllers and the pilots were opposed to the VICON principle. Both supported an aural confirmation of the takeoff clearance. 87% of the tower responders and 67% of the pilots were of the opinion that an aural confirmation was adequate.

Both controller and pilots attributed airport surface accidents/incidents to causes they felt could be corrected by education and enforcement. Controllers attributed the incidents to:

a. Low experience level pilots.

b. Misunderstanding of voice commands, inattention, unawareness.

c. Congested and/or rapid radio communications.

d. Airport configurations, lightning, marking, etc.

Pilots considered:

e. Rapid and congested communications as a prime causal factor and the inability at times to request clarification.

f. Misunderstanding of voice commands, inattention, unawareness in many instances and anticipating voice commands.

g. Locating and identifying runways and taxiways, especially at night.

h. Airport configuration, lightning, signs, marking, etc.

Based on the above an additional option is presented:

Option 5 - Do not deploy VICON but concentrate on eliminating the causes of unauthorized takeoffs and other airport surface blunders.

8. FINDINGS

a. The Users, FAA Controllers and pilots are opposed to the VICON principle. They believe that aural confirmation of takeoff is adequate.

b. FAA Airways Facilities personnel are opposed to the VICON principle since in a four year installation period, their engineering and installation personnel would be engaged in VICON work only and could not fulfill other requirements.

c. FAA regional personnel and FAA tower responders were of the opinion that the cost was prohibitive (189.2 million) for a system that only addressed a small portion of the airport surface problem.

d. FAA regional personnel, pilots and FAA air traffic controllers were of the opinion that a concentrated effort of education and enforcement and improvements in airport configurations would solve much of the airport surface, air traffic control problems.

9. RECOMMENDATIONS

Adopt Option 5, "Do not deploy VICON but concentrate on eliminating the causes of unauthorized takeoffs and other airport surface blunders" as a viable course of action.

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6. Yatsko, R.S., Mackenzie, F., Coonan, J.R., Preliminary Cost Estimate of a Visual Confirmation of Voice Takeoff Clearance (VTVC) Signal System Installation at Bradley International Airport. Material on file at DOT-TSC, prepared December 1977.

ATTACHMENT 1

AIR TRAFFIC CONTROLLER INTERVIEW

BACKGROUND DATA FOR THE VICON PROGRAM

INTRODUCTION

The results of this interview will support a government program concerning the problem of unauthorized takeoff at airports with an operating control tower. The information obtained will enable a Government Steering Group and a non-Government consulting group to identify common causes associated with this problem. Problem analysis will in turn provide background data for a Users' Briefing and a nationwide VICON deployment study. This data is not obtainable from any other known source. A similar interview is being directed to pilot experiences. Limit your response, insofar as possible, to the previous 3 year period.

1. How many times as a local controller have aircraft departed without your permission 2040 ?
How many times have you witnessed aircraft departing without a clearance 2058 ?
Were you able to identify the reason for these transgressions?
If so, explain Low experience level pilots. Misunderstanding of voice commands, inattention, unawareness. Congested and rapid radio communications. Airport configurations. .
How many times after given take-off clearance were:

   a. Takeoffs aborted due to another aircraft crossing the runway 395 ?
   b. Takeoffs aborted due to a vehicle crossing the runway 387 ?
   c. Takeoffs not aborted but another aircraft crossed the runway after takeoff was initiated 476 ?
   d. Takeoffs not aborted but a vehicle crossed the runway after takeoff was initiated 549 ?

2. Have you experienced difficulty with pilots complying with a taxi instruction to hold short of a runway due to a communication problem? Yes X No ___. If yes, how many times 2086 ?
What was the nature of the communication problem (s)?
Same as (1) above.

3. In your opinion, which of the following conditions should be considered as justification for the use of takeoff confirmation equipment/procedures. (Read through the entire list before responding. Note that if both a. and b. are checked, no additional conditions apply.)

   a. For all takeoffs where aircraft cross the departure runway NA*.

*NA = Not applicable to this report.

b. For all takeoffs where vehicles cross the departure runway NA.
c. For all takeoffs where aircraft cross the departure runway and any physical airport condition restricts pilot/controller view of the entire runway in use. NA.
d. For all takeoffs where vehicles cross the departure runway and any physical airport condition restricts pilot/controller view of the entire runway in use NA.
e. For all takeoffs at high-density traffic locations NA.
f. For any takeoff when IFR weather conditions exist NA.
g. (Other conditions - please state) NA

4. With regard to preventing inadvertent takeoffs, in your opinion which of the two techniques has the greatest potential?

a. Visual confirmation of the takeoff clearance using visual aids (lights or signs) as secondary stimuli.
70

b. Aural confirmation of the takeoff clearance requiring radio read back of aircraft and runway identification.
468

Would you please indicate the reason(s) for your selection.

NA

Would your selection be different if you were asked to consider the technique for just the ten busiest airports?
Yes NA No NA

5. Please indicate below, aspects of the current operation that need improvement (or safeguards) listing these in the order of priority (1 for 1st priority, 2 for 2nd priority, etc.) insofar as possible. (Enter a zero if item not a problem).

	RANK
Aircraft exiting runways promptly.	3
Pilot delay in reporting clear of runways.	4
Pilots crossing runways without being instructed to cross	5
Pilots initiating takeoff without being cleared.	6
Rapid communications during high-density traffic periods.	2
Misunderstanding of voice commands.	1
Other (Please state and rank)	

6. Considering the above problems, based upon your experience, list the airports which you have worked at with an indication of the major problem at the airports listed.

   1. Airport name: NA
      Problem: _____

   2. Airport name: _____
      Problem: _____

   3. Airport name: _____
      Problem: _____

7. Additional comments concerning any of the above items or any other related matters. (Use reverse side if additional space is needed).

   NA

_____ _____

Ratings held (Signature Optional)

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ATTACHMENT 2

PILOT INTERVIEW

TAKEOFF CONFIRMATION PROGRAM

INTRODUCTION

The takeoff accident at Tenerife March 27, 1977, which resulted in some 580 deaths, has highlighted the need for efforts to be made to prevent a recurrence of this most tragic accident. Since pilots and air traffic controllers are the people most directly concerned, your help is being sought to provide a firm basis of practical experience on which to base the solution to the problem. The results of this questionnaire will support programs to prevent inadvertent (unauthorized) takeoffs at airports with operating control towers. Please do not consider any incidents which occurred more than three years ago.

"This report is authorized by Section 311 of the Federal Aviation Act of 1958, as amended, while you are not required to respond, your cooperation is needed to make the results of this survey comprehensive, accurate and timely. Information collected in this survey will be used for background purposes only and not to disclose individual identity."

1. How many times have you been involved in, or observed another aircraft conduct an inadvertent takeoff? 130 (Enter a zero if none and continue on to Question 2.) If you were aware of the cause(s), please explain Rapid and congested communications. Misunderstanding of voice commands. Locating and identifying runways and taxiways.

With regard to inadvertent takeoffs, how many times after takeoff was initiated were:

a. Takeoffs aborted due to another aircraft on the runway 34 ?
b. Takeoffs aborted due to a vehicle on the runway 15 ?
c. Takeoffs aborted due to intervention by local control 68 ?
d. Takeoffs not aborted but another aircraft or vehicle was on the runway after initiation of takeoff roll.
Aircraft 35 Vehicle 9 ?

1 April 1980
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2. Have you experienced difficulty, or observed other pilots experiencing difficulty, in understanding an instruction to "hold short of a runway" or "taxi into position and hold" due to a radio communication problem? Yes X No 56. If yes, how many times 547 ? What was the nature of the radio communication problem(s)? Same as (1) above.

Did the problem result in an inadvertent takeoff? Yes - 24
No - 71

3. In your opinion, which of the following conditions should be considered as justification for the use of takeoff confirmation equipment/procedures. (Read through the entire list before responding. Note that if both a. and c. are checked, no additional conditions apply.)

   a. For all takeoffs where aircraft cross the departure runway NA*.
   b. For all takeoffs where aircraft cross the departure runway and any physical airport condition restricts pilot/controller view of the entire runway in use NA.
   c. For all takeoffs where vehicles cross the departure runway NA.
   d. For all takeoffs where vehicles cross the departure runway and any physical airport condition restricts pilot/controller view of the entire runway in use NA.
   e. For all takeoffs at high-density traffic locations NA.
   f. For any takeoff when IFR weather conditions exist NA.
   g. (Other conditions - please state) NA

4. With regard to preventing inadvertent takeoffs, in your opinion which of the two techniques has the greatest potential?

   a. Visual confirmation of the takeoff clearance using visual aids (lights or signs) as secondary stimulas. 67
   b. Aural confirmation of the takeoff clearance requiring radio read back of aircraft and runway identification. 99

   Would you please indicate the reason(s) for your selection.

   Would your selection be different if you were asked to consider the technique for just the ten busiest airports? Yes 13 No 149.

1 April 1980
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*NA = Not Applicable to this report.

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5. Please indicate below aspects of the current operation that require improvement, listing these in the order of priority (1 for 1st priority, 2 for 2nd priority, etc.) insofar as possible. (Enter a zero if item not a problem).

a. Locating and identifying runways. 3.
b. Difficulty in knowing if your aircraft is clear of the runway. 7.
c. Pilots crossing runways without authorization. 5
d. Pilots initiating inadvertent takeoffs. 6.
e. Communication problem with pilots from non-English speaking nations. 4.
f. Rapid communications during high-density traffic periods. 1.
g. Misunderstanding of voice commands. 2.
h. Other (Please state and rank). ____.

6. Considering the above problems, based upon your experience, list the airports which you have an indication of the major problem at the airports selected?

1. Airport name: NA Problem _____.

2. Airport name: _____ Problem _____.

3. Airport name: _____ Problem _____.

7. Place additional comments concerning any of the above items or other related matters in the space below and on reverse side, if necessary.

8. "What pilot certificate(s) do you hold?

a. Private_____
b. Commercial_____
c. Airline Transport_____
d. Military_____

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