PULSE LIGHT APPROACH SLOPE INDICATOR TEST

Final Report

by

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PREFACE

The Alaska Department of Transportation & Public Facilities and predecessor agencies involved in providing air transportation facilities (the Division of Aviation of the Department of Public Works, 1959-1977; and the Alaska Department of Aviation, prior to 1959) engaged primarily in establishing basic airport facilities. Little research was undertaken, for various reasons. For example, by far the majority of the work was conventional "dirt work" requiring little innovation, and budgeting constraints seldom allowed for experimentation.

This project, therefore, represents a relatively new venture. Not only is it disassociated with a specific airport's development, but it involves the field of landing aids rather than basic airport construction. Aside from airport marking and lighting, the State (and Territory, earlier) generally has left all work concerning navigational and landing aids to the federal government, normally the Federal Aviation Administration. Chapter 50 of the 1980 Session Laws of Alaska represented a major move into the realm of such aids. To an extent, this PLASI project might be considered motivated by Chapter 50; but it is equally associated with increased financial resources and an interest in providing improved facilities for the efficiency, convenience, and safety of the travelling public.

Neither the actual undertaking of the project itself nor the findings which are reported herein represent a policy commitment on the part of the State of Alaska to deepen its involvement in navigational and/or landing aids, or to endorse or criticize a particular manufacturer's product. However, the project did reveal considerable information about landing aids. The unanticipated revelations generally concern such matters as the philosophies underlying the installation of landing aids, and the recognition of commonly accepted -- but probably here-to-fore unrecorded -- pilot reactions. This information is of considerable value of itself; it might have gone unnoticed except for the fact that the author had little previous direct experience with the selection and installation of landing aids, and the lack of ingrained methods or preconceived solutions resulted in his having to analyze and answer a number of questions as the project developed. Thus, it is hoped that this report may be of interest and benefit to private industry as well as other local governmental units as it presents new views of a topic previously addressed almost solely by the federal government.

The report has been prepared by the Central Region Division of Planning & Programming, William R. Snell, Director, in Anchorage, through the auspices of the Research Section, Larry Sweet, Research Manager in Fairbanks.

ACKNOWLEDGEMENTS

Special appreciation goes to the DeVore Corporation of Albuquerque, New Mexico; especially to Mr. Gilbert DeVore, President, and Mr. Frank McHugh, PLASI Program Manager, for the loan of equipment, encouragement for its testing, and continued helpfulness throughout the project. Their constant support, and their immediate response to the 'real world' Bethel situation which led to Part Two of the report, were invaluable. Thanks are also due Mr. Bill Mitchell of the Anchorage International Airport Field Maintenance Staff and his crew, Mr. Larry Gulley and Mr. Don Dewoody, who handled the original Anchorage test installation with dispatch, and were responsible for the day-to-day monitoring of the unit while it was in operation there.

The test would not have been possible without the volunteer participation of those pilots who not only 'flew' the PLASI, but who took the time to complete and return the questionnaire. They are too numerous to recognize individually, and many were anonymous, but they are representative of the cadre of Alaskan pilots who are devoted to new developments which will enhance air travel.

Also worthy of recognition are the Federal Aviation Administration personnel, especially those in the Alaskan Region who expressed interest in the PLASI, and those in the national offices who supplied various background data. And, this page would not be complete without expressing thanks to William R. (Riley) Snell, the author's immediate supervisor for the project in Anchorage, and Ron Miller, who represented the Research Section in Fairbanks, for their understanding support and patience throughout the project.

James E. Moody, P.E.
Project Manager

FOREWORD

The PLASI test or Alaskan evaluation was established on a runway at the Anchorage International Airport for the summer of 1981. After the field program had been completed and the test unit had been returned to the manufacturer, and while the report was being written, a critical situation developed at the Bethel Airport which led to the temporary installation of a PLASI there. The threshold of one runway had to be displaced about 1500', and the PLASI was installed for use in designating a new glide path and touchdown point.

The Anchorage test had produced data and valuable experience relative to visual landing aids, but little of an exceptionally positive nature concerning the PLASI itself had been noted. The unexpected practical application in Bethel, on the other hand, may have lacked some of the "research" quality of the earlier test, but it dramatically illustrated both the speed in which the PLASI can be installed and its true benefit under operational conditions. It was obvious that the report should be expanded to cite these results as they partially arose from the original test and gave direction to the future application of PLASIs and other visual glide slopes.

The dissimilarity under which the two installations operated and the partial completion of the report describing the Anchorage test resulted in this final report being presented in two parts. Part One covers the original test, while Part Two records the Bethel situation. The overall conclusion is that there are definitely conditions under which the PLASI is a completely satisfactory, economical, and versatile visual approach guide. This report may serve as a primer for the inexperienced airport operator who is considering the installation of visual landing aids.

P A R T   O N E

ANCHORAGE TEST

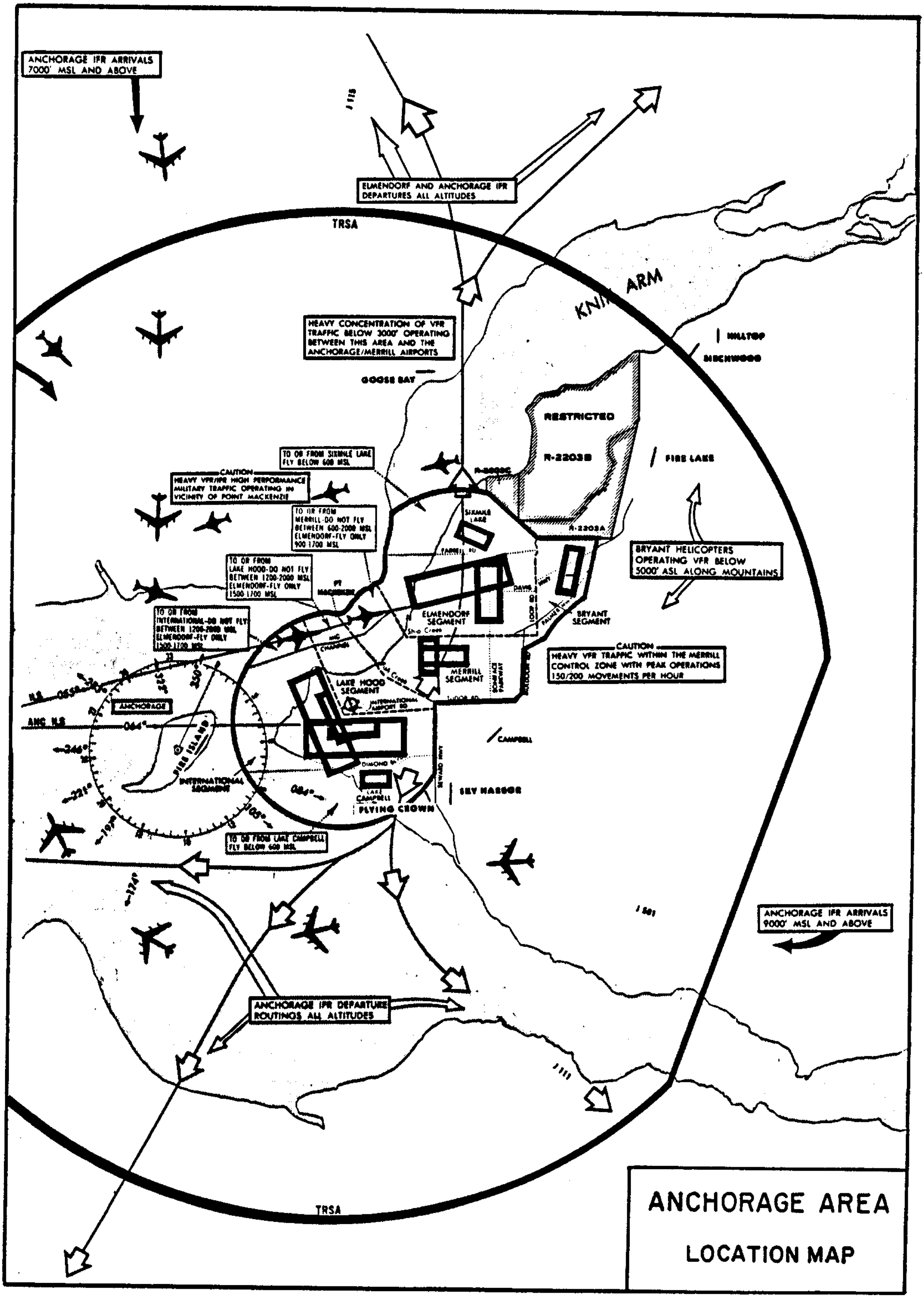
INTRODUCTION

At the time of the February, 1981, Alaska Air Carriers Association meeting in Anchorage, an exhibitor - the DeVore Aviation Corporation of Albuquerque, New Mexico - invited Deputy Commissioner for Maintenance & Operations Patrick P. Ryan to investigate the usefulness of a particular type of visual approach slope indicator under actual working conditions at some Alaskan airport. The invitation was accepted and President Gilbert DeVore of the Corporation left the exhibition unit with his local sales representative while the Department made the necessary pre-installation arrangements. Subsequently the unit was installed on Runway 13 at Anchorage International - the so-called "general aviation runway" or "Lake Hood strip." Personnel from the Alaskan Region of Federal Aviation Administration were invited to inspect the installation and monitor its operation, which ran between April 30 and August 30, 1981. Pilot reaction was sought through the distribution of a questionnaire. Personnel from the airport maintenance staff assisted in the actual installation, monitored the unit's operation, and handled its disassembly and shipment back to the manufacturer.

The manufacturer identifies the unit as a "Pulse Light Approach Slope Indicator", or "PLASI". (When originally submitted to the FAA and Transports Canada for testing, it was identified as a "Pulse Coded Optical Landing Aid", or "PCOLA".) As in the case with other visual slope indicators used at airports, a white light indicates an on-course or above-course position, while a red light indicates a below course or hazardous position. Other types of slope indicators emit or project steady or uninterrupted light beams, from one, two, or more fixtures. The DeVore "PLASI" differs from such units in that its single source light beams pulsate, or are interrupted by moving shutters. Wherein the light patterns produced by other slope indicators merely tell the pilot he is below course, on course, or above course, the pulsating PLASI signals of varying durations indicate to an experienced pilot his position relative to the desired course. As in the case of other single source slope indicators, the PLASI provides reference for one specific touchdown position; in contrast, the multi-source units commonly installed by the Federal Aviation Administration delineate a touchdown area anywhere from 250 feet to 2,000 feet long. (See Appendix B, exhibits 6, 7, and 8.)

PURPOSE

The manufacturer's invitation was accepted with several goals in mind. The experimental installation would expose the new equipment to the Alaskan public, allowing the Department to measure pilot reaction. Secondly, a report on airport lighting subsequent to the enactment of Chapter 50, SLA 1980, recommended the installation of visual approach slope indicators at ten airports, and it was theorized that considerable cost savings might be achieved through the installation of the PLASI unit in lieu of the FAA's conventional VASI system. Moreover, perhaps the most important consideration was the fact that the FAA had not yet sanctioned PLASI installations as eligible for funding under the Airport and Airway Development Act of 1970. While FAA had indicated the suitability of PLASI units for providing visual approach information to helicopter pilots, such approval with equipment specifications had not yet been granted for airplane (fixed wing aircraft) applications. It was thought that by providing an actual test or demonstration project readily available to personnel in FAA's Alaskan Region, there would be a greater chance of expediting overall FAA decisions such that the federal agency itself might elect to program several of the less costly PLASI installations through its established program for providing landing aids, and might also be prepared to approve the use of ADAP funds if such were requested by airport owners sponsoring projects beyond the FAA's routine program.


ANCHORAGE IFR ARRIVALS 7000' MSL AND ABOVE
ELMENDORF AND ANCHORAGE IFR DEPARTURES ALL ALTITUDES
TRSA
KNIK ARM
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GOOSE BAY
RESTRICTED
R-2203B
R-2203A
FIRE LAKE
TO OR FROM SIXMILE LAKE FLY BELOW 600 MSL
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BRYANT HELICOPTERS OPERATING VFR BELOW 5000' ASL ALONG MOUNTAINS
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ANCHORAGE
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CAMPBELL
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TO OR FROM LAKE CAMPBELL FLY BELOW 600 MSL
ANCHORAGE IFR ARRIVALS 9000' MSL AND ABOVE
ANCHORAGE IFR DEPARTURE ROUTINGS ALL ALTITUDES
TRSA
ANCHORAGE AREA
LOCATION MAP

BACKGROUND

Prior to the aforementioned enactment of Chapter 50, SLA 1980, State policy with respect to airport development precluded installing landing aids such as visual approach slope indicators. The FAA has the prime responsibility for installing and operating both navigational and landing aids such as instrument landing systems, including all their electronic and visual components. Chapter 50, however, interjected considerable State financing in the overall field of air transportation in order to expedite the installation of various facilities. The analysis of the airport lighting portion of the Chapter 50 appropriations, as mentioned previously, recommended the installation of visual approach slope indicators at a few select sites where FAA installations had not been programmed.

A number of visual approach slope indicator installations had been made at various State airports. Most of these had been installed by the FAA, but some such as on Runway 24R at Anchorage International had been installed by air carriers. Thus, while DOT/PF personnel had general information concerning VASI installations, they had not actually been involved in the technical details of either the installations or their operation.

FUNDING

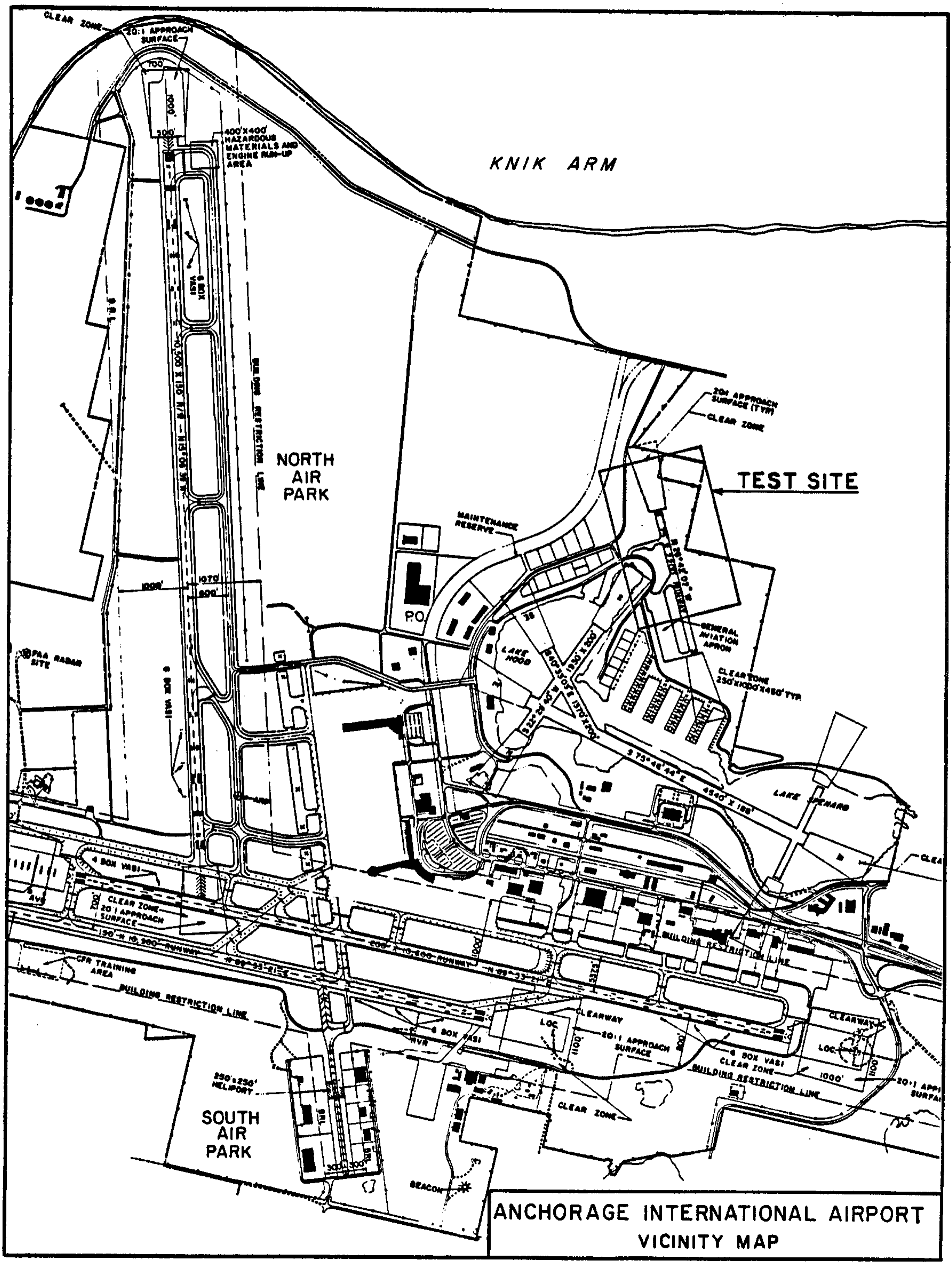
In order to translate the opportunity afforded by Mr. DeVore's offer into working reality, a project was established within the Research Program. Designated as a New Products Testing Project, No. F15891, it had a $10,000 allocation. The initial collocation code was 25-95-5-117, which as of July 10, 1981, was changed to 24-80-6-617. Initial unknowns such as where the test might be conducted precluded a refined estimate on what turned out to be a low cost project. Expenses would have been markedly higher had the test been conducted at a more remote airport. Although the total cost will not be known until this report has been published and distributed, it will likely be less than $4,000. The difference between that amount and the allocation is neither an error on the part of the initial allocation nor an under-expenditure, but rather the natural outgrowth of a number of very favorable circumstances, starting with the site selection. Therefore, the costs encountered on this project should not be used as a pattern for similar future research projects.

INSTALLATION

There were several phases in the installation work, including the overall airport and specific runway selection, positioning and aiming the unit, accomplishing the physical work, and ultimately the flight check.

Mr. DeVore provided the equipment with 'no strings attached' for a test period of up to 90 days (initially), thereby giving DOT/PF considerable latitude in deciding where to conduct the test, and what factors to examine. A number of alternatives were considered relative to the site identification. Some included size of airport or runway (serving light aircraft only, or serving both heavy and light aircraft), location (rural village versus larger urban city), and climatic or other regional variables. Since the test period would encompass spring and early summer weather, and since cold weather testing had reportedly been accomplished, it was decided to exclude snow or weather conditions as major factors in the site selection. It was also decided there would be no advantage to collocating the unit with a 'conventional' VASI.

Central Region Planning & Programming received project administration responsibilities. While this did not confine the selection of a site to that particular region, there were obvious advantages in keeping the project close at hand. Because of the availability of the lighting report, consideration was given to each of the ten sites proposed for VASI installations therein. It was decided that exposure to a large number of pilots was highly desirable, and that the site should be readily available to personnel from FAA's regional headquarters offices in Anchorage. In anticipation that any installations would be made at smaller airports serving primarily light aircraft (under 12,500 pounds gross weight), trunk and larger airports serving heavy aircraft were excluded. The availability of experienced maintenance personnel on a 24 hour basis was also considered an advantage. Ultimately all rural airports were



ANCHORAGE INTERNATIONAL AIRPORT
VICINITY MAP

eliminated from consideration, and the final choice was between Runway 01R/19L at Fairbanks International, a runway at municipally owned Merrill Field in Anchorage, and 13/31 at Anchorage International. The latter was selected because it approximated a rural runway, had good exposure to a large number of pilots, and otherwise satisfied the various criteria.

The choice between making the installation on runway 13 versus 31 was straightforward. Because of conflicts with the seaplane and 06/24 traffic, most of this strip's traffic makes approaches to 13 and departures on 31. Moreover, the relatively tight right hand pattern for runway 31 with its short final leg to avoid conflicts with seaplane traffic would preclude any meaningful exposure to the pulsating glide slope.

The aspects of the installation requiring the most attention were selecting the angle of the approach path and the touchdown point, both of which were directly involved in determining where and how the equipment would be set up. Readily available reference material provided information only on the positioning of 'conventional' multisource visual glide slope indicators. Most of this information was in the form of FAA Advisory Circulars covering that agency's typical installations. It became apparent that such installations differ considerably in several respects from the type contemplated by the State.

The typical FAA installation consists of one or more light fixtures installed at either two or three positions along a runway. (See Appendix B, exhibits 6, 7, and 8.) Each light source emits a red and a white beam (or a red and white split beam) with the former beneath the latter. That is, the red beam has less of a vertical angle than the white beam and generally alerts the observing pilot to a hazard or danger. The concept is universal to visual approach slope indicator systems; an all-red signal indicates that the pilot is too low and may intersect natural or man-made objects beneath the recommended glide path, or land short of the runway. An all-white light beam signals the pilot that he is on or above the glide path, and hence should be free of any obstacles.

The concept behind the typical FAA approved multisource VASI is to better distinguish between a recommended obstruction-free glide path and one which is too high. (The latter would lead to a landing further down the runway, and conceivably lead to overruns.) In making an approach, the pilot is advised to be high enough such that he sees the white or higher portion of the beam from the near or closest unit, and the red or lower portion of the beam from the next unit down the runway. Maintaining such a relative position will lead to a touchdown between the two light units. (Systems incorporating the third unit or set of light sources are intended for runways accommodating the largest aircraft such as the Boeing 747, Lockheed 1011, and McDonnell Douglas DC-10, wherein the cockpit -- viewing -- position is so high above the nose wheel that following the glide slope indicated by the two-unit system could result in a short landing. This second glide path -- using the white or top beam from the second unit and the red or lower beam from the third unit -- provides appropriate guidance for pilots of such large aircraft.)

FAA installations are programmed on the basis of traffic levels or number of landings, and are most commonly located on runways serving heavy aircraft (over 60,000 pounds gross weight) providing commercial or airline service. The runway lengths involved are normally well in excess of those required for a smooth, comfortable landing, and the entire nature of the operation is such that it is not necessary to define a precise touchdown point. Thus, the so-called "conventional" multi-source VASI identifies a touchdown zone that may vary from two hundred fifty feet long to two thousand feet long.

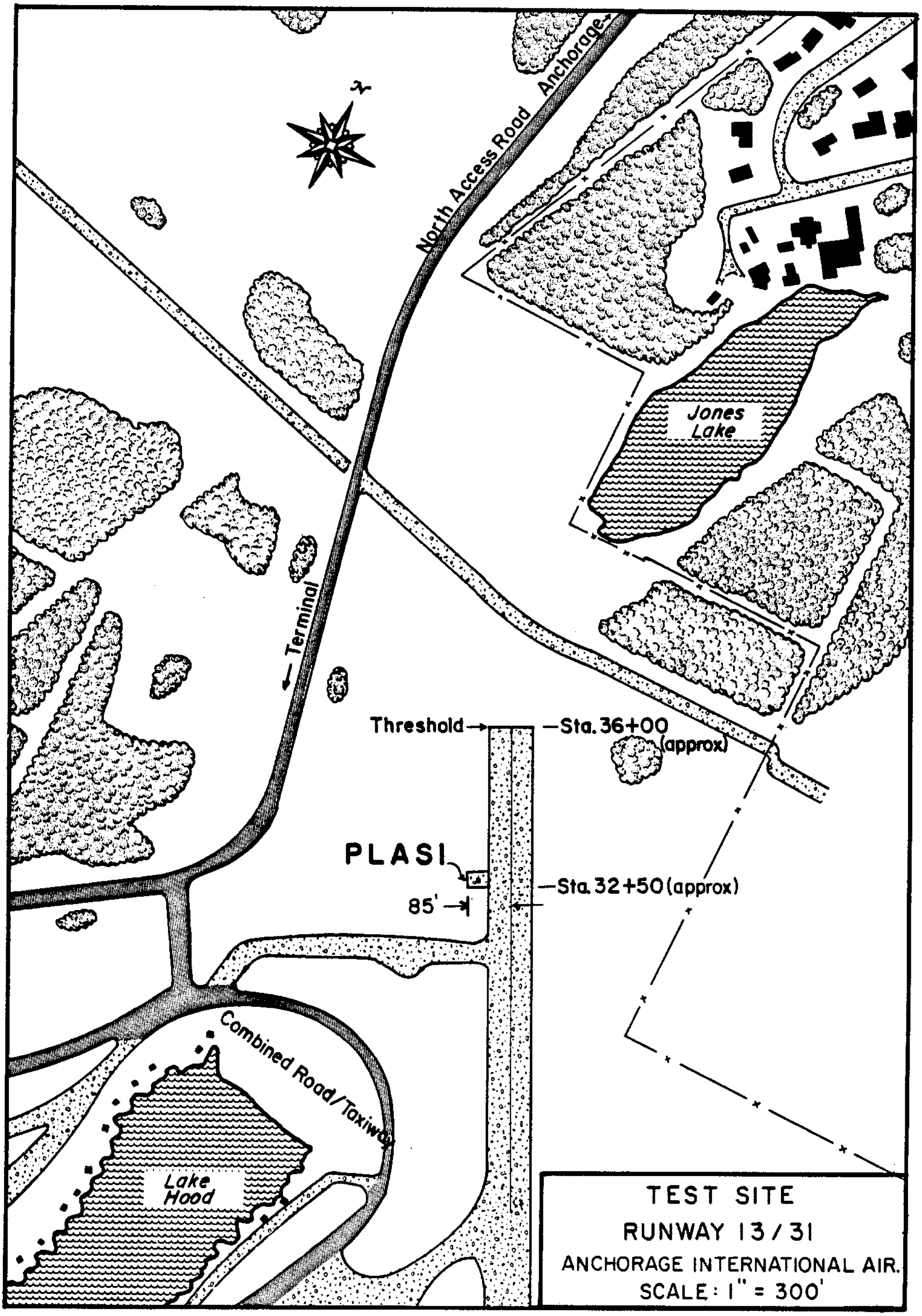
The PLASI "Operating and Installation Manual" (pages 3-5) provided by the manufacturer is also geared to installations serving heavy aircraft. (See also Appendix B, exhibits 2 and 3.) Neither FAA's

Advisory Circulars nor the DeVore Manual provide more than a passing reference to installations on "utility" airports. (FAA Advisory Circular 150/5300-4B defines "utility airport" as "An airport that is constructed for aircraft of 12,500 pounds (5,670 kg) maximum gross weight and less." Chapter 1, paragraph 3(r), page 2-2, of the 12/5/78 edition.)

It had been established in initiating the program that a goal was to determine the usefulness of the PLASI guidance on a shorter runway where the FAA might not otherwise program a VASI installation for many years, and/or where someone other than the FAA may elect to make an installation. The type of runway in question might be described as typically having a length of about 2,500' or even less, and a gravel surface. The airport or runway would have few amenities, and would be a basic transportation facility serving commercial, business, and personal traffic, exclusive of any significant pilot training. Obviously the conventional multisource VASI system delineating a touchdown zone several hundred feet long, and starting over one hundred feet from the threshold, is generally unsatisfactory for such a short runway. Similarly, the PLASI information manual provided little guidance for installations serving this type of light aircraft/short runway operation.

The unsuitability of available siting guidance material and absence of guidelines for positioning single-source approach slope indicators made it necessary to develop criteria independently.

The positioning of the "design" touchdown point on any runway is controlled by factors such as the position of objects limiting the minimum glide slope, the desired glide slope for the 'design' aircraft, the desired threshold crossing height, intended margin of safety for undershooting the runway, aircraft stopping distance (influenced variably by wind conditions, surface conditions, runway gradient, aircraft loading, pilot techniques, etc.), runway length available, and the location of exit points or taxiways to aircraft



TEST SITE
RUNWAY 13/31
ANCHORAGE INTERNATIONAL AIR.
SCALE: 1" = 300'

servicing areas. Another factor which the author recommends be addressed, although it will not be a consideration at the majority of airports, is airspace utilization -- e.g., the existence of flight patterns for other runways, either formally established or identifiable from common practice.

A review of the airport plans failed to disclose any profile, existing as-built clearing, or other plans relative to the height of objects under the approach/departure path, so the author conducted a rudimentary triangulation survey to obtain that information. Controlling features were found to be a stand of trees having tops approximately 40 to 60 feet above runway elevation, roughly 900' from the threshold.

In the author's opinion the touchdown point should be a minimum of 200 feet from the threshold, to allow a margin of safety in cases where the pilot undershoots the glide slope and/or encounters downdrafts or other turbulence. Calculations indicated that if this PLASI were to be aimed to provide 1.2 degrees clearance over the controlling objects, the glide path would have a slope slightly greater than 4.4 degrees when the unit was positioned 200 feet from the threshold. That slope was considered too steep, indicating the unit should be positioned farther down the runway. A complicating factor was that a new taxiway had been established permitting aircraft to exit the runway about 500 feet from the threshold. It was thought that pilots operating aircraft based at the limited apron adjacent to the strip would not be materially influenced by the position of the PLASI, but those based elsewhere on the airport would have a strong inclination to land as close to the threshold as they could in order to use the new exit, which eliminated considerable taxiing distance -- including a long curve with a relatively short sight distance on the joint road/taxiway around the north end of Lake Hood.

The available reference material generally indicates that an approach slope of 3 degrees is desirable, but mentions slopes of up to 4 degrees. From observations and the author's experience (both primarily limited to Alaskan situations) light aircraft pilots tend to make relatively steep -- say 3 degrees to 4 degrees -- approaches to Alaskan strips. (That is a broad generalization, probably pertaining primarily to reasonably long -- say 1,800 feet or more -- fields in good condition. Faced with minimal length runways and/or other adverse conditions, pilots will likely approach on as flat a flight path as terrain or obstructions allow.)

Calculating backwards, in order to permit a 1.2 degree clearance over the controlling trees, the touchdown point would have to be located approximately 370 feet from the threshold for a 4 degree glide slope. The decision was to position the PLASI 350 feet from the threshold. Actually, there were almost no objects materially above runway elevation for about 2,000 feet west of, and on, centerline; the controlling trees in question were primarily located east of centerline. At centerline the tree tops were perhaps 35 feet above runway elevation, and their height increased relatively uniformly to the extreme easterly edge of what would normally be the approach path. Therefore, it was believed that pilots desiring to make the first taxiway turnoff could still fly the PLASI approach, but deviate shortly before touchdown and land closer to the threshold than indicated by the light patterns--and make the desired exit.

The horizonal and vertical alignments of the proposed approach were checked against the various traffic segments, per Part 93 of the Federal Aviation Regulations, and found reasonably satisfactory. Since the PLASI glide path is visible 8 degrees to either side of its aiming alignment, some thought was given to aiming it at a slight angle to the runway centerline -- for better positioning relative to the separate airport traffic areas, to shift the glide path away from the higher trees, and so on -- but this was not done because the benefits were insignificant. Since the elevation of the PLASI equipment relative to the runway centerline determines whether the theoretical touchdown point is directly opposite the equipment or up or down the runway, and since the terrain permitted any of the three options, another decision was needed. Because this was a test installation, it was decided to locate the equipment at approximately runway elevation, so that the touchdown point would be immediately opposite it. The pilot actually looses sight of the light beam at about the time he crosses the threshold (hence it does not blind him) so by establishing the touchdown point opposite the equipment, pilots could still judge how accurately they had flown the designated glide slope. Several other checks were made. The threshold crossing height was computed and found satisfactory -- although considerably lower than recommended for heavy aircraft using major runways. A quasi-access trail crosses the approach zone about 300 feet from the threshold, and although it was blocked by a fence east of the runway and not used, a check confirmed that in the unlikely event that a vehicle was on the road, an aircraft should have adequate clearance over it.

Lastly, it was decided to install the equipment on the right hand or west side of the runway, approximately 85 feet from centerline. The controlling factor in this case was the installation of the power cable for the unit. Power was conveniently available on the west side, but totally absent on the east. Furthermore, although the reference material for 'conventional' VASI installations cites a preference to position the equipment on the left-hand side of the runway (since the pilot sits on that side of the cockpit), it is apparent that there is virtually no such advantage or necessity when making an installation to serve light aircraft on relatively short, narrow, runways.

The actual physical installation was accomplished with ease. A small gravel pad was constructed by end-dumping gravel from the edge of the runway embankment back the necessary distance to about 6 or 8 feet beyond the 85' point. The pad ended up about 30 feet square. Not only was it adequate for positioning the equipment far enough from the runway centerline, but there was ample room to park two vehicles outside the runway light line so that the runway could be left open whenever it was necessary to check the equipment or perform any maintenance work. The electrical hookup was accomplished by laying No. 6 direct burial cable on the surface of the ground about 700 feet from the existing power drop at the small shelter on the nearby apron. A ground rod was driven into the soil near the edge of the pad.

A manufacturer's representative, Mr. Frank McHugh, traveled from Albuquerque to assist in the actual hookup and installation, and to provide instructions to the maintenance personnel. The equipment itself consists of two units, a transformer and the light projector. Since this was to be a temporary installation, no permanent support was installed. Instead, the three-legged projector unit was left attached to the heavy plywood bottom of its shipping crate, placed directly on the gravel pad. Two cast concrete aircraft tiedowns were used to weigh down the unit and prevent it from moving. The transformer unit was placed directly on the gravel pad, just behind the projector.

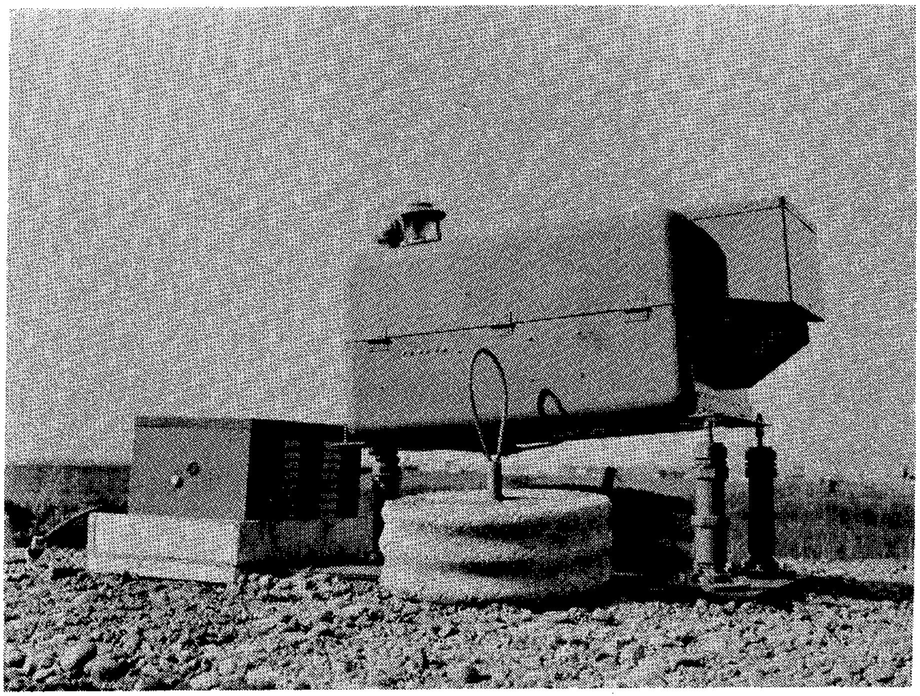


Photo No. 1: The PLASI in place. Transformer at left; concrete tiedowns used to weight down plywood base. PLASI projects to the right. Air intake with filter above opening for light beam.

Horizontal aiming of the projector was accomplished by measuring the distance between centerline and the unit, and establishing a target the same distance from centerline opposite the threshold. The alignment was accomplished by sighting along ridges in the top of the projector case. The unit was leveled using the adjustable legs, as outlined in the installation manual, and the vertical alignment was set. Mr. McHugh checked various components including the automatic dimmer switch, the lamp turntable, shutter assembly, tilt switch, and so on. Airport maintenance staff personnel participating the in the setup were Mr. Bill Mitchell, Larry Gulley, and Don Dewoody.

The unit was activated and flight checked using a Cessna 180 on April 30. Mr. McHugh, the author, Mr. Jerome P. Bushnell (Chief, Flight Standards Division, FAA), Mr. Frank E. Berry (Program Planning & Support, Airway Facilities, FAA) and other DOT/PF and FAA personnel all made several approaches, generally from north of Point MacKenzie.

OPERATIONAL PERIOD

Contacts with the manufacturer around the time the test PLASI was commissioned indicated that DOT/PF could count on about a 90 day test period, lasting to the end of July. Subsequently, the manufacturer generously extended the loan of the equipment through the end of August, when it became apparent that the additional month would be desirable in order to obtain more exposure and response from pilots.

Thoughout the entire test program the operation and maintenance of the unit was virtually trouble free. The airport maintenance staff, primarily Mr. Gulley and Mr. Dewoody, would periodically check the unit to ensure that all components were functioning and that there

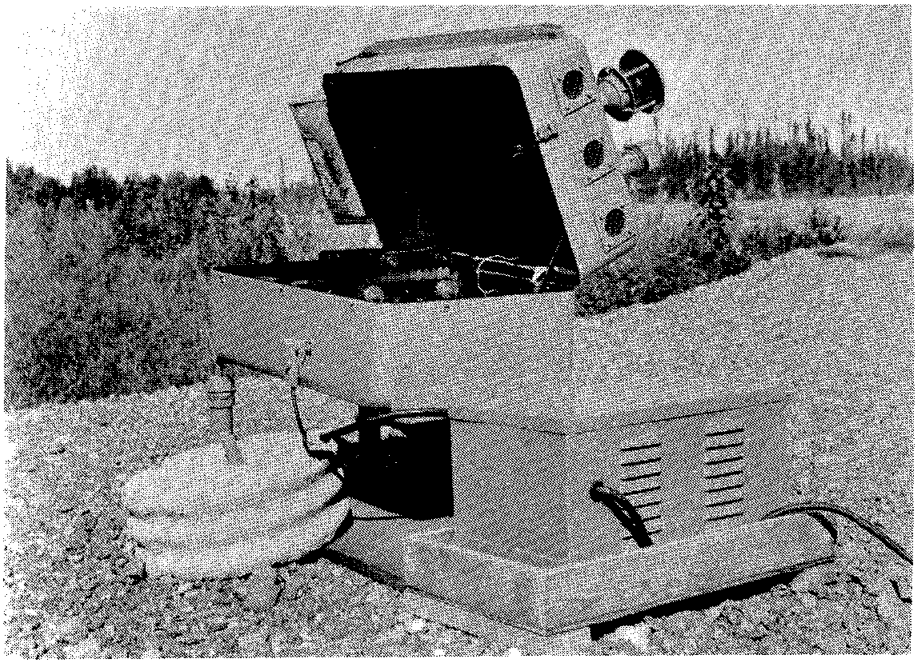


Photo No. 2: The in-place PLASI with the top open for servicing. Cooling air intake filter at far end of top; three exhaust vents at rear or near end. The red 'last bulb' indicator is at left on the top, with the smaller light sensor controlling day or night brightness of the projected PLASI beam to the right.

were adequate lamps remaining. The manufacturer had supplied about six extra lamps at the initiation of the test. During the first month or so the lamps seemed to burn out more rapidly than later in the program, although no specific records were kept. An order for additional lamps was placed in late June, and the unit operated continuously from April 30 until it was disconnected on September first.

Occasional verbal reports were received from pilots who had flown the glide slope, and the author flew it periodically on personal flights, particularily when runway 14/32 was closed.

During the same time period, the manufacturer provided copies of the cold weather test report and the report of the Canadian installation (both noted in the Bibliography). According to both documents, the unit performed satisfactorily. However, it was not until the reports were available that it became apparent that the PLASI had not been tested under actual winter conditions. That is, the cold weather test was performed in a California laboratory; the Canadian installation at Montreal could be considered essentially a routine 'big airport' installation. In all likelihood the controlled laboratory conditions producted accurate results, but unfortunately these were limited to temperature testing and not the full range of climatic conditions. Thus, there apparently was no record of the equipment's performance when exposed to blowing wet snow, drifting snow, freezing rain, and so on. There is no reason to believe that the equipment would not meet such challenges satisfactorily, particularly if specific installations are properly designed. For example, in an area where drifting snow is common it may be desirable to erect the equipment somewhat higher from the ground surface than might normally be anticipated, such that the snow drifts do not reach the level of the equipment. Likewise, snow fencing, simple fiberglass or metal shelters, et cetera, could likely be added to protect against any adverse effects of blowing snow, freezing rain, and so on.

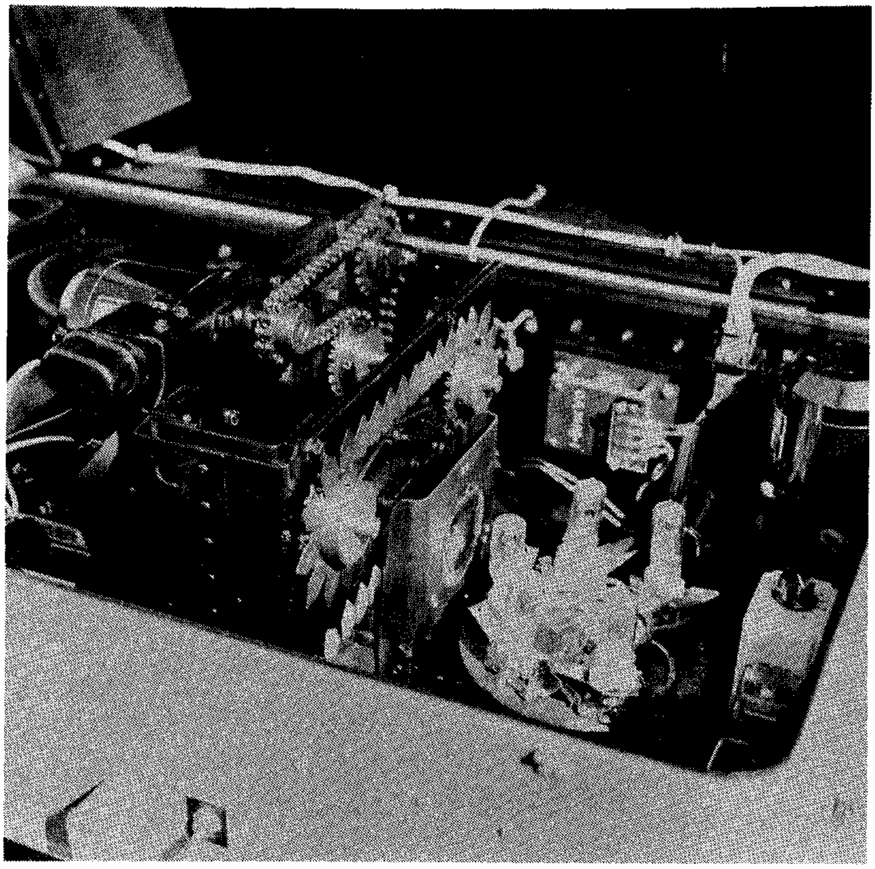


Photo No. 3: The "workings" of the PLASI, with the lid open. Main drive motor and cooling air ducts at left; chain drive at upper center; saw-toothed shutter assemblies at lower center; condensor lens and turntable with five projector lamps at lower right. Main power on/off switch is mounted on exterior of case, bottom left.

The author noticed two items of potential concern, both of which appear to be inherent in the equipment, and possibly easy to modify. One item involved the filter for the cooling air. This filter, built into the hinged top section of the case fits snugly against the somewhat smaller hood protecting the light outlet. Thus, it seems that some of the efficiency of the filter or air intake is diminished; but moreover, it appears that the remaining portions of the filter are apt to become badly clogged by flies, other insects, leaves, or other windblown debris.

level) but the possibility does exist. There is also the slight chance that the arm might be bent or the level indicator somehow knocked out of adjustment. Therefore, it might be advantageous to have a fixed handle placed on the side of the hinged top of the case, and perhaps other means taken to protect the indicator arm.

PUBLIC RESPONSE

During the test period various methods of soliciting public response were considered. In accordance with the low key nature of the test, primary contacts where restricted to formal announcements to the control tower at Anchorage International, and two series of letters. The Alaska Airmen's Association included information about the test in "Air Alaska", a monthly newspaper distributed to every licensed pilot in Alaska. One letter was distributed to the pilots of record who are renting tiedowns on the apron adjacent to the Lake Hood strip. The nearly identical second letter was distributed to the members of the Alaska Airmen's Association. (See Appendix B, exhibit 5.)

In addition, a copy of the letter, a map showing the general layout of the system, and an informational sheet provided by the manufacturer were posted in the small shelter at the north end of the apron. Supplies of the questionnaire and the PLASI instruction sheet were provided in the shelter along with a box to receive the completed forms. Most forms were received in the box, although a few were received by mail. The questionnaire itself was a slightly modified version of one used elsewhere by the manufacturer. A copy is attached as exhibit 4 of Appendix B.

Twenty-seven completed questionnaires were returned, reflecting about 210 daytime approaches and 57 night approaches, for a total of nearly 270 operations. A more detailed analysis of the responses is contained in Appendix A. In brief, it seems that the unit was tried by a good cross section of pilots, from one with a student certificate through commercial pilots with 18,000 or so hours. Aircraft involved represented a typical mix of single-engine light planes. There was some expression that the PLASI provided a "better safety benefit" than the standard VASI system; and the level of the attention "required to maintain the PLASI glide path" was roughly about the same as required to fly the standard VASI.

In view of the initial work in positioning the unit and setting the approach slope, it was interesting to note that while there was general satisfaction with the position of the touchdown point, nearly half of the respondents would prefer a touchdown closer to the threshold, and none wanted it further down the runway. Twenty-two of the twenty-seven pilots indicated that the approach angle was about right, while four felt it was too steep. One pilot did not indicate a preference; none indicated that the angle was too flat.

There appeared to be less official interest on the part of Alaskan Region FAA personnel than anticipated, but several representatives took the time to become familiar with the equipment and its operation. A copy of the FAA letter received after the test is included as exhibit 9 of Appendix B.

FINDINGS, ANCHORAGE TEST

Installing visual glide slopes for use by light aircraft using short runways (under 4,000 feet) is apparently not common enough to have resulted in the development of installation criteria. Pilot reaction to this test project appears to support the assumption that for short runways a single source glide slope, having a specific touchdown point, is definitely preferable to the 'conventional' multi-source VASI units typically installed by FAA to serve large aircraft on runways 4,000 feet or longer.

While there is substantial interest in establishing the touchdown point close to the threshold, the reaction from what appeared to be lesser experienced pilots indicates that a touchdown about as designated in this test -- 350 feet from the threshold -- is desirable. A threshold farther down the runway might be justified depending upon the position of taxiway exits.

The respondents were somewhat intrigued by the pulsating signal, but there was no clear-cut consensus that the pulsating signal is preferable over the steady light type of installation.

While the PLASI had undergone cold temperature testing in a laboratory, it had apparently not been exposed to actual cold weather winter conditions involving snow or other precipitation as of the completion of the Anchorage test. Unique features such as the moving shutters appeared to warrant a further practical winter test to determine the equipment's reliability and anticipated life. The PLASI appears to require little maintenance, but the projector lamps are expensive and stock control (including protection from handling) may be a problem at remote airports staffed by occasional semi- or unskilled labor. However, no data on lamp life, cost, etc. was gathered for other types of visual slope indicator systems for comparisons with the PLASI lamps. (The Bethel installation reported in Part Two of this report updates these findings further.)

Official Federal Aviation Administration interest appears low and the position taken by Washington D.C. personnel (Exhibit 10 of Appendix B) appears to forbode immediate FAA enthusiasm for the PLASI. It should be noted that FAA "approval" of the equipment only concerns visual approach slope indicator installations programmed by FAA itself or proposed using federal funding under the Airport & Airways Development Act. FAA approval or the lack thereof would have no bearing on the type of visual approach slope indicator installed under privately or other non-federally funded projects. The availability or absence of visual glide slopes is not anticipated to have any bearing on approach minimums or other piloting procedures certificated by FAA.

The PLASI is an extremely simple unit to install and commission. It is adaptable for platform installations directly on the ground, individual three stake installations, single piling installations, and so on. It likely shares this ease of installation with other single-source VASI units.

PART TWO

BETHEL INSTALLATION

INTRODUCTION

The Anchorage testing had been completed, the equipment returned to Albuquerque, and indeed most of the preceding text written, when circumstances led to the installation of a PLASI on runway 36 at Bethel. Because nearly everything associated with this second installation was unrelated to the test installation, and the results were dramatically different, it seemed appropriate to record the results in a second part of the basic report.

Since the Bethel installation was done on a semi-emergency basis and was not a research project, the preparations were abbreviated and little data has been collected. Thus, while the end results may be far more significant, this portion of the report is markedly briefer than Part One.

BACKGROUND

Bethel is the major commercial and government center for the several thousand people inhabiting the Yukon-Kuskokwim delta area. The community, with its vital airport, is located on the Kuskokwim River about 400 miles west of Anchorage, and 530 miles southwest of Fairbanks. Daily jet service links it with Anchorage and the "Outside" world, while a steady stream of smaller aircraft provide transportation to and from the surrounding villages. The paved state-owned airport has one 6400' runway and a short cross runway.

What was first noticed as a minor vertical displacement (bumps) in runway 18/36 had over a period of months become a foundation failure of considerable proportion. The relatively abrupt depression was located roughly at station 56+00, or 1400' from the runway 36 threshold. While the affected section of runway was between stations 54+50 and 58+50, the most noticeable portion was about 250' long, wherein the maximum depression was nearly 0.75' or nine inches. By January 1982, this resulting "bump" was so severe as to constitute a hazard, and the Department relocated the runway 36 threshold about 1550 feet.

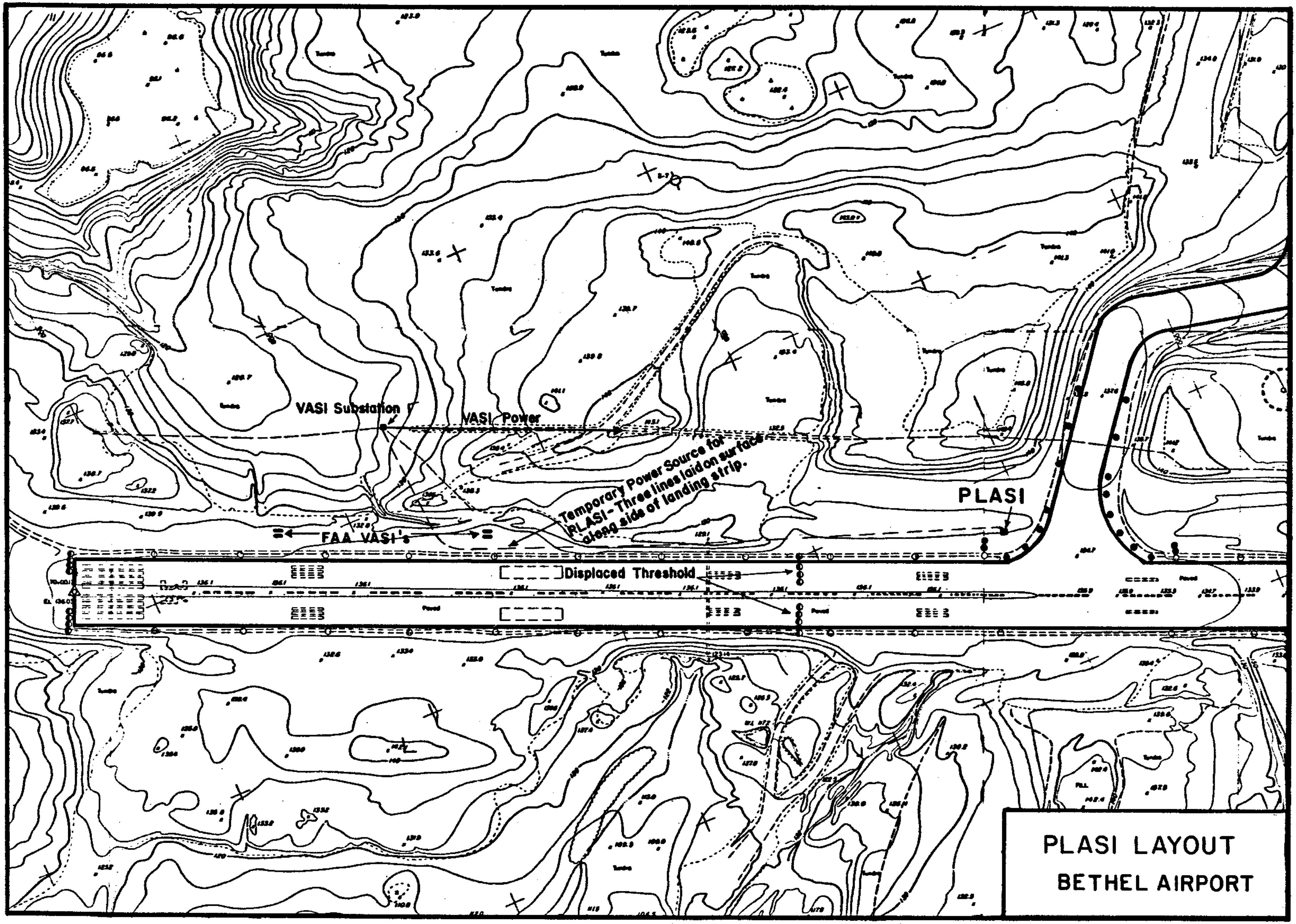
Runway 18, the instrument runway, has an FAA electronic glide slope and VASI; while runway 36 was equipped with an FAA VASI system. Obviously the threshold displacement for 36 rendered its VASI unusable. Bethel wind conditions frequently mandate the use of 36, and since Wien Air Alaska (the prime heavy aircraft operator using the airport) jet operating procedures require the use of either electronic or visual vertical guidance or reference for landings, the carrier was forced to cancel flights using 36. Bethel and its surrounding service area of perhaps 25 villages are totally dependent on aviation as the sole winter transportation link with the rest of the State, so a critical situation developed when the scheduled jet flights were interrupted for several days.

The initial approach was to investigate the possibility of relocating the conventional FAA VASI's. This proved unfeasible, partially as a result of the winter frozen ground conditions. Reportedly FAA would have made the change upon receiving a guarantee of being reimbursed for an estimated $60,000 relocation cost, plus assurance that the State would further reimburse them for the restoration costs when the runway was repaired and the original southerly threshold replaced. Time alone, however, worked against shifting the VASI units.

Departmental personnel working to resolve the situation were familiar with the test PLASI installation of the previous summer, and decided to give serious consideration to using that type of installation.

INSTALLATION

Within a matter of hours after recognizing the predicament, and even before the option of relocating the FAA VASI units had been ruled out, staff members began gathering data on the possibility of acquiring and installing a PLASI system. Decisions were made in rapid order, and the



VASI Substation
VASI Power
Temporary Power Source for PLASI - Three lines laid on surface along side of landing strip.
FAA VASI's
PLASI
Displaced Threshold
PLASI LAYOUT
BETHEL AIRPORT

quasi-emergency nature of the whole task precluded much of a detailed written record. However, the manufacturer -- DeVore Aviation Corporation -- was contacted by phone and confirmed that a PLASI unit was available. The purchase commitment was confirmed within 24 hours when the source of funding had been identified. Since it was essential to restore dependable air service and DeVore was a "sole supplier", expedited State purchasing procedures were used.

DeVore also made special arrangements for quick delivery of the unit, and upon request assigned Mr. Frank McHugh to assist in the installation. The author worked with Maintenance & Operations personnel to select the location for the unit. The work was accomplished under the direction of Mr. Mike Gavin, Acting Director of Central Region M&O. Also working with him was Mr. Chuck Landers. Bethel M&O personnel were under supervision of Mr. John Scott, and included Mr. Jed Atkins and Mr. Ron Norling. M&O identified nearby power sources, located the necessary reels of wire for the hook-up, cleared snow from the site, and otherwise coordinated the entire installation.

Specific data on the displaced threshold location was not available, but the hazard of "undershooting" or landing short of the threshold was of relatively little consequence -- due to the existence of the existing temporarily abandoned runway, in contrast to situations having abrupt profile and/or surface condition changes. Thus, a planned touchdown point of about 750' from the threshold was identified and M&O personnel in Bethel ensured the landing strip shoulder area in that location was free of deep snow, berms, and so on. It was decided to set the glide slope at 3 degrees, which had also been the VASI slope. Final siting of the unit was left to be determined in the field when transverse landing strip gradients, potential conflicts with exit taxiways, and other factors could be determined.

While the remaining usable portion of runway 36 has a negative or downhill gradient, and the total available runway length beyond the "design" PLASI touchdown point would only be about 4200', this was of little concern because runway 36 landings would only be made when there were relatively strong compensating headwinds -- winds of sufficient velocity to preclude using the preferred ILS runway 18, and strong enough to allow for relatively short takeoff and landing distances. The question of which side of the 150' wide runway to locate the PLASI was immaterial as the available power sources were all on the westerly or left -- pilot's -- side.

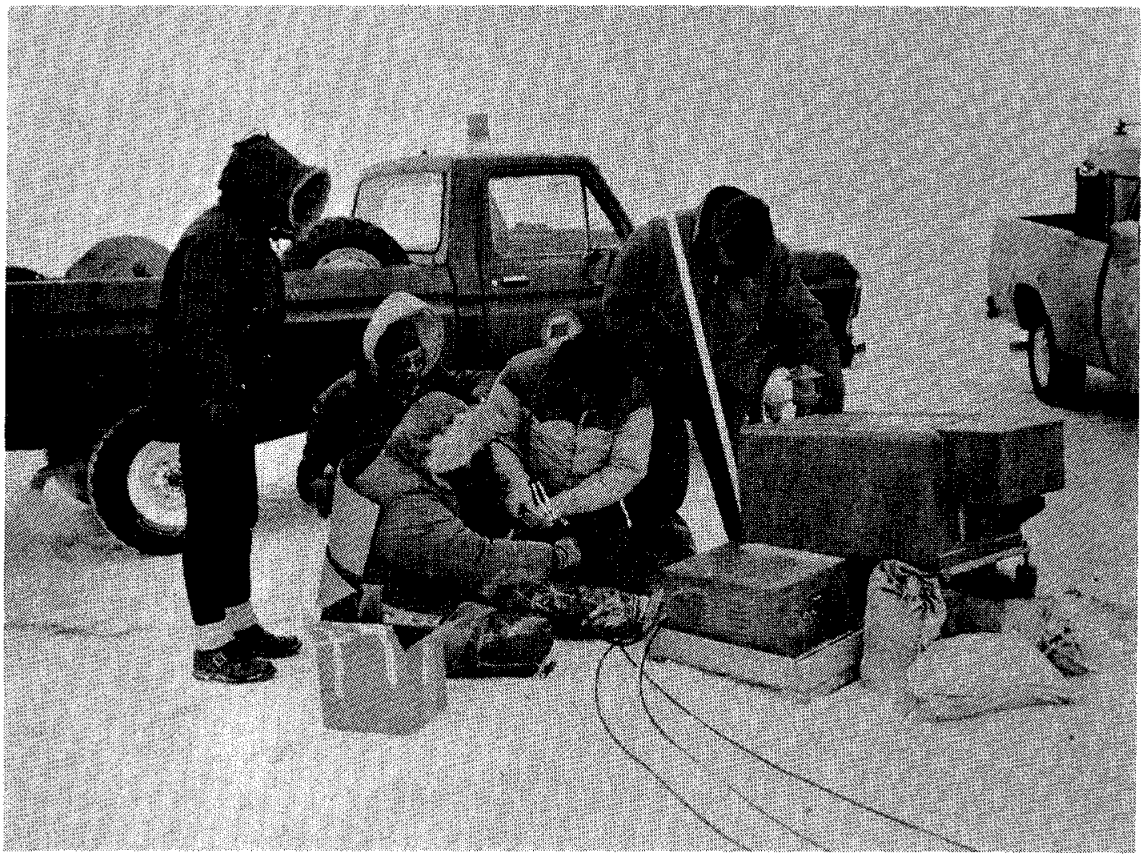


Photo No. 6: Left to right: Frank McHugh, John Scott, Chuck Landers, Mike Gavin, and Jed Atkins splice the power supply cables for the Bethel installation in windy -20°F weather. Vehicles were parked to deflect wind, and pieces of cardboard at Landers' back were also used to minimize discomfort.

Mr. McHugh, Mr. Gavin, Mr. Landers, and the author travelled to Bethel on Thursday, January 14, arriving shortly after 9:00 a.m. The PLASI unit and other materials were on the same flight. When they were unloaded, the PLASI was uncrated in the Department's maintenance shop where Mr. McHugh instructed the Bethel personnel on how to operate and maintain it.

The field installation followed. Three strands of wire were run from the VASI junction box opposite station 62+60 to the PLASI at about 47+60. This was accomplished by mounting three cable reels on a pipe across the bed of a pickup; the lines were hand-strung from the edge of the runway across the snowfield to the box, and unreeled farther as the truck moved down the edge of the strip to the PLASI. The final positioning of the unit was adjusted slightly southerly to compensate for a taxiway fillet, and a relatively level area of frozen landing strip was selected. As in the case of the previous summer's test program, the unit was left mounted on the plywood base of the shipping crate. The base was weighted down with a few sandbags. The transformer was set alongside the PLASI, also helping secure it against movement. The cables were field spliced in a brisk cold wind which, coupled with a temperature of about 20 degrees below zero, resulted in a chill factor of around minus 40 degrees. By about two p.m. that afternoon the hook-up was complete and the switch thrown. Flight Service Station personnel were briefed on the use of the pulsating glide slope so the information could be relayed to pilots. Several aircraft landed shortly after it was turned on, and all reacted positively to it.

The crew drove into Bethel for lunch and then rechecked the installation in late afternoon. The next morning it was checked again. The Wien jet landed on 36 and the crew expressed satisfaction with the visual aid. The author returned to Anchorage about mid-day Friday. In all, probably less than 72 hours had elapsed from the time the decision was made to use the PLASI until its placement in the field. Records show the first tentative call to DeVore Aviation was made on Monday, January 11. That was an exploratory call to determine if FAA had certificated its use for fixed wing aircraft, and whether or not a unit was available. A later call that day -- early evening in Albuquerque -- advised DeVore the Department wanted to purchase a unit, setting in motion the special arrangements for shipping and for Mr. McHugh's assistance. As noted, Mr. McHugh and the equipment arrived in Anchorage Wednesday evening, and by early afternoon Thursday the PLASI was on line and operating.

OPERATIONAL EXPERIENCE

Unlike cases where there are equipment failures, operational problems, and customer/user complaints, the Department has almost no file of information or data on the Bethel PLASI. Pilots -- particularly the Wien jet pilots and crews of other heavy aircraft, for whom the installation was made -- are virtually unanimous in reporting that the PLASI provides satisfactory visual glide slope reference. In the first five months of operation only one unfavorable report (from a jet pilot who had never used the pulsating glide slope) has been noted.

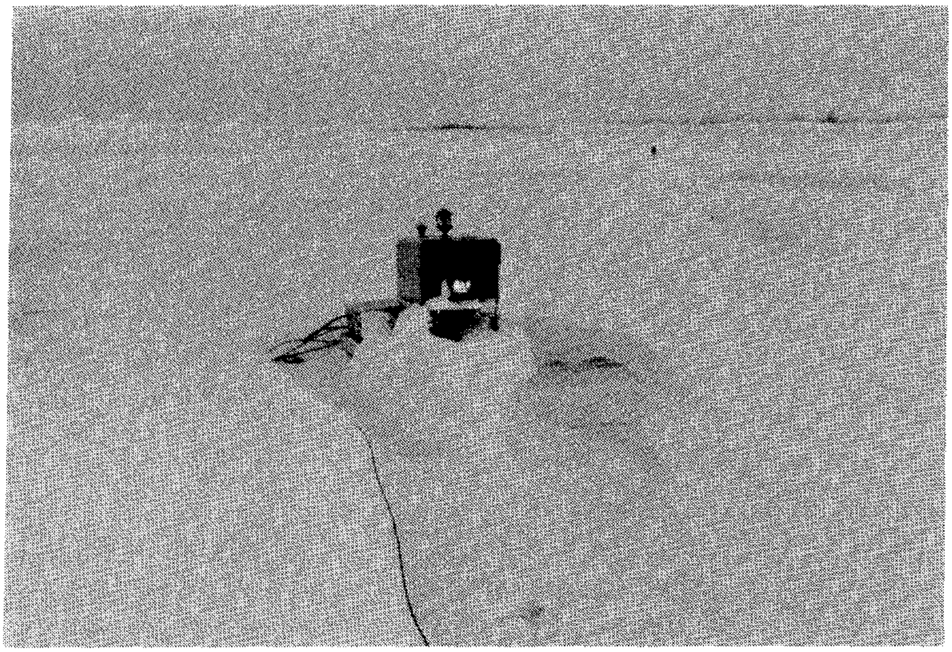


Photo No. 7: Drifting snow had established a pattern around the PLASI within a few hours after its installation. Looking at PLASI from the approach end: exit taxiway at top left, and runway 36 to right.

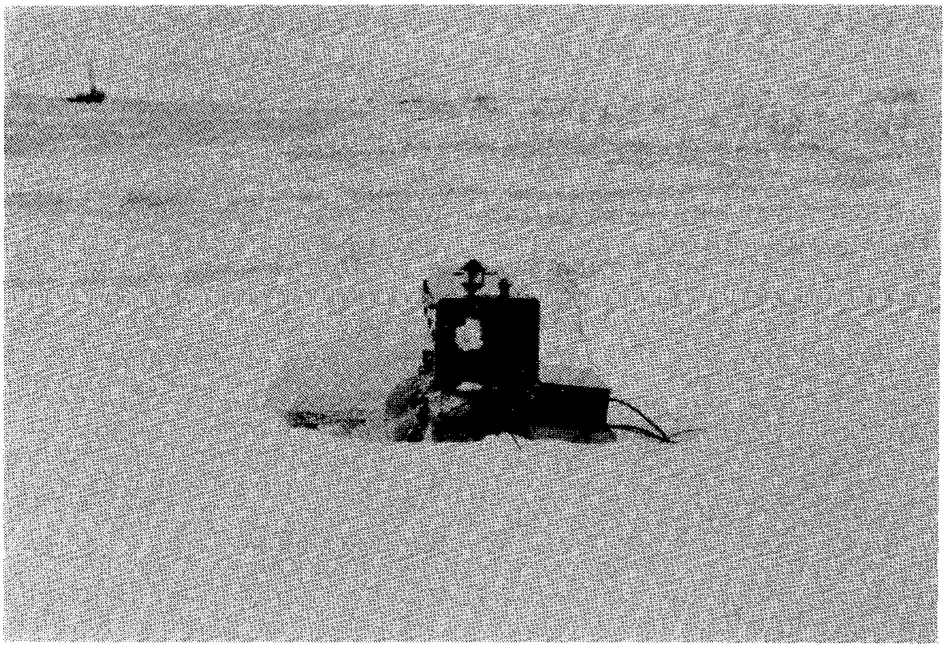


Photo No. 8: Another view of unit taken at same time as Photo 7, looking into approach from rear of PLASI. Drill rig at top left is about on runway centerline at site of runway failure.

The maintenance has been routine, primarily replacing burned out bulbs. A few specific observations have been made and relayed to the manufacturer. Those are as follows:

1. Within the first two or three weeks of operation it was discovered that the power switch on the side of the unit could be turned off accidently when struck by a clump of blown snow, etc., associated with cleaning the runway. The solution was to install a small guard to protect the switch.

2. The "tattle-tale" light (indicating the last bulb is in place) installation was imperfectly sealed, allowing water to enter the main cabinet. This may have been a minor factory defect in the particular unit; the solution is simply to provide a better seal with silicone sealant.

3. The transformer must be set up off the ground (elevated) to keep it dry.

4. The unit itself was not as watertight as advertised. This is apparent as sand has collected within the box. (Blowing sand is a common Bethel phenomenon.) As much as 1/4 inch of sand was collected in the trap around the bottom of the unit. It is uncertain whether the sand was introduced with the cooling air or elsewhere; nor has it been determined whether or not this was a factory defect in the particular unit, or a design deficiency warranting correction.

Aside from those items the only other failure reported was the breakage of a ceramic base for one of the projector bulbs. The assumption was that this failure was not related to temperature or other stresses, but was merely a routine breakage, perhaps due to an unseen manufacturing defect.

FINDINGS, BETHEL INSTALLATIONS

The purpose of the Bethel installation was entirely different from that of the original test in Anchorage, and the results differ also. While the Anchorage test confirmed the summer operation and reliability of the system, the vertical reference guidance supplied by the PLASI was obviously non-essential for that group of users. In contrast, the Bethel installation was born of necessity, has produced a short history of winter operation, and was both useful and appreciated by the B-737 and other heavy aircraft pilots. Moreover, the experience certainly proves the ease and economy of installing the PLASI, especially when compared to a 'conventional' VASI installation.

In all respects employees of the Department and PLASI users seem well satisfied with the installation.

S U M M A R Y

CONCLUSIONS & RECOMMENDATIONS

This Department's experience to date with the PLASI approach guide has proven its value in certain areas, and revealed much information concerning visual approach slope indicators in general. Although some of this information may have been known previously, it is not reflected in commonly available literature.

The observations might be classified as (a) dealing with the PLASI as a specific piece of equipment; (b) dealing with the relative usefulness of the PLASI and other types of visual approach aids to various types of aircraft traffic; and (c) dealing with general information concerning the selection and installation of visual approach aids.

With respect to the PLASI unit itself, it was found to be generally satisfactory and dependable, even under the winter conditions encountered at Bethel. The unit is especially easy to install. Since the unit is relatively inexpensive, the simplified installation only further enhances its financial competitiveness with the conventional FAA VASI and other approach slope indicators. What few observations were made concerning its flawed mechanical operation are minor, and to be expected of a relatively new product.

Slight modifications to the unit appear worthy of consideration. A handle on the hinged top cover and other slight changes might help to preserve the vertical aiming arm. A simple guard for the external power switch would be good. The cooling air intake filter might be examined to see if it should be modified, not only relative to its position against the top of the hood, but with respect to ease in cleaning and/or changing the filters. A more positive method of horizonally aiming the unit might be helpful. It would appear beneficial and relatively easy to include an operating/maintenance instruction manual and a clipboard with a maintenance record sheet that would fit right into the case. It might be helpful to have the necessary small (carpenter's) hand-level provided as an accessary inside the case, also. The sand and water (snow) penetration experienced at Bethel should lead to a review of the various seals, to ensure this is not a common occurrence.

While the apparent lack of reference material covering the installation of VASI units caused frustration during the initial installation for the Anchorage Test, this condition was clarified when it became obvious that VASI's are not normally installed at small airports. That fact had been known, but at least the author assumed the reason was based on economic justification. Instead, it is seemingly obvious that most light aircraft pilots do not require the set glide slope dictated by the VASI. While light plane pilots are usually knowledgeable about the use of VASI's, informal conversations indicate that few actually rely on the glide slope information. Instead, such aircraft operators select their approach path and touchdown spot based on the conditions of the particular landing. Often the VASI's are only available on long runways to accommodate heavy aircraft, and light plane pilots will land "long" or beyond the indicated threshold to avoid lengthy taxiing or traffic conflicts.

A careful reading of the available material, mostly the FAA publications cited in Appendix B and the Bibliography here, does reveal that the primary purpose for conventional VASI installations is to provide positive guidance for large aircraft which lack the maneuverability and short runway capability of light aircraft. Installations are made for light aircraft guidance in specific instances where the approach is obstructed by pole lines or other difficult to see, hazardous, obstacles.

The PLASI is only one of a number of single-source visual approach slope indicators. The others which are marketed from time to time were not tested under this program. It is believed they are considerably less costly, but they are also probably much less effective. (See exhibit 11 of Appendix B.) Most project a simple light beam, broken up through the use of filters such that the red portion signifies a below-recommended-glide slope, while a green portion indicates "on course", and a yellow portion signifies an above-course or too high approach. The colors may vary. Most of these simplier units are intended for use solely at short runways handling small aircraft. They do not produce a strong enough light beam to be distinguished at any great distance from the airport, and hence are considered unsuited for use by large aircraft. They are not substitutes for the conventional FAA VASI's.

The PLASI, in contrast, has a powerful and accurate light beam which is readily visible several miles from the runway, depending on local weather conditions. It is an alternative to the conventional VASI, and should not be classed with the simplier units.

Thus, the Anchorage and Bethel experiences indicate that visual approach slope indicators are seldom needed on runways at typical Alaskan airports handling only light aircraft. Exceptions include cases where the approach is obstructed, or where abnormally short runway length or other factors dictate use of a precise touchdown point. In such cases the PLASI unit is preferable to the FAA VASI due to its lower cost and higher precision. At least in certain cases one of the even simplier visual glide slopes may be entirely satisfactory. None of these have been tested locally to the author's knowledge, and it is recommended that comparison testing be done if such guidance is desired at short runways.

For major runways serving large aircraft, the PLASI appears competitive with the FAA VASI, and its use for new installations should be considered. It has received FAA approval, as described in exhibit 12 of Appendix B.

Finally, the diversity of information concerning the selection and installation of visual approach aids warrants attention. Various references and guidelines are spread through a number of FAA publications and other material. At least five FAA Advisory Circulars each contained bits and pieces of the information. The average user would find the selection and installation of visual glide slope aids greatly simplified if a single publication provided all the necessary information.

A P P E N D I X   A

ANALYSIS OF ANCHORAGE RESPONSES

APPENDIX A

Analysis of "Pilot Questionnaire" Responses

Introduction: The questionnaire was designed for quick responses. It was intended to be answered mainly by simply putting a check mark or "X" in an appropriate "yes", "no", or other appropriate answer block. While this design was used because the need for longer answers might result in few forms being completed, there was an invitation for additional "comments" after nearly every query. The questionnaire was patterned after a PLASI questionnaire used by DeVore at other test installations. However, every effort was made to avoid 'inviting' a particular answer, and special questions were added.

Respondents: Twenty-seven questionnaires were returned, each presumably by a different pilot, representing about 270 approaches. While the form was prepared with the idea that a pilot would submit a copy after each flight, all but two pilots reported multiple approaches on single forms.

Sixteen of the 27 pilots (59%) held private licenses (includes one possible student); seven or (26%) were commercial pilots, and four (15%) had instructor's ratings. Two of the private pilots reported having instrument ratings; while one each of the commercial pilots and instructors held ATP's - airline transport ratings.

In terms of experience, 14 or 52% fell in the range of between 100 and 1000 hours flight time. That grouping included 12 of the 16 private pilots (including the student), and one each commercial and instructor. Four (two private pilots and one each commercial and instructor) had between 1500 and 2000 hours; and another four (two private and two commercial) had between 2500 and 3000 hours. The remaining five (three commercial and two instructors) had between 3800 to over 18,000 hours. The 52% initially mentioned above constituted the tightest "grouping" of respondents; and of them, seven (26%) had between 500 and 600 hours.

Question 12 was prepared (See exhibit 4 of Appendix B) so that simple check marks would indicate three brackets of experience in terms of flight time (under 200 hours, 200 to 500 hours, and over 500 hours) and relative Alaskan experience versus total flight time. However, nearly all pilots reported their actual approximate flight time; and by chance the experience of the few who used the "check" system could be identified reasonably accurately. Thus the foregoing analysis, more detailed than originally intended, is relatively accurate.

Since the prime thrust of the research project was to evaluate the use of the PLASI unit at remote secondary airports which are rarely used by out-of-state pilots, the distinction between total flight experience and Alaskan time was considered an essential ingredient of the study. This was particularly true since the Anchorage population has the highest percentage of short-time residents of any community. Interestingly enough, the responses indicate that in nearly all cases, perhaps 80 percent or more of the total flight time had been logged in Alaska. This unexpected result simplifies and helps verify the validity of the trends in this study.

The aircraft used, per the responses to Question 11, were a smattering of typical light planes. Several had common modifications such as higher powered engines. The grouping included five Cessna 180's, five 172's, three 170's, and two 206's; four Piper PA-18's, two PA-12's, and one each Stinson, Maule, Taylorcraft, Commonwealth, Aeronca Sedan, BE55, and Champ; plus several unspecified makes. Several pilots flew more than one aircraft on the approaches.

Responses: Near unanimity prevailed for the answers to several questions, including numbers 1, 2, 3, 6, and 9. Following are analyses of the individual questions. (Refer to exhibit 4 of Appendix B for an actual statement of the questions.)

Few pilots - only two - reported having any difficulty understanding how the PLASI worked. One did not respond to the question; 24 reported no difficulty.

There was unanimous agreement that there was no difficulty in locating or identifying the PLASI signal or light. Likewise, no pilots reported experiencing difficulty or confusion while flying the approach after picking up the light, although one pilot marked neither the "yes" nor the "no" answer and commented "At first didn't recognize significance between white steady and white pulsing."

Opinion was equally divided between those who considered the PLASI "active" or pulsating signal a better safety benefit than the standard VASI. Thirteen pilots thought the PLASI was better; twelve said "no"; and two did not respond. (In attempting to analyze the responses further, it appeared there was a slight trend for more experienced pilots -- both in terms of hours flown and ratings -- to respond that there was not a better safety benefit.)

Question number 5 sought to compare the relative attention levels necessary to stay on the PLASI glideslope versus a VASI. The majority -- 13 -- felt the attention level was the same, while nine said it was less and four said it was greater. One did not respond. There was no discernable pattern in the answers relative to experience.

The pilots were nearly unanimous in indicating that the level of attention required to stay on the PLASI glidepath did not interfere with other cockpit operations during the landing. Only one pilot (with a private rating and 185 hours) felt following the PLASI did interfere, but commented "Only because it was first time use." Two, both commercial pilots, did not respond directly; one commenting that he was not sure and would need more exposure to the PLASI, and the other stating "It will result in distractions for low time pilots." The 24 who felt there was no interference added no significant comments.

Question number 7 dealt with gaining proficiency, and gave an indication of how many approaches were made. A precise count of operations was not possible since some pilots reported only approximate numbers, such as "20 to 30". However, it appears that the questionnaire results represent about 210 day approaches, and about 57 night approaches. It should be noted that of the latter, 20 -- approximately a third -- were flown by one pilot, who did not report any day approaches. By a count of 16 to 5, the pilots felt that subsequent approaches were easier to fly. Six did not respond to that second part of the question.

Considering published data on the location of VASI's and designating touchdown points, the responses to Question 8 were revealing. As reported in detail under "Installation", the selection of the touchdown point for this research project was complicated by several factors. In the end, the decision was essentially arbitrary, and did not conform to what might be construed as official recommendations. While five pilots did not respond to the question, 17 said the touchdown point was positioned satisfactorily, and seven said it was not. This totals 29, because two pilots marked both answers. In response to the second part of the question, ten pilots would prefer a touchdown closer to the threshold, while none wanted it further down the runway. To summarize the findings, there was a strong expression that the touchdown point should be closer to the threshold, although the location used was generally satisfactory. This response is especially noteworthy because the location was already closer to the threshold than normal VASI criteria would have dictated.

There was unanimous agreement that the approach or glideslope indicated by this PLASI installation provided adequate clearance over obstacles. A strong majority reported that the glide slope or PLASI angle set for this operation was satisfactory. Only four pilots reported it was too steep (one of whom commented, "For my aircraft - others are probably okay."), and none reported it as too flat. Nineteen said it was satisfactory, and two of the four who did not mark a specific blank added the comment that it was "OK". The final tally might be considered as 21 "satisfactory", four "too steep", zero "too flat", and two not responding.

A P P E N D I X B

EXHIBITS

PLASI
HOW IT WORKS

PLASI *(Pulse Light Approach Slope Indicator)* is a visual aid designed for use in VFR weather conditions. The system guides the pilot by means of a single light signal from an installation parallel to the runway near the intended touchdown point.

The light is visible to the pilot from at least 4 miles on a bright, sunny day and provides him with a stabilized approach.

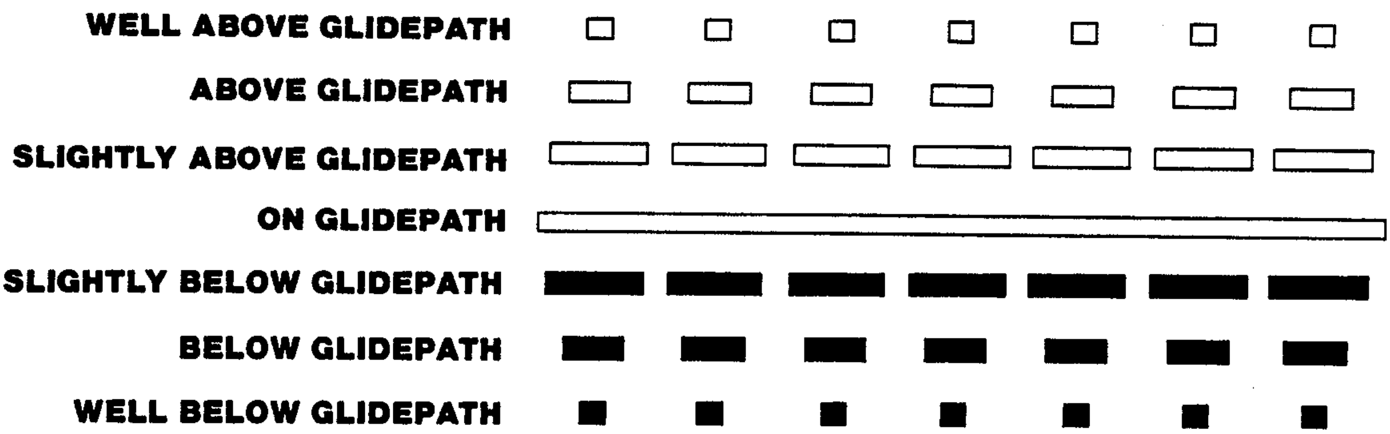
A pilot who is on the glidepath will see a steady white light.

If the aircraft is *above* the glidepath, the pilot will see a pulsing *white light.* The further the aircraft deviates from the glidepath, the faster the pulses appear to the pilot. As the pilot corrects his approach and nears the glidepath, the pulse of the white light appears to become slower, until he intercepts the glidepath and sees one continuous white light.

If the aircraft is *below* the glidepath, the pilot will see a pulsing *red light.* The further the aircraft deviates from the glidepath, the faster the pulses appear to the pilot. As the pilot corrects his approach and nears the glidepath, the pulse of the red light appears to become slower, until he intercepts the glidepath and sees one continuous white light.

The on-glidepath-steady-white light is an angular wedge of 1/3 of a degree. This translates to approximately 1¼ dots above or below the glidepath on an ILS glide slope indicator.

A pictorial representation of the signals is below.



DE VORE AVIATION CORPORATION

6104-B Kircher Boulevard, N.E. Albuquerque, New Mexico Tel. (505) 345-8713 Telex: 660-436

EXHIBIT NO. 1

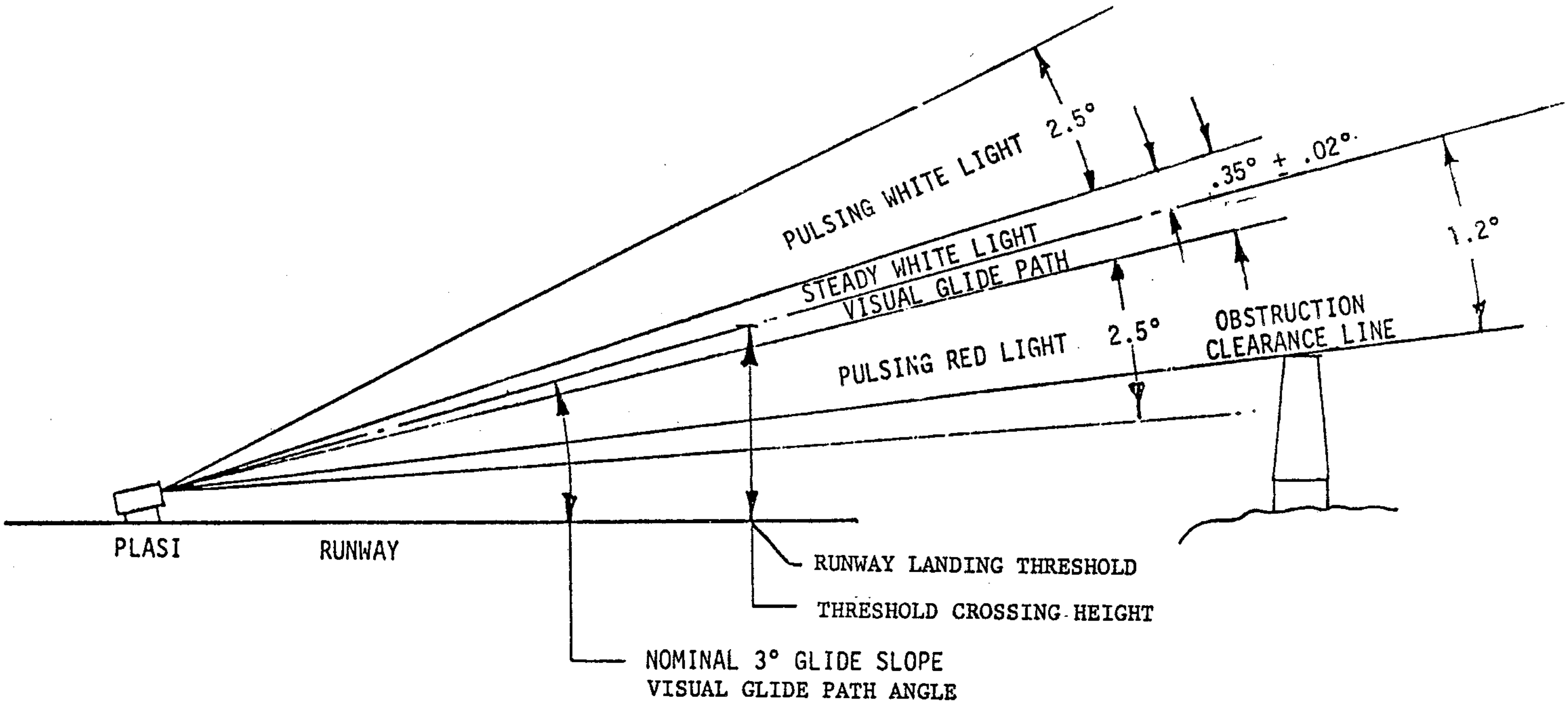
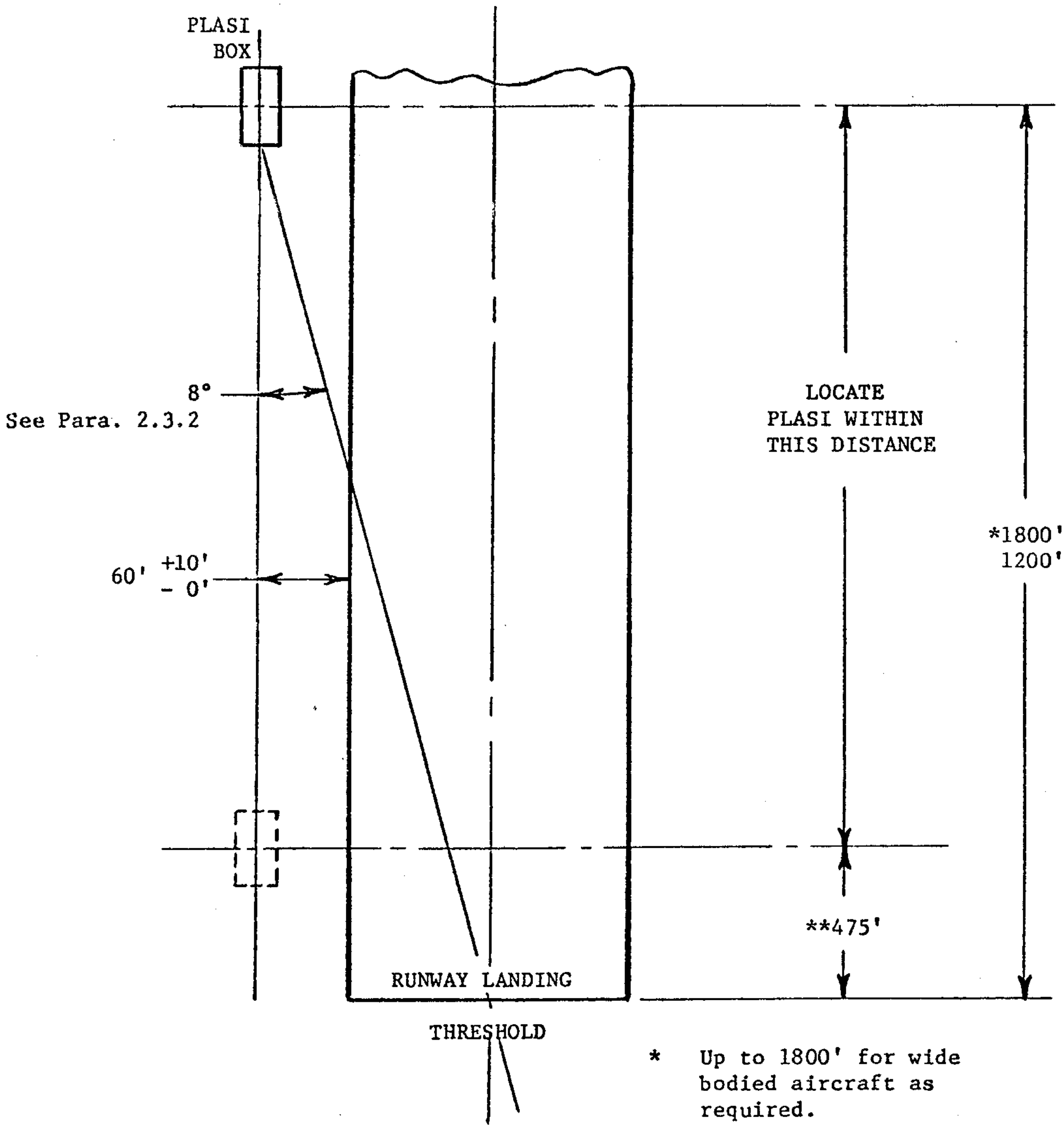


FIGURE 1 - PLASI AIMING AND OBSTRUCTION DIAGRAM



* Up to 1800' for wide bodied aircraft as required.

** For extremely short runways, this distance can be reduced, and/or the PLASI glide path angle increased, if there are "absolutely" no obstacles in the approach path.

FIGURE 2

PLASI SYSTEM LAYOUT

Please complete this questionnaire for each approach on which PLASI was utilized and deposit it in the box at the shelter at the north end of the apron. (Continue comme on rear of form if desired.)

PILOT QUESTIONNAIRE - PLASI VISUAL APPROACH INDICATOR

1. Did you have any difficulty interpreting or understanding PLASI? NO __ YES __
IF YES, WHAT WAS THE PROBLEM? ______

2. Did you experience any difficulty locating or identifying the PLASI signal?
NO __ YES __ COMMENT ______

3. Did you experience any difficulty or confusion while flying the PLASI signal after acquisition? NO __ YES __ COMMENT ______

4. Do you consider the PLASI "active" vertical deviation signal (pulsing white/ pulsing red) a better safety benefit than the standard VASI system while flying a visual glidepath signal? NO __ YES __ COMMENT ______

5. Was the level of attention required to maintain the PLASI glidepath greater or less than that required to fly the standard VASI? GREATER __ LESS __ SAME __
COMMENT ______

6. Did the level of attention required to maintain the PLASI glidepath interfere with other required cockpit duties? NO __ YES __
COMMENT ______

7. How many approaches have you flown using PLASI? DAY ______ NIGHT ______
If more than one, were subsequent approaches easier to fly? NO __ YES __
COMMENT ______

8. Was the PLASI touchdown point positioned well? YES __ NO __
If not, would you prefer a touchdown: ___ Farther down the runway?
___ Closer to the threshold?

9. Did the PLASI provide adequate clearance over obstacles? NO __ YES __
COMMENT ______

10. Was the visual glide slope? About right ___, too steep ___, or too flat ___?
COMMENT ______

11. What type of aircraft was utilized for the approach(s)? ______

12. What is your proficiency?

	Alaskan Hours	Total Hours
Under 200	______	______
200 to 500	______	______
Over 500	______	______

Certificates:

Private ______
Commercial ______
CFI ______

13. Do you recommend that this type of visual glide slope be installed at small airfields throughout the State? NO __ YES __

14. Please comment on your preference between the PLASI and other VASI units, and cite airports where you believe visual approach indicators would be useful:

______

______

EXHIBIT NO. 4

STATE OF ALASKA
DEPT. OF TRANSPORTATION & PUBLIC FACILITIES
Central Division Planning & Programming

Jay S. Hammond, Governor

4111 Aviation Avenue
Anchorage, Ak. 99502
(907) 266-1462

Mail: Pouch 6900
(Telex 25-185)

August 12, 1981

To The Members Of The
Alaska Airmen's Association, Inc:

We're using this means -- a mass-reproduced form letter -- to advise you of an experimental type of visual approach slope indicator (VASI) being tested on the Lake Hood strip. A nearly identical letter was distributed about a month ago to those pilots renting tiedowns at the Lake Hood strip. If you received a copy then, or are not a pilot, please pass this on to an interested pilot. We are fortunate in being able to extend our test program to the end of August, which will provide more experience with PLASI operations, especially after darkness.

We want to describe the device and our involvement, and seek your help in evaluating it. It is an approach slope indicator using a pulsating light beam to indicate the viewer's position above, on, or below the pre-set approach slope. The enclosed information sheet provides details to help you use the signal. In our case the unit is installed for approachs to runway 13. Weather permitting, it is visible beyond Pt. MacKenzie; it is set to indicate an approach path below the Elmendorf corridor. The on-course beam is at about 1200' over Pt. MacKenzie, and about 800' at mid-channel. The beam has a horizontal spread of 16 degrees -- eight degrees to either side of the runway centerline extended. The unit is a small red box west of the runway about 350' south of the threshold, or about 100' north of the new taxiway. It is set such that the beam will pass from view just before the aircraft reaches the threshold. The visual glide slope is set to designate a touch-down opposite the unit, or about 350' south of the threshold.

We became involved when the manufacturer, DeVore Aviation Corporation, exhibited the unit at the Alaska Air Carriers' Association annual meeting and subsequently invited us to test it under local conditions. We are handling the testing as a research project, and "user input" or pilots' comments are essential to our evaluation. The State is still giving priority to providing adequate, safe, basic airports and then installing conventional runway lights; the Department has not made any committment to become involved in providing VASI's, which have traditionally been included in FAA's landing aid program. However, the manufacturer's offer was an opportunity to explore local pilot reactions and familiarize local FAA personnel with the equipment.

If you have an opportunity, please 'test fly' the PLASI on approaches to runway 13 and complete our questionnaire. (Two copies are enclosed; additional copies are in the shelter at the strip.) We do urge that you not concentrate on flying the PLASI so intently that you neglect routine responsibilities -- particularly 'seeing and avoiding' other traffic in this busy Anchorage terminal area airspace.

Completed questionnaries may be deposited in the marked box within the shelter, left at the DOT/PF office south of the Hood-Spenard channel, or sent to us at Mail Pouch 6900, Anchorage, 99502. We would appreciate getting as many completed questionnaries as possible by August 31, the extended close-out date for the field testing. If you have questions or want to discuss the PLASI, please call us at 266-1462 and ask for Jim Moody, or visit our office in the DOT/PF building.

Sincerely,

William R. Snell

William R. Snell,
Deputy Director

Enclosures

EXHIBIT NO. 5

Chapter 2. AIRPORT, AIR NAVIGATION LIGHTING AND MARKING AIDS

Section 1. AIRPORT LIGHTING AIDS

40. INSTRUMENT APPROACH LIGHT SYSTEMS (ALS)

a. Instrument approach light systems provide the basic means for transition from instrument flight using electronic approach aids to visual flight and landing. Operational requirements dictate the sophistication and configuration of the approach light system for a particular airport.

b. Condenser-Discharge Sequenced Flashing Light Systems (SFL) are installed in conjunction with the instrument approach light system at some airports which have U.S. Standard "A" approach lights as a further aid to pilots making instrument approaches. The system consists of a series of brilliant blue-white bursts of light flashing in sequence along the approach lights. It gives the effect of a ball of light traveling towards the runway. An impression of the system as a pilot first observes the flashing lights when making an approach is that of large tracer shells rapidly fired from a point in space toward the runway.

c. Omnidirectional flashing light lead-in approach and runway end identifier light systems are now being installed at several airports. This system consists of five flashing lights located on the extended runway centerline and two located on either side of the runway threshold. The lights flash toward the threshold in sequence.

41. VISUAL APPROACH SLOPE INDICATOR (VASI)

a. The VASI is a system of lights so arranged to provide visual descent guidance information during the approach to a runway. These lights are visible from 3–5 miles during the day and up to 20 miles or more at night. The visual glide path of the VASI provides safe obstruction clearance within plus or minus 10 degrees of the extended runway centerline and to 4 nautical miles from the runway threshold. Descent, using the VASI, should not be initiated until the aircraft is visually aligned with the runway. Lateral course guidance is provided by the runway or runway lights.

b. VASI installations may consist of either 2, 4, 6, 12, or 16 lights units arranged in bars referred to as near, middle, and far bars. Most VASI installations consist of 2 bars, near and far, and may consist of 2, 4, or 12 light units. Some airports have VASI's consisting of three bars, near, middle, and far, which provide an additional visual glide path for use by high cockpit aircraft. This installation may consist of either 6 or 16 light units. VASI installations consisting of 2, 4, or 6 light units are located on one side of the runway, usually the left. Where the installation consists of 12 or 16 light units, the light units are located on both sides of the runway.

c. Two bar VASI installations provide one visual glide path which is normally set at 3 degrees. Three bar VASI installations provide two visual glide paths. The lower glide path is provided by the near and middle bars and is normally set at 3 degrees while the upper glide path, provided by the middle and far bars, is normally 1/4 degree higher. This higher glide path is intended for use only by high cockpit aircraft to provide a sufficient threshold crossing height. Although normal glide path angles are three degrees, angles at some locations may be as high as 4.5 degrees to give proper obstacle clearance. Pilots of high-performance aircraft are cautioned that use of VASI angles in excess of 3.5 degrees may cause an increase in runway length required for landing and rollout.

d. The following information is provided for pilots as yet unfamiliar with the principles and operation of this system and pilot technique required. The basic principle of the VASI is that of color differentiation between red and white. Each light unit projects a beam of light having a white segment in the upper part of the beam and red segment in the lower part

EXHIBIT NO. 6

of the beam. The light units are arranged so that the pilot using the VASIs during an approach will see the combination of lights listed below.

e.

2-BAR VASI

Aircraft Position	*Light Bar*	*Color*
(1) Below glide path	Far	Red
	Near	Red
(2) On glide path	Far	Red
	Near	White
(3) Above glide path	Far	White
	Near	White

f.

3-BAR VASI

Aircraft Position	*Light Bar*	*Color*
(1) Below both glide paths	Far	Red
	Middle	Red
	Near	Red
(2) On lower glide path	Far	Red
	Middle	Red
	Near	White
(3) On upper glide path	Far	Red
	Middle	White
	Near	White
(4) Above both glide paths	Far	White
	Middle	White
	Near	White

g. When on the proper glide path of a 2-bar VASI, the pilot will see the near bar as white and the far bar as red. From a position below the glide path, the pilot will see both bars as red. In moving up to the glide path, the pilot will see the color of the near bar change from red to pink to white. From a position above the glide slope the pilot will see both bars as white. In moving down to the glide path, the pilot will see the color of the far bar change from white to pink to red. When the pilot is below the glide path the red bars tend to merge into one distinct red signal and a safe obstruction clearance may not exist under this condition.

h. When using a 3-bar VASI it is not necessary to use all three bars. The near and middle bars constitute a 2 bar VASI for using the lower glide path. Also, the middle and far bars constitute a 2-bar VASI for using the upper glide path. A simple rule of thumb when using a 2-bar VASI is:

(1) All Red -- Too Low

(2) All White -- Too High

(3) Red and White -- On Glide Path

i. In haze or dust conditions or when the approach is made into the sun, the white lights may appear yellowish. This is also true at night when the VASI is operated at a low intensity. Certain atmospheric debris may give the white lights an orange or brownish tint; however, the red lights are not affected and the principle of color differentiation is still applicable.

42. TRI-COLOR VISUAL APPROACH SLOPE INDICATOR

a. Tri-color Visual Approach Indicators have been installed at general aviation and air carrier airports. The Tri-color Approach Slope Indicator normally consists of a single light unit, projecting a three-color visual approach path into the final approach area of the runway upon which the system is installed. In all of these systems, a below glide path indication is red, the above glide path indication is amber and the on path indication is green.

b. Presently installed Tri-color Visual Approach Slope Indicators are low candlepower projector-type systems. Research tests indicate that these systems generally have a daytime useful range of approximately 1/2 to 1 mile. Nighttime useful range, depending upon visibility conditions, varies from 1 to 5 miles. Projector-type Visual Approach Slope Indicators may be initially difficult to locate in flight due to their small light source. Once the light source is acquired, however, it will provide accurate vertical guidance to the runway.

> *CAUTION:* Pilots should be aware that this yellow-green-red configuration produces a yellow-green transition light beam between the yellow and green primary light segments and an anomalous yellow transition light beam between the green and red primary light segments. This anomalous yellow signal could cause confusion with the primary yellow too-high signal.

43. RUNWAY END IDENTIFIER LIGHTS (REIL)

a. Runway End Identifier Lights are installed at many airfields to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights, one of which is located laterally on each side of the runway threshold facing the approach area. REILs may be located longitudinally 200 feet either upwind or downwind from the runway threshold. They are effective for:

(1) Identification of a runway surrounded by a preponderance of other lighting.

(2) Identification of a runway which lacks contrast with surrounding terrain.

(3) Identification of a runway during reduced visibility.

44. RUNWAY EDGE LIGHT SYSTEMS

a. Runway edge lights are used to outline the edges of runways during periods of darkness and restricted visibility conditions. These light systems are classified according to the intensity or brightness they are capable of producing: they are the High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL), and the Low Intensity Runway Lights (LIRL). The HIRL and MIRL systems have variable intensity controls, whereas the LIRLs normally have one intensity setting.

b. The runway edge lights are white except that on instrument runways aviation yellow replaces white on the last 2,000 feet or half the runway length, whichever is less, to form a caution zone for landings. The lights marking the longitudinal limits of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft.

45. IN-RUNWAY LIGHTING

a. Touchdown zone lighting and runway centerline lighting are installed on some precision approach runways to facilitate landing under adverse visibility conditions. Taxiway turnoff lights may be added to expedite movement of aircraft from the runway.

(1) **Touchdown Zone Lighting (TDZL)** — two rows of transverse light bars disposed symmetrically about the runway centerline in the runway touchdown zone. The system starts 100 feet from the landing threshold and extends to 3000 feet from the threshold or the midpoint of the runway, whichever is the lesser.

(2) **Runway Centerline Lighting (RCLS)** — flush centerline lights spaced at 50-foot intervals beginning 75 feet from the landing threshold and extending to within 75 feet of opposite end of the runway.

(3) **Runway Remaining Lighting** — is applied to centerline lighting systems in the final 3,000 feet as viewed from the takeoff or approach position. Alternate red and white lights are seen from the 3,000 foot points to the 1,000 foot points, and all red lights are seen for the last 1,000 feet of the runway. From the opposite direction, these lights are seen as white lights.

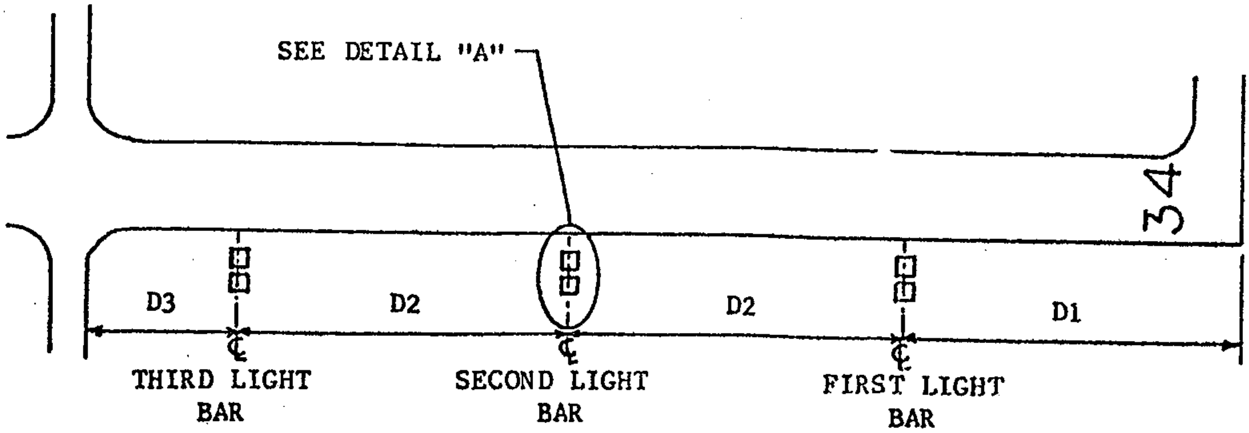
(4) **Taxiway turnoff lights** — flush lights spaced at 50 foot intervals defining the curved path of aircraft travel from the runway centerline to a point on the taxiway.

46. CONTROL OF LIGHTING SYSTEMS

a. Operation of approach light systems and runway lighting is controlled by the control tower. At some locations the FSS may control the lights where there is no control tower in operation.

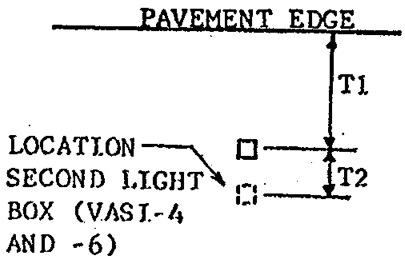
b. Pilots may request that lights be turned on or off. Runway edge lights, in-pavement lights and approach lights also have intensity controls which may be varied to meet the pilots request. Sequenced flashing lights (SFL) may be turned on and off. Some sequenced flashing light systems also have intensity control.

c. The Medium Intensity Approach Lighting System with Runway Alignment Indicators (MALSR) has been installed at many airports. The control of MALSR is now being transferred from the runway light circuits to Air Traffic



ITEM	DIMENSIONS		
	PREFERRED	MINIMUM	MAXIMUM
D1	500'(150 m.)	125'(38 m.)1/	800'(240 m.)
D2	300'(90m.)2/ 700'(210 m.)	250'(75m.)2/ 500'(150 m.)	400'(120 m.)2/ 1000'(300 m.)
D3	--	50'(15 m.)	--
T1	50'(15 m.)	50'(15 m.)3/	60'(18 m.)
T2	16'(4.85 m.)	15.5'(4.7 m.)	16.5'(5.0 m.)

1/ See paragraph 3a.
2/ For SAVASI. May be used for siting VASI-2 on utility airports with space limitations and no plans for expansion to a VASI-4.
3/ See paragraph 5a(1).



DETAIL "A"

NOTES

1. All light bars are located at the same distance from the runway edge.

2. The center of the optical aperture of all light boxes in a bar should be within ±1 foot (0.3 m.) of the runway crown elevation.

3. Longitudinal (D) minimum/maximum dimensions should be used only to avoid taxiways, cross runways, etc., or to achieve the desired unit height required by terrain conditions.

4. Transverse (T) minimum/maximum dimensions should be used only to avoid ditches, catch basins, manholes, etc.

FIGURE 2. VASI SYSTEMS LAYOUT

A = AIMING ANGLE, BAR #3 (3.25°)

B = AIMING ANGLE, BAR #2 (3.00°)

C = AIMING ANGLE, BAR #1 (2.75°)

T1 = THRESHOLD CROSSING HEIGHT (TCH), DOWNWIND ZONE

T2 = THRESHOLD CROSSING HEIGHT (TCH), UPWIND ZONE

RRP = RUNWAY REFERENCE POINT

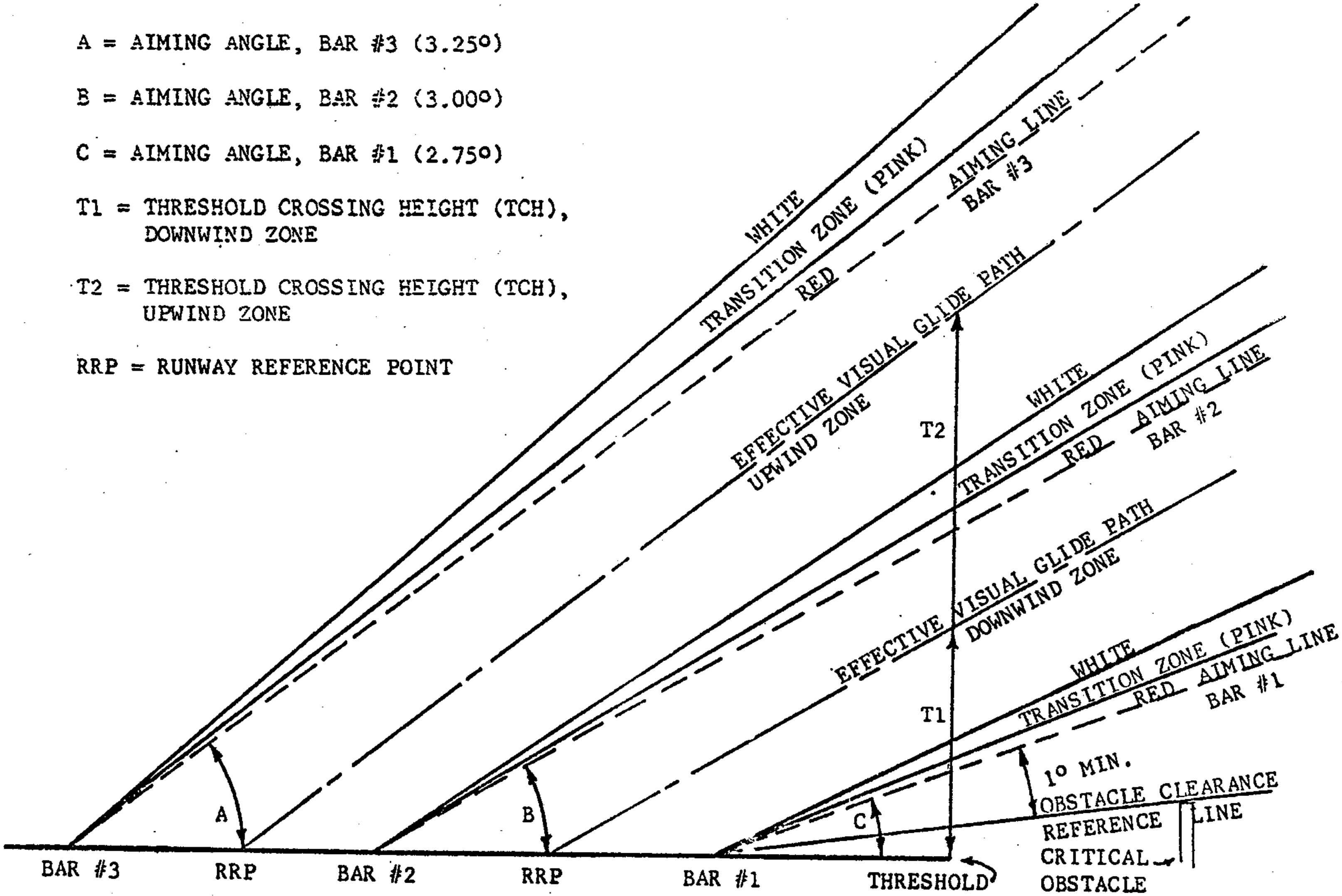


FIGURE 4. AIMING AND OBSTACLE CLEARANCE DIAGRAM FOR A 3-BAR VASI

U.S. Department
of Transportation
**Federal Aviation
Administration**

Alaskan Region

701 C Street, Box 14
Anchorage, Alaska
99513

Mr. William R. Snell, Deputy Director
Dept. of Transportation
and Public Facilities
Pouch 6900
Anchorage, AK 99502

RE: PLASI Research

Dear Mr. Snell:

Attached is a copy of our Flight Inspection of the PLASI. Comments from other FAA pilots range from ok to good to not as good as VASI. Some of those who flew it may have completed your questionnaire.

Our Technical Center (formerly NAFEC) did an evaluation on this system with a generally unfavorable conclusion. The report identification is NA-78-53-LR. If you do not have a copy, call Fred Porter, of this office, 271-5517, and he will send you one.

The PLASI is a mechanically complicated device, with a considerable number of parts (motor, fan, chain belt, etc.) and would be subject to more failures than the VASI, which has an excellent maintenance record.

Sincerely

J.P. Bushnell
Jerome P. Bushnell
Chief, Flight Standards Division, AAL-200

Encl: Flight Inspection Report
Visual Aids

EXHIBIT NO. 9

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
TECHNICAL CENTER
ATLANTIC CITY AIRPORT, NEW JERSEY 08405

June 15, 1981

Received
ANCHORAGE, ALASKA
JUN 24 REC'D
TRANSPORTATION & PUBLIC FACILITIES

Mr. James E. Moody
Department of Transportation
4111 Aviation Avenue
Anchorage, Ak 99502

Dear Mr. Moody:

In reply to your letter of June 2, 1981, we will be happy to provide you with a copy of our "PAPI" Evaluation Report when it is published later on in the year. We expect to have the testing concluded and the report issued by November, 1981. In the meanwhile, I am sending with this letter some data sheets provided by the British manufacturer of the equipment that we are using for our tests. This should serve to give you a better idea of the concepts and angular relationships involved.

Concerning the PLASI, we tested the unit several years ago, when it was called "PCOLA", and I am attaching a copy of our Technical Letter Report covering the test results. You might want to contact Mr. Fred Porter, at the Alaskan Regional FAA Office for further information, since he and I have discussed the "PLASI" at length over the phone only recently.

We do not have any kind of listing of the various vertical angle visual guidance devices here at the Technical Center, since we have by no means tested each of them individually. To the best of my knowledge, only the standard Red/White "VASI" has been "approved" for installation by either the FAA or with ADAP Federal Funds. This "VASI" is the only system described in FAA Advisory Circulars and for which "approved manufacturers" are listed in AC 150/5345-1F, "Approved Airport Lighting Equipment".

The "PLASI" system has been granted an "approval" by the Associate Administrator for Aviation Standards for use in support of helicopter operations, and may well obtain a similar "approval" for use in support of fixed-wing aircraft operations. However, this "approval" merely indicates that the "PLASI" is suitable for operational use when properly installed at an airport or heliport, and does not indicate approval for funding under ADAP or other Government programs. In essence, it means that the "PLASI" is not unsafe for use and, beyond that, nothing more.

The Advisory Circular numbers that you mentioned in your letter pretty well cover the group involved with "VASI" systems, and I cannot think of any others that would be pertinent.

EXHIBIT NO. 10

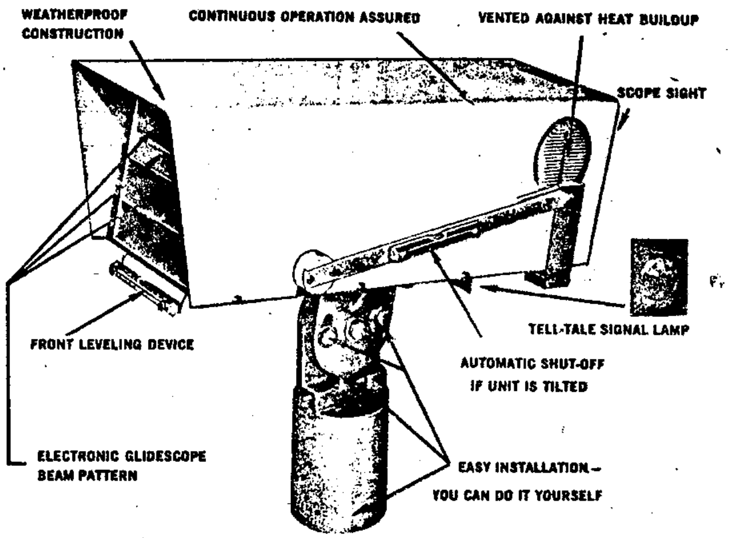
"VASI" systems purchased by the FAA and installed as commissioned systems were, in the past, described in a special document called a "Selection Memorandum", and only the Standard Red/White "VASI" is presently procurred and installed as an FAA facility. While the "Selection Memorandum" procedure has not been utilized lately, I would assume that the "PAPI" would be selected in this manner when, and if, it is adopted by the United States for inclusion in the National Airspace System. This then is the only other form of FAA "Approval" that I know of, and pertains only to systems procurred by the FAA and installed with government funds (not ADAP funds).

I hope that these answers to your questions are satisfactory. Please feel free to call me at any time (Tel: 609-641-8200, ext. 2138) for further information.

Sincerely yours,

Thomas H. Paprocki
Program Manager
Visual Guidance

ACT-410



RICHTER FAIL-SAFE **VASI**

VISUAL APPROACH SLOPE INDICATOR (VASI) insures safe, perfect nighttime landings at small to large airfields. Indicator projects three distinct light beams that are visible at distances up to four miles. The middle GREEN gives the incoming plane the correct approach slope for a perfect landing. A YELLOW beam signals to the pilot that he is too high. RED beam indicates that he is too low. To establish glideslope, simply sight through the scope of the VASI onto an incoming aircraft making a correct approach and then tighten the setscrews. Weatherproof unit is equipped with two 300-watt quartz lamps for long-range visibility. The unit is fail safe. When primary lamp burns out, secondary lamp automatically takes over. Indicator shuts off if unit is accidently or maliciously moved. Easy-to-install unit mounts on any standard 1½" steel pipe above high grass or snow level. Includes complete instructions. Makes nighttime landings safe and smooth. This is the unit Sporty uses at the Clermont County Airport. We had a real nighttime problem here which has been reduced to a no-problem situation with the 3-color VASI. Landing at Clermont County on runway #4 requires an approach over a valley which almost always insures an area of turbulence before crossing the trees that block the approach path. As a result, pilots made their approaches high, steep, and fast. Now with the VASI insuring a perfect approach and assurance that you will not descend into the trees, the full runway length can once again be used for night landings. As simple as this unit can be installed and the comparatively small cost, it is a must for any runway used at night that does not have a clear approach.
2387A. $590.00

EXHIBIT NO. 11

U.S. Department of Transportation
Federal Aviation Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 15, 1981

Mr. Gilbert DeVore
DeVore Aviation Corporation
6104B Kircher Boulevard, NE.
Albuquerque, New Mexico 87109

Dear Mr. DeVore:

This is in response to your letters of October 13 and November 16 in
----

--.

My letter to you dated October 5 reported the operational determinations concerning the suitability of PLASI for use by fixed wing aircraft. These determinations were based on an analysis of the data collected during the test. One of those conclusions was that PLASI is a useable and effective aid to fixed wing aircraft for vertical glide slope guidance and, therefore, the PLASI system is approved for use by both fixed wing and helicopter aircraft in the National Airspace System. However, as stated earlier, before PLASI could be considered for federal funding under ADAP or F&E programs, it would have to be demonstrated that it provided either an operational or economic advantage over the International Civil Aviation Organization recommended systems, i.e., VASI or its expected replacement, Precision Approach Path Indicator (PAPI).

We recommend that you advise any prospective U.S. customers purchasing PLASI of the requirement to notify the National Flight Data Center, AAT-430, Washington, D.C. 20591, of any installation on public use airports or heliports. They should also be advised to coordinate these installations with the appropriate Flight Standards Regional Office in the geographical areas of the planned installation.

Sincerely,

J. Lynn Helms
Administrator

Enclosure

EXCERPTED COPY

EXHIBIT NO. 12

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BIBLIOGRAPHY

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