ORDER

6750.36

SITE SURVEY, SELECTION, AND ENGINEERING DOCUMENTATION FOR INSTRUMENT LANDING SYSTEMS AND ANCILLARY AIDS

11/25/77

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: W – SELECT; RAF/AT/FS/AS/PL-3; RLG/BU-2; CAE/AY/DE-3; FAF-2/3 (Minimum); FAS-1 (Minimum)

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RECORD OF CHANGES

DIRECTIVE NO. **6750.36**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

1. PURPOSE. This document is provided as a guide to engineering personnel engaged in the site survey, selection, and engineering documentation of instrument landing systems (ILS) and ancillary aids. Sufficient information supplemented with typical drawings is provided to enable the engineer to perform the site survey and prepare reports and drawings necessary for selecting and establishing Category I and Category II ILS.

2. DISTRIBUTION. This order is distributed to selected offices in the Airway Facilities, Air Traffic, Flight Standards, Logistics, and Systems Research and Development Services and the Offices of Airports Programs, Budget, and Environmental Quality in Washington headquarters; to branch level in the regional Airway Facilities, Air Traffic, Flight Standards, and Airports divisions and Planning staffs; to division level in the regional Budget and Logistics divisions; to branch level in the Airway Engineering Support Division, FAA Academy, and FAA Depot at the Aeronautical Center; and to all Airway Facilities sectors and Airports district offices.

3. BACKGROUND. Recent agency experience with ILS site surveys has highlighted the need for comprehensive guidance for the site survey, selection, and engineering documentation for ILS and ancillary aids. The agency expertise has been unavailable to newer FAA employees as well as to site survey contractors. Technical continuity, a greater degree of uniformity among the various regions, and significant cost economies in all facets of ILS establishment are needed. With the considerable input and invaluable assistance of many individuals both in the Washington headquarters and the regions, such a document has been prepared. It is designed to focus diverse elements into a common purpose and standardize them to levels that will enhance technical performance.

4. APPLICATION. This document is to be used as a companion document with Order 6750.16A, Siting Criteria for Instrument Landing Systems, to assist the plant engineering organization involved with the site survey, selection, and documentation of ILS systems.

5. IMPLEMENTATION. The basic requirements for the site survey, selection, and engineering documentation for ILS and ancillary aids, as presented herein, are applicable FAA-wide. However, there are many approaches, methods, and techniques that are and can be employed successfully to achieve the same goals - the effective, efficient, timely, economical, and safe establishment of ILS and ancillary aids. There are significant differences in regional organizations and the distribution of responsibilities, which impact significantly on how such projects are accomplished. Thus, to derive maximum benefit from using this document in day-to-day activities, it is imperative that each region develop

implementation instructions to reflect its own policies, practices, and procedures - either as a formal supplement to this directive or as a companion document. Such implementation guidance should be published within 120 days of the issuance of this order and should include, but not be limited to, delineation of the following:

a. Organizational responsibilities within the regional Airway Facilities division for the planning, programming, siting, engineering, establishment, and coordination activities described herein. This includes those involving the project engineer and site survey engineer as defined in paragraph 8.

b. Interface responsibilities of the regional Airway Facilities division, and the regional Airports, Air Traffic, Budget, Flight Standards, and Logistics divisions and Planning staff.

c. Coordination responsibilities between the regional Airway Facilities division and Airway Facilities sectors, Airports District offices, airport traffic control towers, and Flight Standards field offices, and the airport sponsor.

d. Feasibility study concept, including the nature, timing, regional/local participation, documentation of findings, and management concurrences.

e. Site survey accomplishment via FAA personnel and/or via contracting for limited scope engineering services or for the complete survey and documentation. This includes the preparation of the proper written guidance defining the work requirements.

f. Site survey report, including format, content, coordination, and management concurrences.

g. Authorization for and/or restriction on site survey engineers to conduct discussions with airport sponsors, utility companies, and property owners.

h. Airport obstruction survey responsibilities, including its accomplishment, verification, and validation plus the resultant removal of penetrations to the applicable obstruction surfaces.

i. Maximum practicable use of national standard drawings and specifications issued by the Airway Facilities Service to enable FAA-wide uniformity compatible with site technical requirements and local cost economies.

6. DIRECTIVE VERBS. The material in this order contains FAA criteria, policy statements, recommended practices, and other guidance material that require the use of certain directive verbs such as SHALL, SHOULD, WILL, and MAY. In this order, the explicit meaning of these verbs is as follows:

   a. SHALL - The action is mandatory. For example: "The glide slope antenna SHALL be sited in accordance with Order 6750.16A."

   b. SHOULD - The action is desirable or recommended. For example: "When a runway has been designated and authorized for the establishment of an ILS, the project engineering SHOULD commence promptly."

   c. WILL - The action is to be taken in the future. For example: "A DME WILL usually be planned where an outer marker facility is not practical."

   d. MAY - The action is permissible. For example: "In some areas, particularly where property is very valuable or property lines are ill defined, it MAY be desirable to use a registered land surveyor to perform plot surveys for markers."

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CHAPTER 1. GENERAL INFORMATION

1. INTRODUCTION.

   a. The instrument landing system (ILS) provides guidance to pilots of properly equipped aircraft, which assists them in landing safely under conditions of reduced ceilings and lowered visibility. The ILS consists of a localizer (LOC), providing lateral guidance along the approach runway centerline extended; a glide slope (GS), providing vertical guidance along the approach path; and marker beacons (MKR), indicating approximate distances of the approaching aircraft from the runway threshold. Figure 1-1 indicates a typical layout of an ILS.

   b. Instrument landing systems are categorized according to the minimum visibility and ceiling conditions in which aircraft landings are permissible. Category I ILS provides guidance for minimums of approximately one-half mile visibility (or 2,400 feet runway visual range (RVR) and 200-foot ceiling; in conjunction with other navigational aids, the minimums may be further reduced to 1,800 feet RVR. Category II ILS provides guidance for minimums of approximately one-quarter mile visibility (or 1,200 feet RVR) and 100-foot ceiling. Category III ILS systems are designed for minimums approaching zero visibility and ceiling. There are intermediate steps for various combinations of navigational aids and airport configurations.

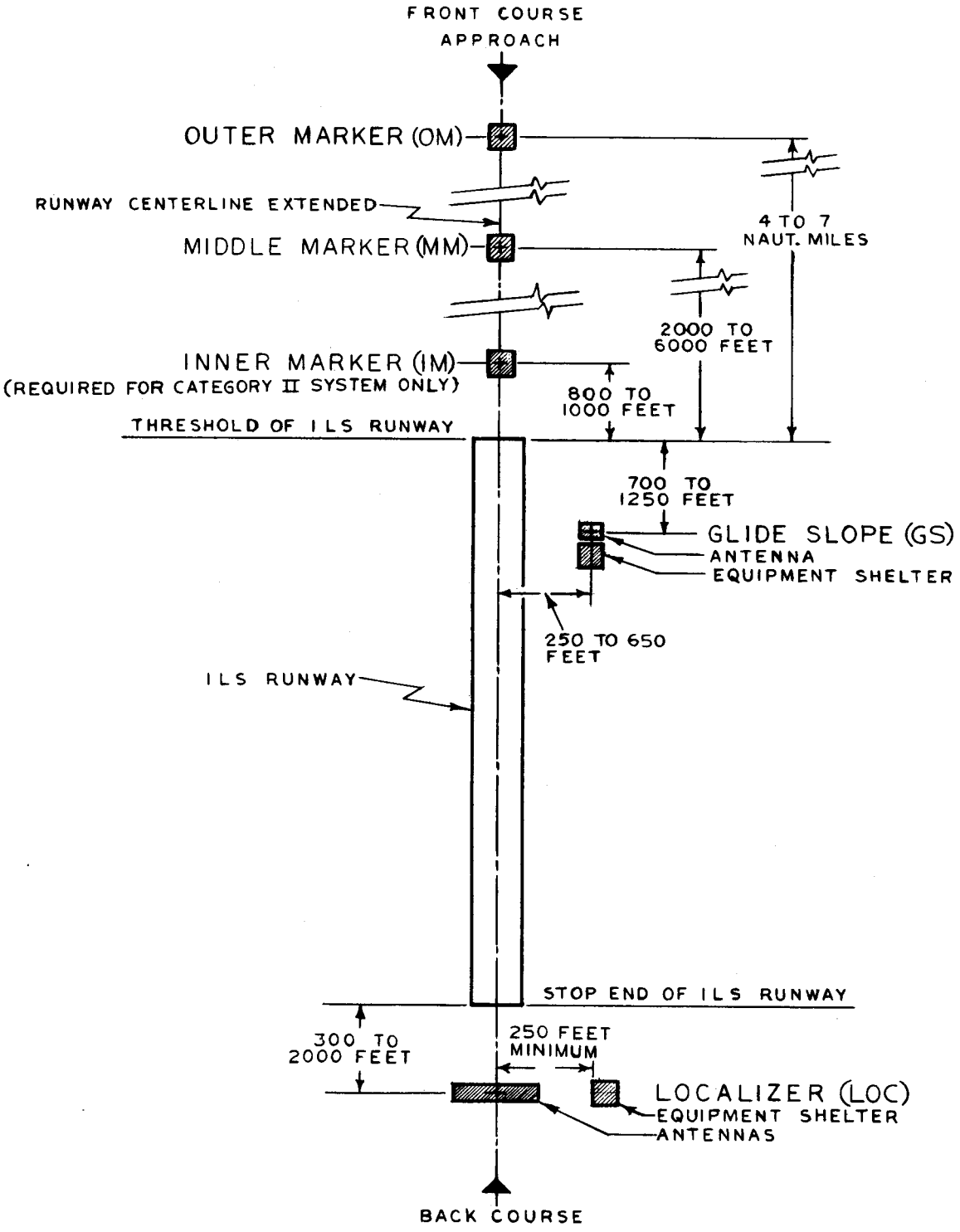
   c. Additional navigational aids, which are sometimes used with the ILS, are nondirectional beacons (NDB) (such as the compass locator (COMLO), distance measuring equipment (DME) (usually located at the localizer site), and the various approach lighting systems (ALS).

2. GENERAL. This order sets forth validated techniques, methods, and procedures for use by FAA personnel and/or FAA contractors engaged in the site survey, selection, and construction of an ILS and its ancillary aids. Particular attention is devoted to conducting efficient, effective, and economical in-office and onsite survey activities. National standardization in this area will better enable site survey engineers to present data collected in the office and in the field in a fashion suitable for FAA management to make appropriate decisions, and to develop a completely detailed site drawing and specification package that can be used for competitive bidding and construction purposes.

3. EMPHASIS. This publication contains information that:

   a. Is primarily directed to civil, architectural, structural, mechanical, electrical, electronics, environmental, and land acquisition aspects of an ILS establishment.

FIGURE 1-1. TYPICAL ILS FACILITIES PLACEMENT



b. Responds to the needs of the Airway Facilities, Air Traffic, Airports, Environmental Quality, Flight Standards, and Logistics elements of the FAA.

c. Covers the siting aspects of Category I and II localizers, glide slopes, markers, and ancillary aids.

d. Indicates the use of national, regional, and industry standards, and identifies those standards and parameters for which compliance is mandatory.

e. Stipulates the specific engineering and nontechnical data that shall be obtained as part of an ILS site survey. A sample checklist is provided herein.

f. Establishes a standard format and content for a site selection report.

g. Identifies the coordination and interface requirements within the FAA as well as with other Federal, state, local, airport, private property owners, and utility company representatives.

h. Delineates criteria, procedures, techniques, cost vs. benefit tradeoffs, and validation required to survey, select, and construct an ILS.

4. ABBREVIATIONS, ACRONYMS, AND PUBLICATION REFERENCES. Abbreviations and acronyms relating to FAA organizations, equipments, and terminology as well as references to FAA directives, advisory circulars, and regulations are used extensively throughout this document. All abbreviations and acronyms are fully explained in Appendix 1, Glossary of Abbreviations and Acronyms, and the complete titles of all cited publication numbers are provided in Appendix 2, Applicable FAA Documents.

5. RELATIONSHIP WITH OTHER ILS SITING DOCUMENTS. This order largely consolidates the methods and techniques for ILS site survey, selection, and engineering documentation that are delineated in other ILS siting documents. Basic siting criteria for ILS equipment and ancillary aids has been extracted from Order 6750.16A. Placement limitations of ILS components and descriptions of their operational characteristics are contained in Orders 6750.4, 6750.7, 6750.13, and 6750.20, and Handbook 8260.3. These publications contain the primary siting guidelines available to the site survey engineer. A list of other applicable material with which the site survey engineer should be familiar is contained in appendix 2. This order will be updated as required to reflect accurately data revised in other existing documents as well as additional information in new documents.

6. RESPONSIBILITIES. A great degree of coordination and interface is required during the site selection and establishment process. It is the intent here to list most of the FAA and out-of-agency elements with whom interaction may be required. The site survey engineer should be

thoroughly familiar with the FAA organizational structure at the national and regional levels. By knowing who is responsible for the various aspects of an ILS establishment, the site survey engineer will be better equipped to seek assistance when required. It is recognized that some functions of the regional elements may vary and, thus, the identity and titles of Airway Facilities division branches will differ from region to region.

a. FAA Elements.

(1) Washington Office.

(a) Airway Facilities Service.

1 Establishment Programs Division. Budget estimates, project authorizations, funds adjustments, etc.

2 Navaids/Communications Engineering Division. Program management, siting criteria development, waivers to siting criteria, electronic engineering, etc.

3 Environmental Systems Division. Plant engineering support.

(b) Flight Standards Service. Compatibility of siting criteria with aircraft operations; reviews waivers to siting criteria, etc.

(c) Air Traffic Service. Impact on air traffic procedures.

(d) Office of Airports Programs. Interface with Airport Development Aid Program (ADAP) policy.

(e) Logistics Service. Real estate and utility service acquisition policy.

(f) Office of Environmental Quality. Environmental quality policy.

(2) Regional Office.

(a) Airway Facilities Division.

1 Planning and Programming Branch. Budget estimates, project assignment, funds adjustments, environmental assessment (Environmental Impact Statements, Negative Declarations), A-95 Notification. See paragraph 6a(2)(a)2 below.

2 Establishment/Engineering Branch. Program implementation including feasibility study, concurrences, site survey, project transmittal, liaison with Airports district offices, and ADAP program, etc. (also, may be responsible for environmental assessment in lieu of Planning and Programming Branch).

3 Maintenance Operations Branch. Liaison with Airway Facilities sectors concerning day-to-day maintenance problems, safety, etc.

4 Frequency Management and Leased Communications Staff. ILS frequency assignments, processes lease requests for telephone lines, etc.

(b) Air Traffic Division. Airspace approval and concurrence.

(c) Airports Division. Liaison with Airports district offices (ADO), airport sponsors, ADAP program, etc. (e.g., airport obstruction clearances).

(d) Flight Standards Division. Consultants in determination of marker beacon search area, glide slope angle calculations, and obstruction studies; establishes liaison with Flight Standards National Field Office (FSNFO); establishes ILS procedures, glide slope intercept altitude, etc.

(e) Logistics Division. Processes procurement requests for real property, commercial electrical service, construction invitation for bids; provides custodial management of real property records; secures option for acquisition of real property.

(3) Field Offices.

(a) Airway Facilities Sector. Responsible for maintenance of existing local FAA navaid facilities.

(b) Airport District Office. Status of ADAP projects dealing with the proposed ILS.

(c) Airport Traffic Control Tower. Responsible for air traffic activity on and in the vicinity of the airport.

b. Non-FAA Elements.

(1) Airport Sponsor. All airport related activities.

(2) Airport Engineer or Consultant. Airport construction drawings and special airport construction requirements. Contact with these elements should be made through the airport sponsor.

(3) Utility Companies. Technical discussions regarding power service, telephone line services, intervening utilities, etc.

(4) Contracted Professional Services. Professional engineers, surveyors, aerial photographers, geotechnical engineering firms.

(5) Property Owners. Ascertain attitudes of property owners regarding property lease or purchase by FAA (when so authorized by regional Logistics division).

7. TECHNICAL REFERENCES. Appendix 3, Technical References, contains a list of suggested reference material for surveying, cost estimating, and electrical design. These documents provide additional guidance in specialty areas which are discussed herein as they apply to ILS establishments.

8. PROJECT ENGINEER VERSUS SITE SURVEY ENGINEER. The terms "project engineer" and "site survey engineer" are used extensively throughout this document and are defined as follows.

a. Project Engineer. The project engineer is the regional Airway Facilities division engineer assigned the responsibility of scheduling the site survey, compiling the necessary preliminary site survey data, and overseeing the project to completion.

b. Site Survey Engineer. The site survey engineer is the FAA regional Airway Facilities division engineer or private site survey contractor engineer assigned the responsibility of performing the field survey work as detailed in paragraph 81, chapter 5, and documenting the results of the field survey effort in the form of site drawings and a site survey report.

9.-20. RESERVED.

CHAPTER 2. ILS PROGRAMMING AND PLANNING

21. GENERAL. It is recognized that the availability of time, manpower, and/or funding may be the overriding factors in determining the method employed to establish an ILS. It is the intent here to identify and define all of the tasks required during the conceptual planning stage of an ILS establishment. The concept of a feasibility study prior to the budget submission is the most logical approach, although it may not always be the most workable, since in some cases the ILS runway has not been designated. A designated instrument runway is one that has, or is anticipated to have at some future time, a precision type landing aid. An ILS instrument runway (including approach direction) should be designated on the sponsor's airport layout plan at the earliest practicable date on which the location meets the required level of activity in annual instrument approaches (AIA) per Order 7031.2, or where it is forecasted that the activity level will be reached in the near future. The designation of the instrument runway is a coordinated determination based on a preliminary study by the Airway Facilities, Air Traffic, Flight Standards, and Airports divisions.

22. FEASIBILITY STUDY. In order to properly respond to the call for F&E budget estimates, it is recommended that an onsite technical feasibility study be conducted. The feasibility study should be primarily an Airway Facilities function. If circumstances (e.g., lack of project funding) do not permit the feasibility study to be conducted prior to the budget submission, it should be performed as soon as practicable after project authorization (see paragraph 26). Optimally, the feasibility study should consist of a study of existing documentation conducted in the regional office and an actual onsite visit. The onsite study will serve both to confirm data indicated in the documentation (topographic data, as-built construction drawings, etc.) and to identify any potential problem sites. The assigned Airway Facilities personnel should coordinate all site meetings and gather all documentation relative to the site in question.

a. Office Planning. Before conducting the onsite study, the project engineer should obtain the following data, preferably in writing, from the indicated regional organizations:

(1) ILS data.

(a) Runway designation - Air Traffic, Flight Standards, Airports divisions, or project authorization (PA) sheet.

(b) Tentative glide angle, threshold crossing height (TCH), decision height (DH), and intercept altitude - Flight Standards division.

(c) Category of performance required, and expected landing minimums - Flight Standards division.

(d) Acceptable marker search area - Flight Standards division.

(e) Pertinent information already contained in the project file - Airway Facilities division.

(f) Construction history at the airport from personnel previously involved in work at the site location - Airway Facilities division.

(g) Ongoing or planned ADAP and non-ADAP projects at the airport - Airports district office, or Airway Facilities division liaison group.

(h) Ascertain availability of frequency channels for proposed ILS installation - regional frequency management officer, Airway Facilities division.

(2) Maps and Drawings. (The following are described in greater detail in chapter 4, paragraph 62.)

(a) USGS topographic maps.

(b) Airport obstruction charts.

(c) Instrument approach procedure charts.

(d) FAA drawings and/or maps.

1 Airport layout plans.

2 Air navigational facilities drawing.

3 Plans and detail drawings of previous FAA construction.

(e) Airport civil works drawings.

(f) Other published maps and drawings.

1 Aerial photographs.

2 Photogrammetrics.

3 Sectional aeronautical charts.

b. Participants. The project engineer should contact and arrange to meet with the following personnel, as required, at the site. It is essential that Airway Facilities division civil and/or electronic engineering personnel be in attendance during the field trip since this is a technical feasibility study. However, if the runway assignment and desired minimums have not yet been established, personnel

from Air Traffic, Flight Standards, and Airports divisions will also be required. A checklist of participants should include personnel from the following organizations:

(1) Airway Facilities division.

(2) Flight Standards division.

(3) Air Traffic division.

(4) Airports division.

(5) Logistics division.

(6) Airway Facilities sector office.

(7) Airport management or authority (non-FAA).

(8) Airport engineering or consultant (non-FAA). (Request airport consultants participation only at the invitation of the sponsor since there is usually a contractual agreement between the sponsor and the consultant.)

c. Onsite Feasibility Study. The onsite study should be planned as a one- or possibly a two-day trip. The type of information that should be obtained and the determinations that should be made should include but should not be limited to:

(1) General.

(a) Ascertain airport sponsor's attitude towards acquiring land located off airport property. (See Order 4660.1)

(b) Determine names and addresses of utility companies.

(c) Determine any airport work that may affect the proposed ILS.

(d) Identify any ILS siting or construction waivers that may be required.

(e) Obtain photographs of candidate sites (refer to chapter 5, paragraph 105 for a discussion on photographs).

(f) Record any existing or proposed structures or obstacles that may cause electronic or other interference to the proposed ILS.

(2) Localizer and Glide Slope.

(a) Determine tentative locations.

(b) Investigate potential access road, utility routings, and alternates. (Actual contact with utility representatives will not usually be possible because of time limitations.)

(c) Record general terrain and soil conditions.

(d) Determine land ownership and acquisition feasibility (not intended to imply actual title search).

(e) Generally estimate grading and clearing requirements. Extensive site preparation, usually accomplished by the airport sponsor with ADAP funds, may warrant a cost analysis of the possible installation of an upgraded glide slope (including its maintenance costs) as an alternative resulting in the least cost to the Government.

(f) Determine airport expansion and construction plans.

(g) Consider potential sources of signal interference (e.g., hangars, water towers).

(h) Identify fm radio stations broadcasting in the airport vicinity within interference range of the localizer and glide slope signals. See paragraph 100.

(i) Identify security requirements for locations off airport property (possible at some localizer locations).

(3) Markers On Airport Property.

(a) Determine tentative location.

(b) Investigate access road, utility routing, and alternates.

(c) Record general terrain and soil conditions.

(d) Generally estimate grading and clearing requirements.

(e) Consider possible signal obstructions.

(4) Markers Off Airport Property.

(a) Locate potential marker sites in search area. Actual entry onto private property may require written permission in certain areas.

(b) Estimate distance from public access and utilities.

(c) Make effort to determine land ownership (sponsor may have this information).

(d) Record terrain and soil conditions.

(e) Make note of any obvious environmental considerations, e.g., television interference (tvi).

(f) Identify security requirements.

23. FEASIBILITY REPORT. The data package developed during the feasibility trip should be condensed into a report form (such as a trip report). This data should also be recorded on an ILS project data checklist similar to that contained in appendix 4. This will enable reviewing organizations to make appropriate decisions relative to the ILS establishment. It is not intended that the feasibility report be as extensive or conclusive as the site survey report described in chapter 6, section 3; however, the report should include as much pertinent information as possible to help management make a go-no-go decision or possibly even recommend a partial ILS. It should also serve as a basis for site engineering and establishment cost estimates. The feasibility report should be made a permanent part of the project file since it will be useful in the future, particularly should the project be postponed. The type of information that should be detailed in the feasibility report should include:

a. Date and purpose of trip.

b. Participants.

c. Recommendations for equipment locations (including alternatives).

d. Recommendations for access, power, and control (including alternatives).

e. General description of site preparation.

f. Recommended equipment types compatible with sites.

24. BUDGET ESTIMATE. The data compiled during the feasibility study will enable the engineer to prepare the budgetary estimate on a more knowledgable basis. Order 6011.3 should be consulted to cover those line items whose costs cannot be determined based upon data derived from the feasibility study. By using cost estimates based upon the best available data, a greater correlation will be achieved between the appropriated funds and the actual construction costs. Land acquisition costs, coordinated with the Logistics division, shall be included in the budget submission as a line item. This action will help to ensure that sufficient funds will be provided, thus avoiding delay to the project.

25. INITIAL CONCURRENCE. Upon completion of the feasibility study and preparation of the budgetary estimate, a review by the Airway Facilities, Flight Standards, Air Traffic, and Airports divisions shall be made to receive the necessary concurrence. A concurrence of this nature will help to obtain uniform agreement and understanding of the decisions reached by all organizations involved in F&E projects. Once all concurrence has been met, the budget (or, if the project has already been approved, necessary requests for funding adjustments) is submitted to the Washington office.

26. PROJECT AUTHORIZATION (PA). The project authorization is an enabling document defining project scope and funding limitations. The PA, FAA Form 2510-11, is issued by the Office of Budget, Facilities and Equipment Division, in Washington. The PA is sent to the regional Budget division, which furnishes a copy to the Planning and Programming branch in the Airway Facilities division. Internal regional project assignments are developed therefrom, to establish scope and funds allocations to cognizant branches within the Airway Facilities division.

27. SPONSOR NOTIFICATION. The sponsor generally is not aware of the pending approval of a proposed ILS project for his airport; consequently, he should be officially notified. Depending on the prevailing regional practice, this notification action should be accomplished by the Airports division, or by the Airway Facilities division in coordination with the Airports division. This notification should be given prior to any site survey work being conducted at the airport and should include information that indicates:

a. That an ILS has been programmed to be installed at his airport, including the category of ILS and ancillary aids, if any.

b. The runway designation.

c. The ILS siting requirements and the possible eligibility of required land acquisition and/or construction under ADAP as outlined in AC 150/5300-2. This should include the site grading, clearing, land acquisition, and building restriction requirements.

d. The estimated project start and completion date.

e. That a commitment to support the project is required of the sponsor.

28 A-95 REVIEW PROCESS.

a. General. The A-95 review is a parallel but separate process from the environmental impact statement/negative declaration process. The Office of Management and Budget has provided guidance to Federal agencies dealing with state and local governments concerning the evaluation, review, and coordination of Federal assistance programs in its OMB Circular A-95, Federal and Federally-Assisted Programs and

Projects Evaluation, Review and Coordination. The A-95 notification shall take place prior to contract bid advertisement. If the A-95 notification is completed as early as possible in the ILS establishment process, it can be a useful instrument to alert planners to potential problems. Order 1200.21 transmits for appropriate office and service action Order DOT 4600.4. These orders should be referenced for guidance when implementing the regulations in OMB Circular A-95.

b. Data to be Provided in A-95. Since the ILS comes under the category of being a federally funded program, notification must be made to the state and area-wide planning and development clearinghouses having jurisdiction in the area where the project is to be located. A typical A-95 notification data sheet is contained in appendix 17. The project notification should contain the following information:

(1) Location of the project, including the name of airport, city, and county. The actual physical location of all of the components of the ILS system is probably unknown early in the ILS planning stages; however, since the siting criteria for ILS is restrictive, the optimum locations for a typical system may be specified in the A-95 notification. The optimum locations for ILS facilities is detailed in Order 6750.16A.

(2) Description of the project in relation to area wide and community development. This brief description will enable clearinghouses to make appropriate distribution of the notifications.

(3) Program under which project is planned.

(4) Date on which project is scheduled to begin (actual development, construction, or other activities involved in its physical implementation).

c. Submission of A-95 Notification. The A-95 process may take up to 60 days, 30 days in which the clearinghouse informs state agencies and local or regional governments of the proposed project, and 30 days to review the recommendations and comments produced by the review process.

29.-40. RESERVED.

CHAPTER 3. PROJECT ENGINEERING

41. GENERAL. When a runway has been designated and authorized for the establishment of an ILS, the project engineering should commence promptly. The general guidelines for the project engineering are defined in chapter 7, Order 6750.16A. In order to comply with the requirements of the various project engineering phases, close coordination between planning/programming, engineering, and establishment is essential. The preliminary survey and report suggested in chapter 7, Order 6750.16A is related to the feasibility study discussed in this document.

42. SCHEDULING. The engineer assigned to the project has the function of coordinating his efforts with planning/programming, plant, and electronic engineering with regard to:

    a. Reviewing money allocated in the project authorization for adequacy.

    b. Determining the type and availability of equipment scheduled for installation.

    c. Scheduling the site survey and engineering.

    d. Scheduling construction, installation, and commissioning.

    e. Coordinating with Air Traffic, Flight Standards, and Airports divisions, the Maintenance Operations branch in the Airway Facilities division, as well as the local Airway Facilities sectors.

    f. Developing the project file folder, where not previously established.

43. PROJECT FILE DATA. Assuming that an ILS feasibility study as outlined in chapter 2 has been accomplished, most of the following data should be available. In any event, the project file should be established as soon as the PA is obtained.

    a. ILS Data.

        (1) Airport.

        (2) Category of ILS.

        (3) Runway designation.

        (4) System geometry including glide angle, threshold crossing height, decision height, etc.

b. Equipment Types (not always known at time of onsite survey).

(1) Equipment programmed.

(2) Equipment availability date.

(3) Power requirements.

(4) Control/monitoring requirements.

c. Interface Requirements with Existing Facilities.

(1) Interlock requirements (i.e., facing or multiple ILS).

(2) Compatibility with the location of visual approach slope indicator (VASI) units (see Order 6850.2).

(3) Taxiways, restricted areas, etc.

(4) Frequency assignments.

(5) Construction in approach light systems.

d. Constraints to Construction.

(1) Unsuitable terrain conditions and the status of any ongoing or programmed ADAP construction or land acquisition projects.

(2) Inadequate space because of limited terrain or property boundaries.

(3) Requirements for installation of elevated platform for localizer antenna array(s).

(4) Inaccessibility to proposed facility locations.

44. ACCOMPLISHMENT OF SITE SURVEY.

a. Responsibility of Project Engineer. The project engineer, as defined in paragraph 8a, is responsible for arranging, monitoring, and sometimes supervising the actual onsite survey work that will be required for the establishment of an ILS.

b. Personnel Performing the Field Work. Within the Airway Facilities division, the engineering organization(s) responsible for performing the field survey shall be determined by the region. The designated project engineer may choose to perform most of the field survey work himself, possibly with engineering assistance from other FAA personnel or specialized commercial engineering services. More often, the field work may be performed by a site survey engineer(s) under the technical direction of the project engineer. Where personnel

availability, time, or efficiency dictates, the region may decide to contract for engineering services. These services may be of limited scope as required, or by means of a formal contract for the entire site survey effort. Figure 3-1 depicts in graphic form the various means by which the field site survey effort may be performed.

c. Site Survey Engineer. The site survey engineer, as defined in paragraph 8b, performs the actual field survey work and supplies ILS engineering data, sketches, and/or drawings to the project engineer. If the project engineer and the site survey engineer are within the same organizational element, the initiation and technical direction of the field survey work performed by a site survey engineer(s) may be verbal but should preferably be written (e.g., internal letter). If the project engineer and the site survey engineer are in two separate organizational elements, the task may be defined by a more formal work order, detailing the site survey work to be performed and the engineering data required. The technical direction by the project engineer, whether verbal or written, shall specify the detailed requirements of the field work to be performed. Paragraph 45 outlines the technical survey work to be performed and the ILS engineering data required.

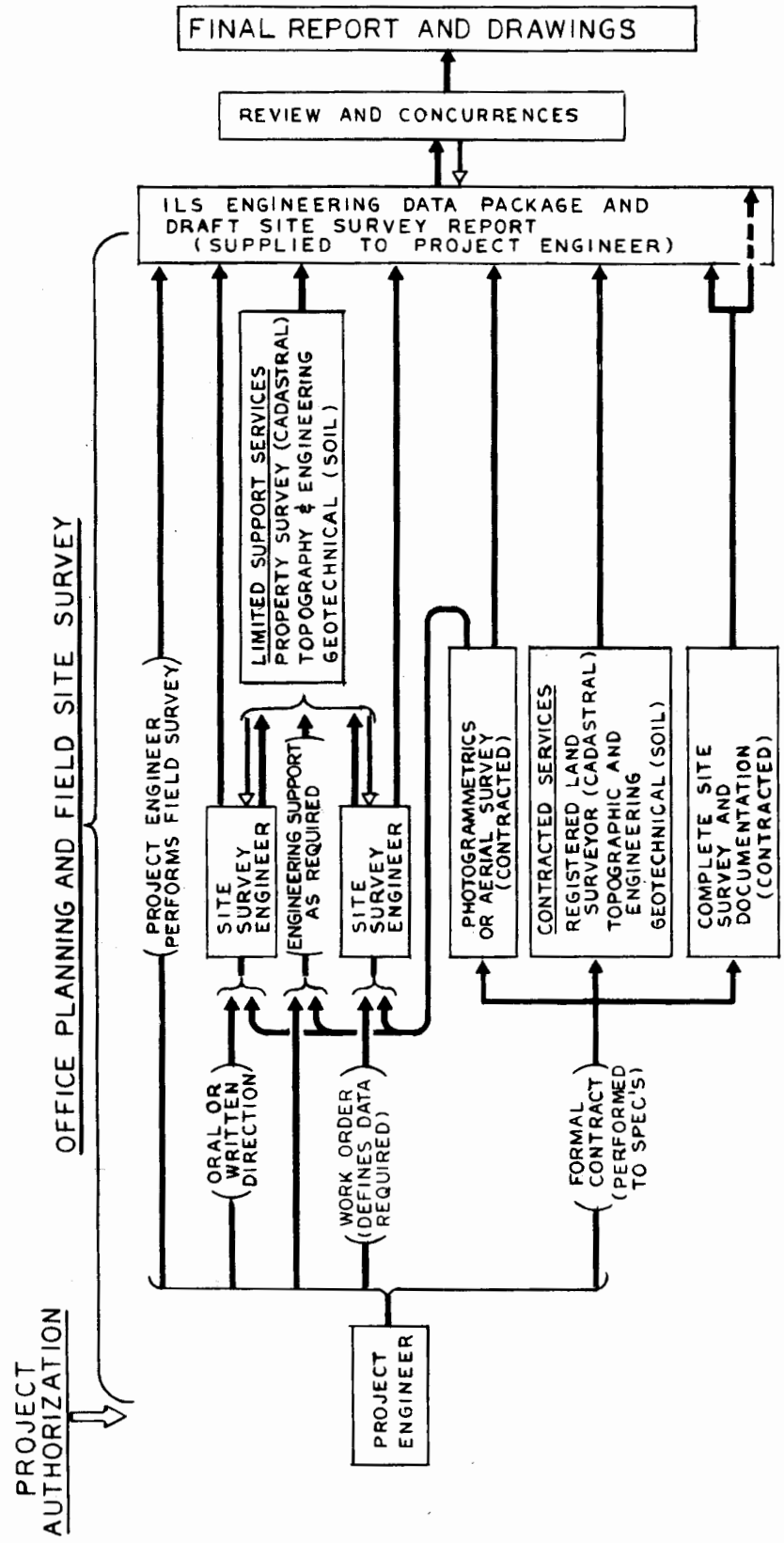
d. Contracted Engineering Support.

(1) Support Requirements (Limited Scope). In some regions, the project engineer may use particular types of engineering support services, such as a local land surveyor for a marker property survey or an engineering service for a topographical survey in front of a glide slope. If the work to be performed by the service is of limited scope and dollar value, the project engineer may be able to engage the service by arrangement at the field site, outlining the work and technical data required by verbal agreement or a letter.

(2) Support Requirements (Extensive Scope). Where the engineering support work to be performed is extensive, the work should be performed under a formal contract arranged through the Logistics division. In such cases, a formal statement of work or specifications outlining the work and technical data required will have to be prepared.

(3) Photogrammetrics. In some instances, the region may desire a complete aerial survey, requiring that photogrammetrics be supplied to the project engineer prior to performing an onsite field survey effort. Such arrangements are usually made by formal contract through the Logistics division and will require a thorough statement of work or specification of the service to be provided. Paragraph 46 outlines the typical work to be performed under a photogrammetrics contract.

FIGURE 3-1. METHODS USED FOR PERFORMING ILS SITE SURVEY



(4) Complete Site Survey Service. In some instances, a region may find it desirable to have the entire site survey effort (including the complete site survey report and construction drawings) performed by an engineering firm through a formal contract arranged by the Logistics division. Where work is to be performed in this manner, the project engineer shall prepare a thorough statement of work or technical specification, fully describing the survey to be performed and the ILS engineering data to be supplied in the report and drawings.

45. TECHNICAL AND ADMINISTRATIVE REQUIREMENTS FOR SITE SURVEYS. Regardless of the methods used to accomplish the ILS site survey, the technical requirements of the site survey as well as the technical documentation to be produced are essentially the same, whether accomplished by FAA engineers or by a contract service. The major variations are the coordination procedures before, during, and after the onsite activities as well as the extensiveness of the required documentation. The type of information that should be included in work orders, statements of work, technical specifications, or other written descriptions of work requirements is discussed below. The intent is to delineate for the site survey engineer what is expected and to provide information and standards as applicable to the work effort. Not all items will be appropriate for every site survey. A sample field work order, which may be prepared on FAA Form 1196 or on a specially designed regional form, is contained in appendix 5. These guidelines should also be followed in contracting for a complete ILS site survey (in which the contractor is responsible for the site survey, selection, and engineering documentation), recognizing that some of the information may be part of the contract provisions vis-a-vis the technical specifications.

a. Administrative Data.

(1) Work order, statement of work, or specification number.

(2) Project code.

(3) Type of project; e.g., final site survey.

(4) Organization initiating work to be done.

(5) Organization accomplishing work to be done.

(6) Project commencement and expected completion dates.

(7) Project engineer who will provide technical direction and/or consultation.

(8) Estimate of employee-hours and costs (on work order only).

b. Background Information. The site survey engineer should be provided with the following background information, along with a copy of the feasibility report (if a feasibility study has been conducted as detailed in chapter 2 of this order).

(1) Geographic location of site.

(2) Runway identifier.

(3) Desired category of ILS operation.

(4) Full (LOC/GS/MM/OM) or partial (LOC/OM or GS/MM) ILS.

(5) Requirements for COMLO, NDB, DME, and/or far field monitor (FFM).

(6) Model of ILS equipment programmed for installation, including:

(a) Antenna and shelter size.

(b) Power requirements.

(c) Power panel and demarcation box locations.

(d) Monitoring and/or control requirements.

(7) Desired glide angle, TCH, and DH.

(8) Search areas for markers as approved by the regional Flight Standards division.

(9) Air navigational facilities plan and/or other relevant drawings.

(10) Contact points at regional office, Airway Facilities sector, airport, and utility companies.

(11) Status of ongoing construction that may affect the project.

c. General Site Survey Requirements.

(1) Facility Site Survey.

(a) If exact equipment locations are already known, provide corresponding station numbers for these locations and include a drawing detailing the proposed locations. If exact equipment locations are to be determined as a part of the site survey, indicate that the site survey engineer shall determine the exact location of the ILS system components - localizer, glide slope, marker(s), monitoring equipment, distance measuring equipment (where required), and compass locators (where required).

(b) ILS siting shall be in accordance with Order 6750.16A. If the selected locations exceed any of the governing criteria of Order 6750.16A, the site survey engineer shall be required to contact the project engineer before proceeding with the site survey.

(c) The site survey engineer shall stake the center of the antenna points for the localizer, glide slope, and all associated markers.

(d) The site survey engineer shall use bench marks for vertical control.

(2) Access and Utilities Survey.

(a) The site survey shall determine the routing of primary power, telephone lines (if required for control or remote monitoring), and access roads to the various sites, including trenching and ducting requirements.

(b) If traverses are to taken along access road centerlines and along cable routes, they shall be specified.

(3) Clearing, Grubbing and Grading. The site survey engineer shall determine the approximate acreage of clearing, grubbing, and grading that will be required to ensure satisfactory ILS performance, accommodate ILS shelters, and provide proper drainage of the sites.

(4) Land Availability and Acquisition.

(a) In association with airport authorities and the Airports division or ADO representatives, the site survey engineer shall obtain land acquisition and availability data. For details concerning determination of property ownership and land availability, the site survey engineer shall refer to the regional Logistics division personnel through the project engineer.

(b) The scope of lease data that should be obtained on the work order by the site survey enginneer shall be indicated.

(5) Accuracy Requirements. Specify the minimum degree of accuracy to be attained in each of the onsite measurements. Refer to paragraph 91 for the accuracy requirements of an ILS site survey.

(6) Environmental Assessment. Indicate what type (if any) of environmental data is to be obtained by the site survey engineer. If an environmental assessment is conducted by

non-FAA personnel (e.g., a contractor), a formal environmental assessment report must be prepared per Order 1050.1.

(7) Photographs. Indicate to the site survey engineer the types and quantities of photographs to be taken at the proposed sites.

d. Localizer Site Requirements.

(1) Localizer Topography. The site survey engineer should be directed to:

(a) Obtain contour data for the antenna and equipment shelter plot. A cross section should be obtained at the antenna location for at least the full length and width of the antenna foundation. If staking is required, specify it.

(b) Obtain contour data for the full right-of-way width of the access road, including drainage data.

(c) Indicate on a topography drawing the location and height of any obstructions in the localizer restrictive zone (e.g., structures, poles, trees, fences, etc.).

(d) Obtain an extended runway centerline profile from the adjacent runway threshold to the centerline of the localizer.

(2) Localizer Property Survey. The site survey engineer should be directed to obtain a property survey for a typical localizer plot including the access road right-of-way. The site survey engineer should check with the project engineer for legally acceptable tie-in points.

(3) Localizer Access and Utilities Survey. The site survey engineer should be directed to:

(a) Locate all drainage structures with recommended size based on 10-year flood intensity. The 20- and 50-year flood elevations should be noted.

(b) Coordinate acceptable power routing with the power company. The site survey engineer should obtain power company specifications for electrical installations and details for transformer pads, if required.

(c) Perform subsurface investigation by probing or boring for all construction functions (i.e., trenches, equipment installation locations, etc.). The site survey engineer should note if bedrock or rock outcrop is encountered and indicate the extent of surface and subsurface drainage problems affecting foundation and earthwork.

e. Glide Slope Site Requirements.

(1) Glide Slope Topography. The site survey engineer should be directed to:

(a) Obtain contour data for the glide slope site survey areas defined in figure 5-5 of this order and figure 3-11a of Order 6750.16A. Area "A" should always be included, but areas "B" and "C" should be included only where the terrain roughness dictates the need for this information.

(b) Obtain contour data for the full right-of-way width of the access road including drainage data.

(c) Obtain an accurate runway centerline elevation at the point opposite the antenna mast.

(d) Determine the highest point in the runway touchdown zone (TDZ) to the nearest 0.1 foot.

(e) Indicate on the topography drawing the location and height of all obstructions in areas "A", "B", and "C" of the glide slope survey areas (see paragraph 45e(1)(a) above).

(2) Glide Slope Property Survey. The site survey engineer should be directed to obtain a property survey for a typical glide slope plot (see sample in appendix 6), including the access road right-of-way and the monitor antenna. The site survey engineer should check with project engineer for legally acceptable tie-in points for locations on airport property.

(3) Glide Slope Access and Utilities Survey. Same as for localizer; see paragraph 45d(3).

f. Marker Beacon Site Requirements.

(1) Marker Beacon Topography. The site survey engineer should be directed to:

(a) Obtain contour data for all marker facilities. Limits of data will be dependent on relevant antenna plot sizes.

(b) Obtain contour data for full right-of-way of access roads, including drainage data.

(c) Check marker beacon restrictive area in accordance with figure 4-3, Order 6750.16A. The site survey engineer shall indicate the height and location of possible interference sources on site drawings.

(d) Locate and indicate a clearly defined bench mark if construction is to be done to an exact grade.

(2) Marker Beacon Property Survey. The site survey engineer should be directed to obtain property descriptions by metes and bounds for markers and needed access roads located off airport property and make property ties to recognized property corners. If the marker is to be located on airport property, the site survey engineer should contact the project engineer for legally acceptable tie-in points. He should also determine the owner-of-record for off-airport properties. The responsibilities, authority, and restrictions of site survey engineers in conducting discussions with property owners should be clearly specified.

(3) Marker Beacon Access and Utilities Survey. In addition to the access and utilities survey requirements listed in paragraph 45d(3), the site survey engineer should be directed to:

(a) Locate and identify any roads, railroads, overhead or underground utilities, fences, etc., in the area to be contoured.

(b) Locate and indicate the height of isolated trees or groups of trees in the area with enough information pertaining to tree size and density to permit a clearing contract to be issued.

g. Obstruction Survey. If an obstruction survey to the ILS final approach surface is required, specify it. Define its scope and accuracy requirements.

h. Project Engineer/Site Survey Engineer Coordination. The site survey engineer should be made fully aware of the coordination procedures to be followed:

(1) Pre-Site Survey. A pre-site survey meeting should be held between the project engineer and the site survey engineer to ensure complete mutual understanding of the requirements.

(2) During Site Survey. The site survey engineer is expected to maintain close liaison with local airport authorities and FAA representatives. The FAA project engineer at regional headquarters shall be contacted if there are any unusual or unforeseen conditions that may influence the work. Before leaving the field, the site survey engineer shall contact the project engineer to ensure that all necessary data has been obtained, thus possibly avoiding the need for an additional trip.

(3) Post-Site Survey. Before the site survey data is developed into final form, the field sketches and data should be reviewed by the project engineer. This coordination effort will serve to point out any relevant information that may be lacking and to highlight any additional details that the project engineer will want to see discussed in the report.

i. Airport Coordination and Safety. The site survey engineer should be directed to coordinate his schedule of work on airport property with the airport manager and the local Airway Facilities sector (and/or sector field office (SFO), airport traffic control tower (ATCT) personnel), and ensure that all airport safety regulations are strictly complied with regarding work areas, parking, and movement. Radio controlled vehicles are usually required when operating on airport property.

j. Preparation of the Site Survey Report. The work requirements should indicate that a formal report is to be prepared to document the site survey findings and recommendations. The report shall include all essential information for site construction and installation, as applicable, within the criteria set forth in applicable FAA documents relating to ILS siting criteria (see chapter 1, paragraph 5). The report shall encompass location details of equipment to be installed, site preparation, electrical power service, construction of access roads, communication lines, foundation details, ground planes, grading, trenching, ducting, and cables requirements, and routing for power and monitoring lines. The report should include a recommendation for a computer study or site testing where, because of poor siting conditions (terrain irregularity close to the glide slope or the presence of large metal structures along the runway), it is not possible to predict the quality of facility performance. Depending on regional practices and the complexity of the field work effort involved, reports prepared by FAA site survey engineers may range from relatively concise trip reports with illustrative attachments to more comprehensive documents intended for management review, approval, and/or action. Reports prepared by a site survey contractor, which shall provide detailed justifications of site recommendations, shall be similar in format and content to the sample report presented in appendix 7.

k. Preparation of Site Construction Drawings. The work requirements should discuss the preparation of site construction drawings.

(1) FAA Site Survey Engineer. Depending on regional practices and the complexity of the field work effort, the FAA site survey engineer should provide usable sketches or full-size engineering drawings (suitable for tracing by drafting personnel) for ultimate use as facility construction drawings. The required type and degree of completeness of these drawings should be conveyed to the site survey engineer either in the work requirements or during the pre-site survey coordination meeting.

(2) Site Survey Contractor. Site surveys conducted by a contractor shall culminate in complete site construction drawings. The drawings to be submitted with the site survey report shall outline all siting geometry, construction details, instructions, specifications, and materials necessary to accomplish the installation. These drawings are to be ultimately used in the Invitation for Bidders (IFB) package, and thus shall be usable for competitive bidding. Sample site drawings are included in appendix 6 of this document. The drawings shall include as a minimum:

(a) The location of all transmitting antennas together with the associated equipment shelter, buried cable routing, and monitoring devices for all components of the instrument landing system.

(b) Site preparation requirements including clearing, grubbing, and grading.

(c) Information required for the construction of access roads and the installation of protective fencing.

(d) Primary power installation details including terminal poles, transformer mountings, substation layouts, and wiring.

(e) Monitor/control circuit routing and details of installations where required in ATCT cabs.

(f) Schedule of national and/or regional standard drawings to be used in conjunction with site drawings for the various portions of an ILS (e.g., localizer, glide slope, etc.)

1. Submittal of Report and Drawings. Indicate in the work requirements when and to whom the site survey report and drawings are to be submitted. In the case of a contracted site survey, the engineering report and associated drawings should be submitted in at least four copies (one of which is reproducible) to the Government Contracting Officer for review and approval. One copy of the report should be returned to the contractor, either with a statement that the report is acceptable and approved by the Government or with a statement of disapproval pointing out deficiencies and recommendations for correction. In the event of the latter, the contractor shall resubmit the revised report for approval.

46. CONTRACTED ILS SITE SURVEY SERVICES (SPECIALIZED). When specialized engineering services (e.g., land surveys, geotechnical analyses and/or unique foundation designs, and photogrammetrics) are required prior to or as a part of an ILS site survey, the procurement methods employed (e.g., IFB, Request for Proposal (RFP), Request for Quotation (RFQ), Standard Form 44, etc.) will vary according to regional procedures,

complexity of work, and the anticipated cost. The technical requirements should thoroughly outline the work to be done and they may be conveyed verbally if limited in scope. Procedures for obtaining such specialized services are discussed below.

a. Land Surveys. The services of a land surveyor may be required to obtain property data for a particular ILS site(s), and may be engaged by verbal contract in the field when the site survey engineer is authorized to do so. Information necessary to prepare a plot description is discussed in appendix 9.

b. Geotechnical Engineering Services. Where, because of questionable local soil conditions, geotechnical engineering services are to be obtained, the technical description for the service should include the following, as appropriate.

(1) Administrative Data.

(a) Type of project; e.g., ILS site survey.

(b) Organization initiating work to be done.

(c) Project commencement and expected completion date.

(d) Project engineer assigned to provide technical direction and/or consultation.

(e) Scope of contract, defining requirements,and limitations of work.

(2) Technical Data. The geotechnical engineering firm should be provided with the location(s) of the proposed site(s), foundation, and/or access road alignment (as appropriate) clearly shown on an engineering drawing. In addition, the size, weight, and wind-loading requirement of the ILS equipment scheduled for installation should be provided.

(3) Contractor Work Requirements. The work requirements should contain provisions that the geotechnical engineering firm provide the following as appropriate:

(a) Test borings at the locations indicated on the accompanying drawing. (Proposed construction over suspected unstable boggy soil, fresh land fill, or at a near-surface water table may require more frequent soil samplings.)

(b) Technical inspection of the boring work so that depth and sampling methods can be varied to meet subsurface conditions encountered.

(c) Performance of laboratory tests and analysis on soil samples recovered from subsurface explorations as required to aid in soil classification.

(d) Analysis related to geotechnical engineering aspects of foundation design and construction, and an engineering report, which will include the following items applicable to the project and site:

1 Boring logs and records of other field explorations indicating soil and rock conditions and water table.

2 Location plan of subsurface explorations.

3 Results of laboratory soil tests.

4 Recommended foundation type with foundation design criteria including allowable bearing capacity, pile loading, foundation depth, and other information required for final design and preparation of plans and specifications.

5 Evaluation of construction problems related to soils and foundations including excavation and filling.

6 Recommended pavement cross section for access roadways.

7 Estimate of cost of excavation and granular fill replacement, if applicable.

(4) Airport Coordination and Safety. The geotechnical engineering firm should be instructed to coordinate its schedule of work on airport property with the airport manager and local Airway Facilities sector/SFO and ATCT personnel, and that all airport safety regulations shall be strictly complied with regarding work areas, parking, and movement.

c. Photogrammetric Drawings. Photogrammetric drawings, using aerial photography techniques, prepared at sites with severe terrain conditions may enable the site survey engineer to locate prospective equipment locations, consider drainage characteristics, determine site preparation requirements, locate promising marker locations, prepare site construction drawings, and identify objects penetrating Federal Aviation Regulation (FAR) Part 77 surfaces. The technical specification for this service should include the following types of information.

(1) Administrative Data.

(a) Type of project, e.g., preliminary ILS site survey.

(b) Organization initiating work to be done.

(c) Project commencement and expected completion date.

(d) Project engineer assigned to provide technical direction and/or consultation.

(e) Scope of contract, i.e., definition of requirements and limitations of work.

(2) Drawings to be Provided. The work requirements should describe the photogrammetric drawings desired. Specify the precise requirements as noted along with the quantity and scale of the drawings desired.

(a) An airport general plan should indicate:

1 Runway numbers and dimensions.

2 Runway true azimuth.

3 Airport reference point and magnetic variation.

4 Existing airport features and property lines.

(b) Approach coverage drawings should indicate:

1 Specified length and width of coverage.

2 Runway centerline extended marked at specified nautical mile points.

(c) Plan and profile drawings (if an ALS is planned) should indicate:

1 Elevation contours at specified intervals.

2 Specified coverage area.

3 Vertical scale specified for profile drawings.

(3) Conventions to be Followed and Definitions to be Reflected. Specify the following conventions and definitions to be followed or reflected on the drawings.

(a) All elevations should be above mean sea level (amsl).

(b) Directions to the left and right-of-runway centerline should be those of an observer facing in the direction of an aircraft on straight-in final approach (i.e., as the pilot sees it).

(c) Penetrations to the final approach and transitional surfaces shall be those defined in FAR Part 77.

(d) The threshold of the runway should be considered a line perpendicular to the runway centerline marking the beginning of the runway surface available for landing.

(e) The TDZ elevation is defined as the highest point in the runway within the first 3,000 feet of runway beyond the threshold.

(4) Photographic Quality and Layout.

(a) Drawing Types. Specify in the work requirements the type of reproducible sheets to be used. Nonphotographic features should be drafted on the sheets in ink.

(b) Drawing and Drafting Practices. Specify such information as required to ensure conformance with FAA drawing practices; e.g.,

1 FAA format and title block.

2 Orient layout to depict true north toward the top of the drawing.

3 All sheets should bear the runway true azimuth, the Government agency that determined the azimuth, and the date of survey from which the azimuth was determined, e.g., 249° 36' 08" (NOS 8/74).

4 All planimetric features (such as rivers, lakes, roads, schools, churches, etc.) should be identified.

5 All airport property lines, runways, taxiways, etc. should be identified.

(5) Contract Coordination. Indicate in the work requirements that:

(a) The contractor should contact the FAA technical representative for clarification of the technical requirements and to report any unusual or unforeseen conditions.

(b) The contractor should make necessary arrangements with the airport sponsor to the extent authorized by the contract requirements.

47.-60. RESERVED.

CHAPTER 4. OFFICE PLANNING

61. GENERAL. Systematic office planning should be accomplished prior to the actual field investigation and survey work. Thorough office study and planning will provide a good understanding of the site survey effort that will be required and allow for the best use of field personnel.

62. OBTAINING MAPS AND DRAWINGS. Obtain the existing maps and drawings, not previously obtained, which are necessary and useful to the preliminary design, sketch preparation, and field planning. In the event adequate drawings and/or maps are not available for plotting the location of the facilities or the search areas, a decision should be made regarding the possibility of obtaining documentation through the sponsoring airport or by means of contracted engineering services. Where photogrammetrics are used as a matter of regional practice, the preparation of specifications for contracted services is discussed in the foregoing chapter 3. The drawings and maps that generally will be available are outlined in the following subparagraphs.

a. U.S. Geological Survey Topographic Maps.

(1) The U.S. Geological Survey (USGS) publishes standard topographic maps to cover the United States, Puerto Rico, Guam, American Samoa, and the Virgin Islands. The most useful quadrangles are those covering 7-1/2 minutes of latitude and longitude with a scale of 1:24,000 (1 inch = 2,000 feet). In some areas of the United States, quadrangle sheets are only available in the smaller scale 15 minute series (1:62,500, 1 inch = approximately 1 mile). Each of the quadrangle sheets bears a geographical name and should be obtained by that name. Maps of abutting quadrangles join without a break in continuity of map detail. These maps are available from:

(a) Branch of Distribution
U.S. Geological Survey
1200 South Eads Street
Arlington, Virginia 22202, or

(b) Branch of Distribution
U.S. Geological Survey
Federal Center
Denver, Colorado 80225

(2) Additionally, the U.S. Geological Survey publishes an index map showing the location and name of the quadrangle sheets in each state; these index maps further give the names of local dealers stocking the maps in principal cities. Topographic sheets should be obtained that embrace the area approximately 1 mile on either side of the proposed ILS runway centerline extended, and

between points approximately 8 miles from either end of the proposed ILS runway. This area will cover the approach end of the runway and provide information over the missed-approach area beyond the opposite end of the runway.

b. Other Topographic Maps. In some instances, public lands under the control of U.S. Forest Service, national parks, military facilities, and other agencies are not covered by the USGS quadrangle sheets. Topographical maps covering these areas are generally available from the governmental agency in control of the land. Maps along the coastline and navigable streams are also published by the applicable Government agency and may readily be obtained from the appropriate agency when required.

c. Airport Obstruction Charts. The Airport Obstruction Chart (OC) shows selected planimetry, a plan of the airport including obstacles in the aircraft circling areas, and a plan and profile of the runways, their approaches, and obstacles therein. An aerial photographic portrayal of the entire chart area, or of only the airport and its immediate surroundings, may appear as background. The chart is used for determining the status of obstructions. OC charts are prepared for the FAA and are published by the National Ocean Survey (NOS) of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Each chart bears the name and location of the airport, an OC chart number, and the date of the field survey. These charts, and an index of the OC charts, are available from:

National Oceanic and Atmospheric Administration
Distribution Division
6501 Lafayette Avenue
Riverdale, Maryland 20840

d. Instrument Approach Procedure Charts. Charts indicating certain instrument approach procedures that should be used at the airport are useful in determining navaid facilities available and the current applicable minimums for the airport. Instrument Approach Procedures (charts) are prepared under FAA direction and are published by the Defense Mapping Agency Aerospace Center (DMAAC), NOS, and by various non-governmental publishing concerns. FAA regional office personnel in the Flight Standards and Air Traffic organizations generally have these charts on file and may be consulted when required. One source for the procedure charts is:

National Ocean Survey
Distribution Division, C44
Riverdale, Maryland 20840

e. FAA Drawings and/or Maps. The following FAA drawings and/or maps may have been previously prepared and should be obtained if they are available.

(1) Airport layout plans may have been prepared by the sponsoring airport and reviewed and approved by the Airports division. A similar drawing may be titled as an Airport General Plan or as an Airport Master Plan. Copies of these plans are usually available through the Airports division. In addition to providing a master layout of the airport, they may include facilities planned for the future and indicate the sponsor's past planning with respect to preparation for the proposed ILS system. Such drawings may also indicate the airport property boundaries, provide runway azimuth data, and other information that will be useful.

(2) Air navigational facility (ANF) drawings of the existing FAA navigational facilities (i.e., existing ILS, VOR, ALS, or VASI facilities, etc.) should be in the regional office files. These drawings provide important data regarding potential power sources, extent of control cables installed, and the possible interface with other systems with respect to physical conflicts and shared services. ANF drawings are a variation of the airport general plan and/or layout drawings.

(3) Plans and detail drawings for FAA construction of existing or proposed FAA facilities should be available in the regional office files. Typical of these will be ALS construction drawings, which would be helpful in determining the preliminary siting of localizer antennas and markers. These should include drawings covering work performed at both ends of the runway. In some instances an airport power and buried cable plan is maintained. This information will enable more thorough planning for both the preliminary engineering design and for the following site survey.

f. Airport Civil Works Drawings. These are prepared by airport public works authorities or by sponsor-contracted architectural and engineering organizations are available in the regional office. Drawings prepared for runway extensions, drainage construction, sewage, buried utilities, and earthwork provide an excellent source of contour information. Every effort should be made to determine that these drawings represent the true "as-built" conditions.

g. County Soil and Geological Maps. These are available in most locations and will yield valuable information on subsurface conditions.

h. Other Published Maps and Information. Some that may be readily available (sometimes at the regional office), are:

(1) Aerial photographs over many areas have been made by various governmental agencies and may be available either in the appropriate agency field office or the office of the mapping and consulting engineering firms who contracted the work. Aerial photographs over rural and farming areas are generally on file in the agricultural extension department of the counties or parishes concerned. These are especially useful in siting of marker facilities and determining the ownership of property.

(2) Photogrammetrics have been made for many purposes by mapping and consulting firms and are often available from their offices in principal cities. Photogrammetrics are particularly helpful inasmuch as they generally give contours at two-(2) foot intervals over areas that would otherwise require costly ground survey effort. Paragraph 46 further discusses the use of photogrammetrics for ILS engineering and siting.

(3) Sectional aeronautical charts are published by NOS and developed by the FAA. These charts are used primarily for navigational purposes but are readily available and useful in selecting the proper USGS topographic quadrangle sheets (see paragraph 62a) where exact airport locations are difficult to identify on the USGS state index sheets. Sectional aeronautical charts are titled with the name of one of the principal cities within the area covered by the chart.

63. PLOTTING POTENTIAL SITES. Following the accumulation of the maps and drawings available in the regional office, the proposed facility locations and marker search areas should be plotted on that map or drawing that will provide the most useful data for determining and planning the field survey requirements. Appendix 8, ILS Equipment Requirements, will aid the engineer in determining the typical plot sizes and layouts desired for the system.

a. Facilities to be Located on the Airport.

(1) General. In the case of ILS equipment to be located on the airport, the airport general plan drawings, prepared for existing or proposed ALS facilities, or detailed drawings used for runway construction, with elevation information, may be most useful. Since some of the drawings may contain so much information as to be congested or confusing, it may be advantageous to prepare a new sketch at the appropriate scale containing only that information required for the proposed ILS work. Photogrammetrics may be very useful at this stage of the planning.

(2) Inner Marker. In most cases, the Category II ILS system inner marker location will be on the airport property and the marker location may be plotted on the airport or general layout plan. The location tolerances for the inner marker

(within a radius of 25 feet from the desired DH point) is given by Order 6750.4.

(3) Localizer Elevated Antenna. Where there are requirements for a localizer elevated platform, or problems associated with antennas penetrating approach surfaces or approach light systems, it will be useful to make a simple vertical plot or calculation of the facility and surfaces involved. Figure 4-1 suggests a non-scaled presentation of the vertical situation. This type of plotting minimizes the study time required in the field and gives the engineer a quick reference, which helps to ensure that all of the information required by the field investigation is, in fact, obtained.

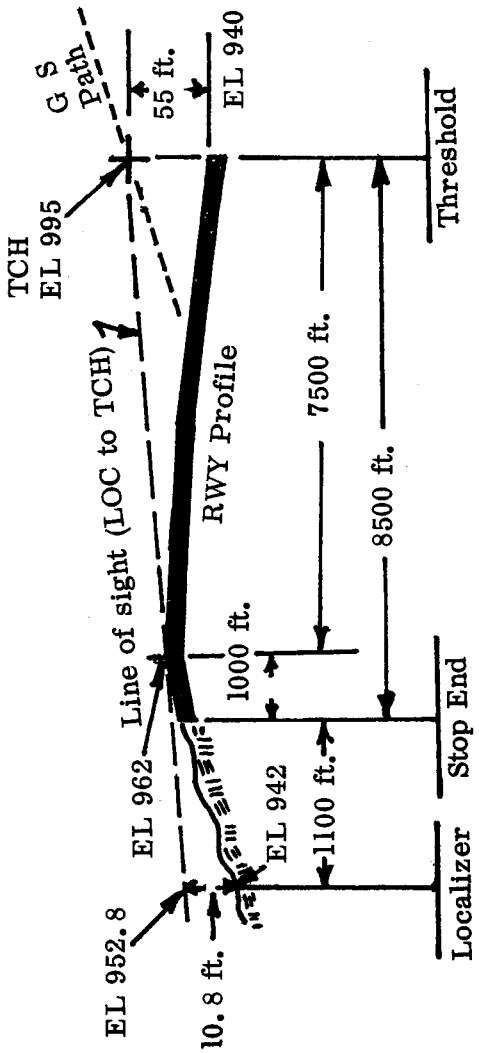
b. Facilities to be Located Off Airport Property. The USGS topographic maps will be most useful for plotting the proposed location or search area for the outer marker, COMLO, NDB, and possibly the middle marker. If photogrammetrics with the extended runway centerline are available, the plotting may be accomplished directly on the photogrammetric or photograph. Figures 5-8 and 5-9 suggest the manner in which the search areas should be plotted. Where the Flight Standards division and others have identified a specific marker location that is required by specific approach procedures, the tolerance of the search areas should extend from the specific point rather than the entire 4-to 7-nautical miles from runway threshold.

64. FIELD LIAISON. Prior to actually going to the field to perform the site survey, contact should be made with field personnel who are responsible for, and cognizant of, the facilities and operations at the airport. In general, the following personnel or organizations should be contacted.

a. The Airway Facilities sector and/or sector field office, and the Airports district office should be contacted and advised of the proposed site survey and the approximate time frame over which the field work is proposed.

b. The Airport Manager and/or the Airport Authority responsible for the airport operation should be contacted. The airport manager is aware of personnel or departments knowledgeable with airport civil works such as power, ducting, and drainage. He can also provide information on consulting engineering firms that will have drawings and documentation related to planning, construction, finished elevations, and previous survey work. Advance scheduling and arrangements should be determined as much as possible with respect to general airport security and access. Details regarding access arrangements and work requirements may be arranged after arriving at the airport.

FIGURE 4-1. VERTICAL SKETCH OF LOCALIZER ANTENNA HEIGHT REQUIREMENTS



c. USGS and National Geodetic Survey (NGS) Datum (bench marks) available in the area may be determined by a telephone call to the nearest appropriate government office or from the consulting engineering firm retained by the airport. Paragraph 91b describes the source of monumented locating points.

65. AIRPORT DEVELOPMENT AID PROGRAM (ADAP). Although it is not the function of the site survey personnel to participate in any discussions or arrangements regarding the role of ADAP in the ILS site preparation, the site survey engineer should acquaint himself with the status and extent of proposed site preparation. This information may be obtained from the Airports division in the regional office or the local ADO. Copies of the drawings indicating the proposed finished grades may be available. This information, whether obtained during the office planning work or during the site survey, is necessary in the preparation of the final design locations and elevations. The Airport division or ADO is especially cognizant of ADAP construction plans and scheduling.

66. ENVIRONMENTAL. The Airway Facilities personnel in the regional office are responsible for coordinating the environmental impact considerations relating to the establishment of ILS systems. In some instances, they may also prepare the environmental assessment and subsequently an environmental impact statement (EIS) or negative declaration (ND). The environmental considerations and statements shall be in accordance with Order 1050.1. The engineers performing the site survey work should familiarize themselves with those items that will have an impact on the proposed installation. For on-airport facilities, the airport sponsor or the Airports division of the regional office may have already developed an environmental assessment encompassing ILS elements.

67.-80. RESERVED.

CHAPTER 5. FIELD SURVEY

SECTION 1. INTRODUCTION

81. FACTORS TO CONSIDER. The field survey work should proceed in a planned and orderly manner to best use the available time, interface with the normal airport operations, and ensure that the required data for the ILS design and documentation is complete. It is suggested that the field work proceed along the following lines:

a. Contact Local Personnel. Contact and discuss the task with the local FAA and airport personnel.

b. Access Arrangements. Make the necessary airport access arrangements.

c. Obtain Maps and Drawings. Obtain those maps and/or drawings not previously available.

d. Ascertain Special Requirements. Ascertain special construction standards required by the airport, as well as insurance and security requirements.

e. Cursory Visual Inspection. Make an initial visual inspection of the areas where the proposed facilities are to be located.

f. Examine Sites Requiring Real Estate Action. Accomplish investigation for outer marker and/or COMLO facilities sites. Logistics division real estate personnel should be advised of the site requirements prior to beginning the field survey work. Investigation for the other markers or facilities, which may be off the airport property, should also begin early in order to provide as much time as practical for the real estate considerations. Bear in mind that the LG division would prefer to have a minimum of four months to lease and six months to purchase real property wherever possible.

g. Detailed Survey of Sites. Accomplish detailed survey of the proposed facilities.

h. Prepare Preliminary Report and Review. Prepare field sketches or drawings and evaluate data.

82. PERSONNEL LIAISON. Upon arrival at the airport, the site survey engineer should make arrangements for access to the areas to be surveyed and determine the sources of information available for the survey.

a. FAA. The ADO office should have the information on the status of the sponsor's site preparation as well as other information that will be needed. The local Airway Facilities organization will be cognizant of all existing facilities and may be able to provide on-airport transportation and assistance with the investigation and survey work.

The local air traffic control personnel are familiar with the operations and can assist in scheduling work. All work performed on the airport should be coordinated with local air traffic personnel.

b. Airport Manager. The airport manager can provide existing sources of documentation that have been used for construction and planning. He can further advise of consulting engineering sources that have been responsible for airport planning and engineering and that often have complete sets of drawings. The equipment facilities of many of the larger airports are under the control of an airport authority or county or municipal public works department. These organizations usually have one or two engineers whose particular responsibility is the airport engineering. The use of airport power sources, duct bank availability, access roads, and other matters should be discussed with the airport manager or those responsible for the airport engineering. In discussions of the ILS project with the airport manager or other local authority, care must be taken regarding the facility site preparation plan since the airport manager may not be aware of the distinction between the Airway Facilities and the Airports organizations. Unless specifically authorized to do so, the site survey engineer should not conduct discussions regarding plans for site preparation work with the sponsor. He may discuss the extent and progress of work regarding ILS site preparation with the Airports divisions or local ADO.

c. Civil and Consulting Engineers. Airport civil and consulting engineering organizations should be contacted, through the airport sponsor whenever necessary in order to determine what additional drawings, proposed or finished elevations, construction conditions, and previous survey work have been accomplished and may be useful in the ILS survey work. In most cases drawings and information will be supplied without cost.

83. LOCAL MAPS AND DRAWINGS. Those maps and drawings providing information for the survey and not previously available in the regional office should be obtained through the sources discussed in paragraph 82. Paragraph 62 describes these maps and drawings.

84. CURSORY INSPECTION OF POTENTIAL ILS SITES. Before beginning the survey work for each of the components of the ILS system, it is suggested that a cursory general inspection be made of the areas involved. The purpose of such a visual inspection is to learn if there may be unusual requirements and/or problems that may be encountered in the survey. Examples of the insights to be gained by a visual inspection are listed.

a. A shelter or antenna located in dense undergrowth may require the need for additional help for surveying.

b. Areas temporarily flooded or under standing water may necessitate the rescheduling of work.

c. Obvious construction difficulties or unusual terrain may require reconsultation with the project engineer or other regional engineers.

d. Marker search areas in densely populated communities may suggest consultation regarding other means for establishing approach fixes.

e. Obvious requirements for waivers because of physical restrictions, etc.

f. The site survey engineers can better plan their work if they are familiar with the area over which they will be working.

85.-90. RESERVED.

SECTION 2. GENERAL ILS SITE SURVEY REQUIREMENTS

91. DETERMINATION OF COORDINATES, DISTANCES, AND ELEVATIONS.

a. Tolerances. The required survey accuracy of the locations of ILS facility elements is determined by the headquarters Flight Standards Service. The location accuracy of ILS equipment antennas situated on the airport (including the middle marker) shall be determined to within ±1 foot in the horizontal plane and elevations of the antennas shall be determined within ±0.1 foot. The accuracy location of the outer marker and/or COMLO or NDB shall be within ±40 feet in the horizontal plane and ±100 feet in elevation. An accuracy in location of 1 foot in distance is approximately equivalent to 0.01 second of latitude and approximately 0.01 second of longitude at the equator to approximately 0.02 second of longitude at sites located in northern Alaska.

b. Published Information.

(1) The geographical coordinates of the airport reference point (ARP) and certain runway ends for many airports have been determined by NOS, Department of Commerce, National Oceanic and Atmospheric Administration. These surveys by NOS are "third order" surveys and the coordinates and runway centerline azimuths are shown on many published OC charts. The coordinates of the runway ends are shown to the nearest hundreths of a second. The geodetic azimuth of the runway centerlines are shown to the nearest second. The coordinates of the ARP are shown to the nearest tenth of a second. The information determined by the NOS surveys has been supplied to the FAA and is available from the FAA National Flight Data Center (AAT-430). Many monuments or horizontal and vertical control positions have been established over the United States and at most airports by USGS, and by NOAA, National Geodetic Survey (formerly the U.S. Coast and Geodetic Survey). Where these monuments can be located and identified, information regarding their position and elevation is available from the appropriate agency. Information regarding USGS monuments may be obtained from:

U.S. Geological Survey
National Center
Reston, Virginia 22092
Attention: Geodetic Control Section
Phone: (703) 860-6045

(2) The USGS also publishes a list of the horizontal and vertical control positions, which is available from the National Center. Information regarding monuments established by the National Geodetic Survey is available from:

National Oceanic & Atmospheric Administration
Director, National Geodetic Survey
Rockville, Maryland 20852

(3) In addition to the monuments established by the above mentioned Federal agencies, many states have established a plane coordinate system, which may be used for accurately determining the position of approach navaid facilities.

c. Determination of Locations.

(1) Scaling of coordinates and distances from an OC chart will normally yield accuracies of approximately ±0.2 second for geographical coordinates and ±10 feet in distance; consequently, to meet the accuracies required in paragraph 91a, the coordinates and distances of ILS facilities located on the airport will have to be determined by actual measurement from existing data. Careful scaling from the 7-1/2 minute series (scale approximately 1 inch = 2,000 feet) of USGS topographic charts can yield an accuracy of approximately ±40 feet; consequently, this method may be used for determining the location of a distance to the outer marker and/or COMLO or NDB where no other datum is available. The site survey engineer should make an effort to locate and use either USGS, National Geodetic Survey, or state plane coordinate system monuments if practical. The distance and geodetic azimuth between sets of geographic coordinates may readily be calculated with hand-held calculators using the following equations:

$$D = K \cos^{-1} \left[\sin(L_1) \sin(L_2) + \cos(L_1) \cos(L_2) \cos(\lambda_1 - \lambda_2) \right]$$

$$B = \cos^{-1} \left[\frac{\sin(L_2) - \sin(L_1) \cos(D/K)}{\sin(D/K) \cos(L_1)} \right]$$

where: L_1, λ_1 = latitude and longitude of first point

L_2, λ_2 = latitude and longitude of second point

D = distance between the points (see K)

B = bearing from first point to second point

K = { 60 for D in nautical miles
K = { 364, 566.90 for D in feet
K = { 111.120 for D in kilometers

(2) The coordinates of locations on and in the vicinity of the airport may more conveniently be determined by using the distances per second of latitude and longitude. One (1) second of latitude is equal to a north-south distance of 101.3 feet. The east-west distance represented by one (1) second of longitude varies due to the convergence of meridians and is given in table 5-1 for latitudes between the equator and 70 degrees.

TABLE 5-1. LENGTH OF A SECOND OF LONGITUDE

LATITUDE (DEGREES)	FT./SEC. OF LONGITUDE	LATITUDE (DEGREES)	FT./SEC. OF LONGITUDE
0	101.45	36	82.17
1	101.44	37	81.12
2	101.39	38	80.05
3	101.31	39	78.95
4	101.21	40	77.83
5	101.07	41	76.68
6	100.90	42	75.51
7	100.70	43	74.31
8	100.47	44	73.10
9	100.21	45	71.86
10	99.92	46	70.60
11	99.60	47	69.32
12	99.25	48	68.01
13	98.87	49	66.69
14	98.46	50	65.34
15	98.02	51	63.98
16	97.55	52	62.59
17	97.05	53	61.19
18	96.52	54	59.77
19	95.96	55	58.32
20	95.37	56	56.86
21	94.76	57	55.39
22	94.11	58	53.89
23	93.44	59	52.38
24	92.73	60	50.86
25	92.00	61	49.32
26	91.24	62	47.75
27	90.46	63	46.18
28	89.65	64	44.60
29	88.80	65	43.00
30	87.94	66	41.38
31	87.04	67	39.76
32	86.12	68	38.12
33	85.17	69	36.46
34	84.20	70	34.80
35	83.20		

d. Determination of Elevations. The elevations for the approach navaid facilities located on the airport (including the middle marker) shall be determined by ground level surveying to the nearest 0.1 foot, using datum at the airport such as the elevation of the runway threshold or suitable bench marks. The elevation of the ground at the outer marker and/or COMLO or NDB may be carefully interpolated from the contours on the 7-1/2-minute series of USGS topographic charts if no reliable datum is available in the vicinity.

e. Recording of Distances, Elevations, and Coordinates.

(1) Horizontal Distances. Horizontal longitudinal and lateral distances on the airport (including the location of the middle marker) shall be recorded to the nearest foot. The corresponding distances to the outer marker and/or COMLO or NDB shall be recorded to the nearest 10 feet. The distance to the outer marker should also be recorded in nautical miles (1 nautical mile = 6,076 feet) to the nearest one-hundreths of a mile as calculated from the distance used in feet. The international unit now officially used in the United States is equal to 6076.115 feet. The old United States unit equal to 6080.20 feet has not been used officially since July 1, 1959.

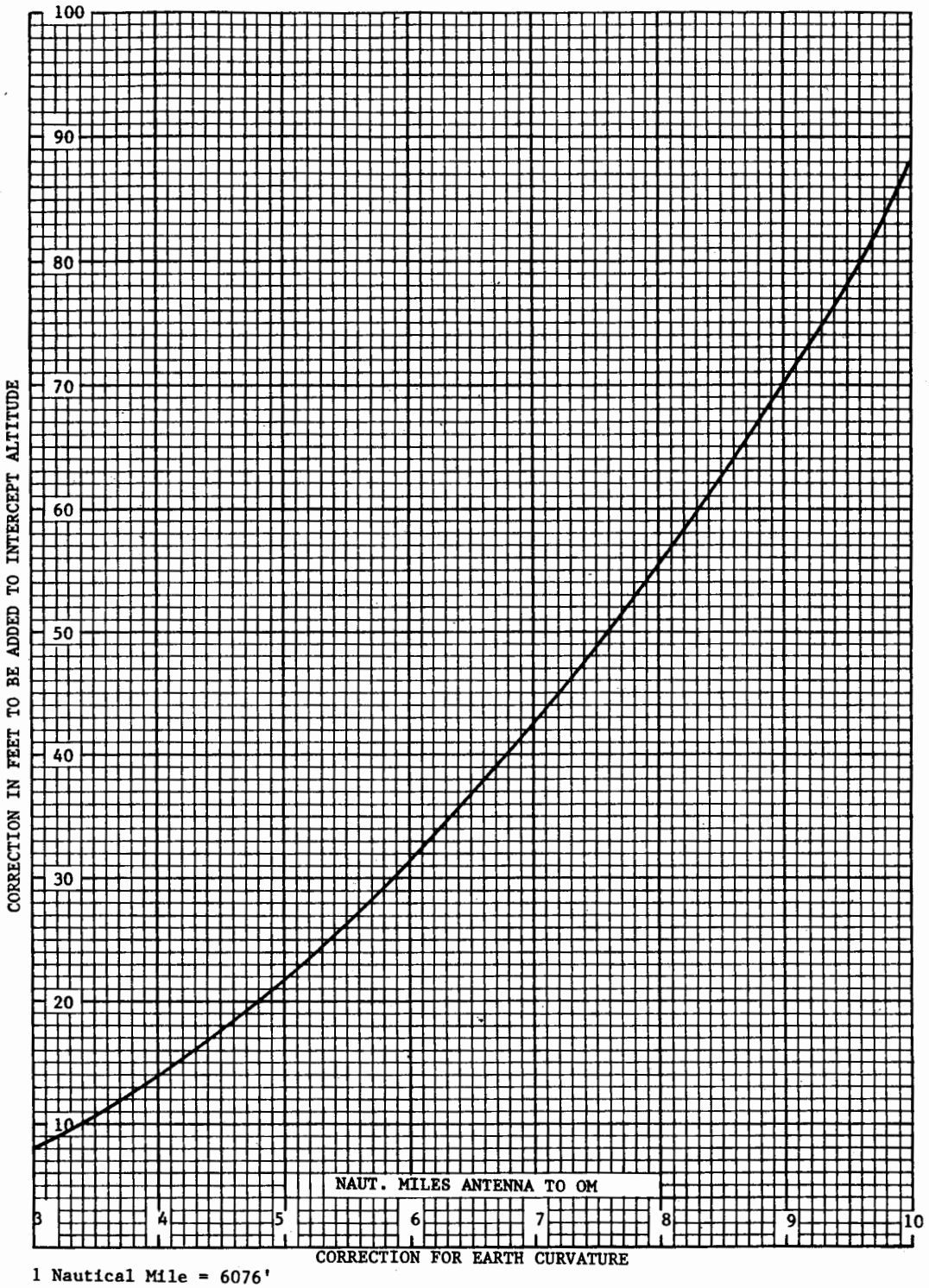
(2) Elevations. Elevations of the ground and/or structures associated with the approach navaids facilities on the airport shall be recorded to the nearest tenth of a foot. Elevations of the ground at the outer marker and/or COMLO or NDB shall be recorded to the nearest 100 feet. However, since the contour intervals shown on the USGS topographic maps are 20 feet, the site survey engineer may record the elevation that can readily be interpolated from the map.

(3) Geographical Coordinates. The geographical coordinates of the approach navaid locations on the airport shall be recorded to the nearest 0.01 second. The coordinates of the outer marker and/or COMLO or NDB shall be noted to the nearest one-half second.

(4) Threshold Crossing Height. The calculated threshold crossing height shall be recorded to the nearest tenth of a foot. The calculated specific intercept points along the glide path above the markers shall be recorded to the nearest foot.

f. Intercept Altitude. The intercept altitude of the glide path with respect to the outer marker should be calculated. At distances beyond 2 miles from the runway threshold, corrections that are due to the curvature of the earth become significant and should be added to the elevation computed from the glide slope path extended from the airport. The earth curvature may be calculated or may be conveniently taken from Figure 5-1, Correction for Earth Curvature. The calculated elevation of the intercept of the glide slope approach plane

FIGURE 5-1. CORRECTION FOR EARTH CURVATURE



1 Nautical Mile = 6076'

with a point directly above the outer marker shall be noted in feet above mean sea level. Figure 5-2 is a sample application of the earth curvature correction.

92. REAL ESTATE CONSIDERATIONS.

a. Availability of Land. Land used for the outer marker, COMLO, and NDB (and sometimes the middle marker) sites are located away from the airport. The location for the facility plot will depend upon the availability of land in the desired area.

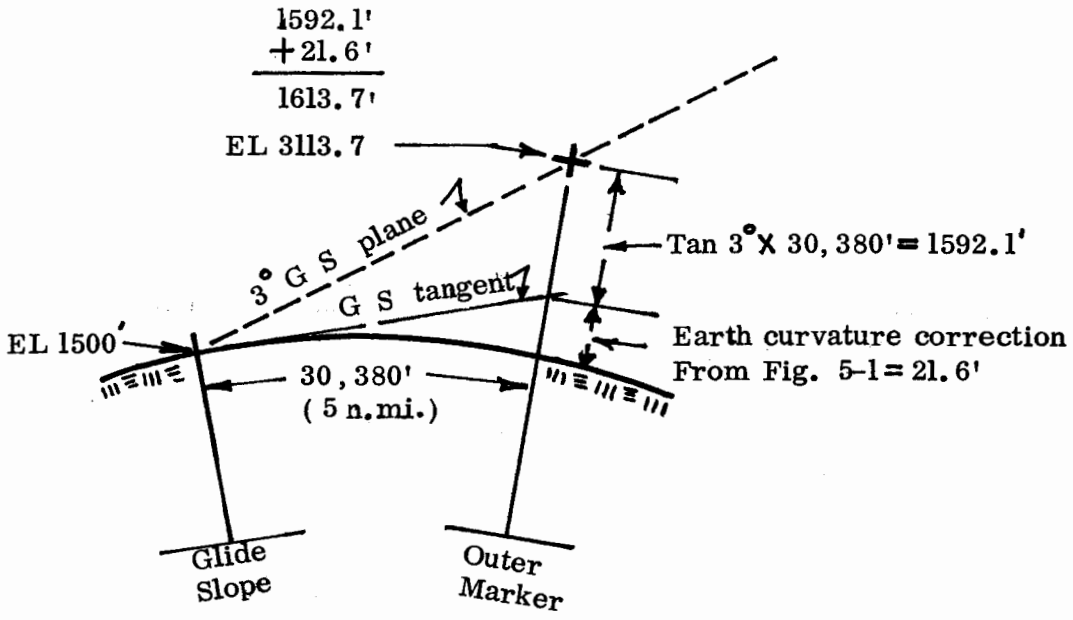
b. Lease or Purchase of Land. The decision as to whether land for a facility plot should be leased or purchased will be made by the Logistics division and depends upon the value of the land, the recurring costs for leasing, and the period of time the facility may be required. Orders 4423.2 and 4660.1 prescribe the policy that will be used.

c. Contacting Property Owners. The site survey engineer should not conduct negotiations with a property owner either for purposes of leasing or purchasing a site. He may, with the permission of or at the direction of the Logistics division (real estate), participate in discussions relating to the conduct of surveys and general information necessary to determine the suitability of the site and the construction requirements. In this connection, the site survey engineer should become familiar with the general provisions and implications of the Uniform Relocation Assistance and Real Property Act of 1970 (Public Law 91-646). The Logistics division real estate personnel will provide guidance on FAA precautions and responsibilities under this Act. The Logistics division will need to know of the requirements for a plot as soon as a suitable location or locations can be determined. It is desirable that real estate personnel from the regional Logistics division accompany the survey engineer in the field. Where Logistics personnel are unavailable at the time of the survey, the required information may have to be exchanged with real estate personnel by mail or telephone. In some instances, the site survey engineer may have to return to the site for detailed survey work after negotiations are completed.

d. Right-of-Entry Permits. In some instances, the right-of-entry to a property for the purposes of a physical survey and examination may be accomplished by a verbal agreement with the land owner. In other instances, a formal written right-of-entry agreement will be required. In either case, Logistics division personnel should be consulted and the method of approach to the property owner determined by them.

e. Property Owner. The site survey engineer should determine the "owner-of-record" and obtain the necessary information by which Logistics division personnel may contact the owner. It is not

FIGURE 5-2. SAMPLE OF EARTH CURVATURE CORRECTION AT OUTER MARKER



necessary that the site survey engineer perform a legal title search. He should, however, obtain the name of the owner by examination of the tax rolls or the warranty deed records together with the description or plot plan of the area under consideration.

f. Property Survey. A legal description of the desired marker plot area should be prepared from actual field data to ensure accuracy (e.g., so that tree clearing, right-of-way, etc., will not infringe on other properties). However, where circumstances permit or dictate, a legal description can be prepared from the deed records and property plats without performing an actual detailed survey on the land. An actual survey will, of course, be required to physically set the boundaries of the plot. Where a datum for accurately locating and describing a plot of land is obscure or involved in dispute, the services of a land survey engineer may be required and the Airway Facilities project engineer should be consulted regarding the requirement. Appendix 9 provides a brief general discussion regarding the location of property records and information required for a property survey. Also see paragraph 288.

g. Plot Description. Appendix 9 provides a brief discussion regarding plot descriptions, together with examples using different datums for locating the plot. A complete legal description will be required for leased or purchased plots located off the airport. The type of description used for plots located on the airport will vary according to the local custom and will be determined by agreement between the airport owner and the Logistics division.

h. Requirements for Access Roads and Cables. Arrangements for the use of the land for navaid facilities should include the requirements for an access road and space for power and control cables serving the site. The road right-of-way may be included as a part of the plot description or as a separate right-of-way agreement. In either case, ownership data and square footage (or acreage) data will be required. The Logistics division will determine the method to be used in describing and acquiring the access. Where practical, the requirements for power and cable easements should be incorporated with the road requirements. In some instances, these requirements may be handled by the power company serving the site.

i. Restrictive Easements. The site survey engineer should not be involved in negotiations involving restrictive easements, either at the approaches to the runway or in the area around the markers. He should advise the project engineer if it appears that there is vegetation or planned construction that may affect the performance of the ILS.

93. ELECTRICAL POWER AND CABLES.

a. General. The selection of a site should consider the cost of bringing power to the facility, i.e., the distance of the site from an available source of power and the right-of-way required for power cables. In most instances, power for the outer marker, COMLO, or NDB will have to be obtained from the local commercial power company. ILS equipment to be located on the airport may sometimes obtain power from services existing on the airport. The availability of power may be a factor in deciding on which side of a runway to locate a glide slope system or localizer shelter.

b. Power Requirements. Appendix 8, Figure 1, Category I and II ILS Equipment Requirements, and Figure 2, ILS Equipment Construction Requirements, give the power requirements for the various ILS equipment elements. When the specific type of equipment is not known at the time of the site survey, the engineer should plan for:

(1) 15 kVA, 120/240 V ac, single phase for the localizer and/or DME. For pre-Mark I and Mark I with V-ring antenna heaters, plan for 25 kVA.

(2) 15 kVA, 120/240 V ac, single phase for the glide slope.

(3) 5 kVA, 120/240 V ac, single phase for each of the markers and/or COMLO's and NDB's.

c. Power Reference Data. Orders 6030.20, 6950.2, and 6950.11 should be reviewed in conjunction with selecting prime power and auxiliary power sources for ILS facilities. These orders detail the quality of electrical power desired at all National Airspace System facilities.

d. Power Cable Routing. The routing of the power cable should be examined by the site survey engineer. He should investigate and determine the routing that will be most economical and provide the operational reliability required. This should include a determination of which sections of a power cable may be buried and which sections may be constructed above ground.

(1) Off Airport Property. Routing of cable off the airport will depend upon the location of the power service and the easement requirements. At collocated Marker/COMLO's, the incoming power cable should be buried within 100 feet of the COMLO antenna to minimize signal interference.

(2) On Airport Property. The routing of cables on the airport will more likely depend upon physical constraints such as runways, taxiways, and other structures as well as the location of the power source. Most power runs on airport property will be direct earth buried.

(3) Metering. The site survey engineer should determine whether the utility company can supply the power cable and meter at the equipment shelter or whether it will be necessary for the FAA to install a cable to the nearest power line or selected metering point. Consideration should also be given to locating the metering point at a position that will not require a power company representative to enter a secure area.

(4) Cable Ducts. The routing should consider the availability of ducts, the type of cable burial required by the airport, the type soil through which the cable is to be placed, and possible interference with existing cables, utility pipes, and drainage systems. Where it is necessary to pass under runways, taxiways, roadways, and other paved surfaces, a thorough investigation should be made of the possibility of using space in existing duct banks or conduits. FAA Airway Facilities maintenance personnel and local airport maintenance personnel generally have knowledge of the location, availability, and the condition of existing conduits, duct banks, and manholes. The site survey engineer shall verify that such ducts do indeed exist and are in suitable condition for installing cables. Power cable runs passing under runways, taxiways, and railroads shall be installed

in rigid steel or concrete encased ducts or conduits. Cable runs that cross existing buried cables and buried utility facilities shall be protected by heavy wall nonmetallic ducts. Where threading cable through a duct is impractical, split ducts, which are slitted longitudinally to permit placement over existing cables without cutting the cable, may be used.

(5) Soil Conditions. The character of the ground through which the power cable is to be placed should be examined for conditions that may impact the construction costs. Obvious rock outcrop, boulders, swampy areas, and conditions that would make trenching expensive should be noted. In some areas, probing with a steel bar to ascertain the depth of subsurface rock shield may be desirable. Consideration may be given to making a portion of a power run above ground, provided power line poles do not become obstructions and the wiring does not cause any derogation of the system performance.

e. Selection of Service Voltage. Where the power company cannot provide 120/240 V ac service to the equipment shelter, it will be necessary for the site survey engineer to recommend the voltage operating level of the supply cable. A low-voltage cable run should consider the voltage drop along the cable, which should not exceed 3 percent with full load. Conductor sizes will have to be large to minimize the voltage drop. High voltage cables may use smaller electrical conductors but a step down transformer will be required at the shelter. Although the final selection of the cable type and operating voltage may be made in the office, the site survey engineer should obtain sufficient data during the field survey to enable a cost effective selection to be made.

f. Construction Specifications. Where the cable run distances are sufficiently short to allow a low voltage service, the power utility company may provide the cable and perform the metering at the equipment shelter. In some instances, the power company will provide the cable for long runs operating at high voltages, provided the FAA pays for the one-time construction costs. Where the cable is to be installed by the power company in a trench provided by an FAA construction contractor, the power company specifications for the trenching should be obtained. Power cables supplied and installed by the FAA shall comply with specification FAA-C-1391, Installation and Splicing of Underground Cables. The local airport authority should be consulted to ascertain if there are special required specifications for the installation of buried cables on the airport. Some airports require that all cable ducts be encased in concrete. Where the construction will require cutting and trenching through existing paved surfaces, the site survey engineer shall determine the airport or road authority specifications or requirements for subsurface compaction and surface restoration.

g. Discussions with Power Company Personnel.

(1) The site survey engineer should maintain a record of discussions with representatives of the commercial power company. Information discussed relating to the type of service, construction required, estimated nonrecurring (one-time) costs, location of metering point, and other matters affecting the installation should be included as a part of the site survey report. The site survey engineer should not conduct construction and tariff negotiations with the power company except for estimating purposes or as directed by the project engineer or the Logistics division. Appendix 10, Installation of Utilities in a Highway Right-of-way, contains additional information,which may be required when planning electrical service to ILS facilities.

(2) The site survey engineer should determine if the power company requires a plot plan drawing of the preferred location of service equipment. This may be necessary to enable concurrence with the route of the service lateral or service drop desired.

(3) A power company will usually energize the service only upon satisfactory evidence of the safe condition of the electrical installation. The site survey engineer should thus determine what inspection authority is acceptable to the power company.

(4) The site survey engineer should determine what service equipment:

(a) The power company will provide and install.

(b) The customer will provide and the power company will install.

(c) The customer will provide and install.

(d) The power company will provide and the customer will install.

(5) The site survey engineer should determine the grounding requirements of the power company.

(6) The site survey engineer should determine the acceptable type and location for the meter panel.

h. Use of Existing FAA Power Sources. Where the power is to be obtained from another FAA facility or source of power, the site survey engineer should determine what switching and protective circuits will be needed and if there is sufficient capacity for the additional load.

i. Power Cable Length. The length of power cable should be determined by the site survey engineer where advance ordering information is required. Sufficient cable slack should be allowed at the termination points.

j. Identification of Potential Problems. The site survey engineer should identify possible problem areas relating to the power cable installation or use. Typical of such problem areas may be the requirement for marine cable, areas subject to rodent damage, cable failure resulting from caustic soils, unusual temperatures, etc.

94. ACCESS ROADS, TURNAROUNDS, AND PARKING AREAS. The site survey engineer shall obtain that information necessary to determine the routing, type of construction, parking, and turnaround requirements for the access roads.

a. Standard Access Roadway Drawings. The design of access roads shall be in accordance with Order 6940.1, and Drawings D-5980-1 and 2, Access Road Cross Sections for FAA Facilities and Typical Drainage Details.

b. New Construction Requirements. Access to ILS and ancillary aids located off the airport will generally require the construction of a new roadway from an existing public road or street. Access to facilities located on the airport can usually be made by constructing a new road to a taxiway, runway, or existing airport perimeter road or other access road. The site survey engineer should examine possible existing access routes to the site and determine the extent of new road construction requirements and the accessibility to the area for construction purposes.

c. Survey of Centerline and Cross Sections. An investigation along the centerline of the proposed access road should be performed. If the proposed routing will involve earthwork other than normal surface grading for the subbase and smoothing, a survey should be conducted. A traverse of the centerline should be performed and a centerline profile provided. The centerline elevations should be recorded at elevation intervals of not more than 2 feet. Cross section elevations extending a minimum of 20 feet to either side of the centerline should be obtained in those areas involving appreciable slope and consequent cut and fill. Similarly, these elevations should be recorded at elevation intervals not greater than 2 feet. Where the terrain is such that earthwork will be required more than 20 feet from the centerline, sufficient cross section elevations should be obtained to cover the construction requirements. Where the roadway does not abut a property line, an accurate traverse of the centerline may be required to prepare a right-of-way description for the roadway.

d. Right-of-Way. The access road right-of-way should be large enough to contain all ditch and embankment slopes.

e. Drainage. When the routing of the roadway requires a drainage culvert under the road, the area to be drained should be examined in order to determine the size of the opening. Culvert or drain pipes smaller than 15 inches in diameter should not be considered as they are subject to clogging. The site survey engineer should consider the effects of the runoff away from the culvert as well as the area to be drained. This consideration should extend to the erosion and flooding effects outside of the proposed right-of-way (and on other property).

f. Grade of Roadway. The grade of the access road should not exceed 10 percent unless unique conditions would require excessive construction or routing costs in order to maintain a low grade. Where it is judged necessary to exceed a 7 percent (10 percent if paved) grade, Airway Facilities division civil engineering personnel should be consulted regarding the design of excessively steep grades. In areas subject to long periods of snow cover and icing, the grade should be kept as low as practical.

g. Guard Posts and/or Reflectors. Guard posts and/or reflectors should be installed where there is danger of a vehicle accidentally striking any of the structures associated with the equipment or where there may be danger to a vehicle if the vehicle accidentally leaves the roadway. In areas subject to heavy snowfall, reflectors and road markers on light frangible standards may be specified.

h. Paving of Access Roads. Access roads that terminate at a runway or taxiway on which jet powered aircraft operate shall be paved per Order 6940.1. The paving of access roads under other circumstances will depend upon local conditions. The determination of paving requirements should be made by the project engineer.

i. Roads Shared with Other Facilities. ILS elements located on the airport may share the access road with other facilities, or use an airport maintenance or perimeter road. If an approach lighting system with an access road exists, the inner and middle markers can make use of the same roadway without additional construction costs. If a localizer antenna is to be installed in an existing approach lighting system, it may be necessary to reroute the existing light lane access road so as to clear the localizer antenna. The final determination regarding the extent of the relocation so as to minimize the effect of vehicles to the localizer signal should be made by the project engineer.

j. Cable Barriers. Where it is desirable to restrict road access to authorized personnel, and gates are not practical, a cable barrier may be used. Drawing CN-D-0006, appendix 6, shows a typical cable barrier.

95. MONITOR AND CONTROL CABLES.

a. General. The requirements for wire line monitoring and control of ILS and ancillary aids are discussed in those paragraphs relating to the siting of the facilities. When it has been determined that wire line or cable monitoring and/or control is to be used, the site survey engineer should examine the availability of circuits in existing cables and determine the routing of new cables. The functions of monitoring and control can generally be accomplished in the same multiconductor cables.

b. Use of Spare Circuits in Existing Cables. Where multiconductor cables have previously been installed for existing facilities, the site survey engineer should determine what spare circuits may be available. The Airway Facilities maintenance personnel at the airport should be familiar with the location of existing multiconductor cables and whether usable spares are available. Avoid splices where possible. It is more desirable to extend the monitor and control cable to a junction box even if some additional length of cable and trenching is required.

c. Installation of New Cables. The site survey engineer should determine the routing and cable length required for the installation of new cables. The same general considerations should be given to the routing of monitoring and/or control cables as discussed in paragraph 93 for routing of power cables. Where practical, the same trench may be used for both cables, provided monitor and/or control cables are separated by not less than 6 inches from power cables carrying 5000 volts or below and by not less than 12 inches from power cables carrying above 5000 volts.

d. Use of Telephone Company Cables. Wire lines from the local telephone company may be available. In such cases, the telephone company will be responsible for the maintenance of the cable. The site survey engineer may undertake technical discussions with personnel of the telephone company in order to select the most satisfactory method of monitoring. Discussions regarding financial arrangements should be made only at the direction of personnel in the Airway Facilities division leased communications staff.

96. FENCING AND SECURITY.

a. General. ILS and ancillary aids should be secure from access by unauthorized personnel. Facilities located off the airport will generally require a protective fence. Equipment and antennas installed on the airport will generally be inside of the airport fenced secure area and should not require additional fencing.

b. Fencing of Marker, COMLO, and/or NDB. The equipment shelter and antenna supports for the markers, COMLO, and/or NDB located off the airport should be enclosed with a class "F" metallic fence. The

fencing shall comply with specification FAA-E-2065, Fences. The power metering should be located such that the meter may be read by the power company representative without actually having to enter the fenced area. Fencing of the entire area embracing the COMLO antenna buried ground radial system should be provided only if required for security reasons.

c. Fencing of Localizer and Glide Slope. Where localizer and glide slope facilities require fencing for reasons of security, the derogating effects of fencing in the vicinity of the antennas must be considered. Wooden fencing may be used to minimize the derogating effects. If it appears that such fencing is required, the site survey engineer shall contact the project engineer to determine the extent and type of fencing that should be used.

d. Facilities Located on Secure Government Property. Where marker, COMLO, or NDB facilities will be located on secure government areas (such as a military reservation), the site survey engineer should determine access requirements for FAA maintenance.

97. INVESTIGATION OF SOIL CONDITIONS.

a. Visual Inspection. The site survey engineer should perform a visual inspection of the area at each of the proposed facilities, and make inquiries of local engineers regarding previous construction and known foundation conditions. This should include limited ground probing, and the visually apparent character of the soil. Obvious rock outcrop or boulders, standing water, swampy conditions, and the existence of fresh land fill material are among those characteristics that should be noted.

b. Geotechnical Engineering Services. Where it appears, either visually or by discussion with local engineers, that the soil may make construction or foundation requirements uncertain, the site survey engineer should contact the project engineer regarding the possibility of obtaining the services of a geotechnical engineering firm. The data that can be furnished by a subsurface soil investigation will enable Airway Facilities engineers to determine the suitability of a national standard access road or foundation design or to design a special one. The site survey engineer should contact the project engineer before authorizing or arranging for such services. Refer to paragraph 46b for information required to prepare a statement of work for this type of service. In some instances, soil borings in the vicinity of the proposed facility may have previously been performed for purposes of runway or taxiway construction. Usually the best source of this data is through the airport manager's office.

c. Standard Foundation Designs. The national standard concrete foundation designs for ILS facility elements are generally based upon a soil bearing pressure of 3000 psf. The siting of a foundation on

soils of lesser bearing strength will require a more substantial foundation design; conversely, the siting of a foundation on soil of greater strength may justify a more economical foundation design. The site survey engineer should obtain sufficient information to enable the project engineer to determine the type of foundation required.

d. Frost Depth. The site survey engineer should verify the local maximum frost penetration depth. This information can usually be obtained from the architectural and engineering consulting firm associated with the airport planning and construction.

98. ENVIRONMENTAL INFORMATION.

a. General. Environmental considerations affecting ILS establishments are sometimes apparent only when performing an onsite field survey. Unless specifically authorized to do so, the site survey engineer should not conduct discussions in the field relating to environmental matters, particularly with property owners. He should, however, make note of and advise the project engineer of those factors that may become apparent as a result of his survey work.

b. Environmental Factors. Possible environmental factors, which may be observed and should be noted, are:

(1) The location of sites on or adjacent to wilderness areas, historical sites or buildings, archaeological areas, flood plains, coastal waters, wet lands, and park areas. Consideration should be given to the possibility of interfering with important wildlife breeding, nesting, or feeding grounds, or the alteration of the behavior pattern of any species. Also, determine if rare or endangered animal or plant species are known to exist in the proposed project area.

(2) Extensive earth moving requiring the moving of considerable volumes of earth from one location to another. This would include the consequences of removing and relocating undesirable material such as peat.

(3) The effect of drainage changes and water runoff that may be brought about by the construction of an access road. Also consider any adverse effects to the water table or water quality in the area.

(4) Television interference caused by the signal from the marker transmitter must be considered where the marker is to be located in a residential or densely populated area. Interference is most likely to occur on the low band vhf tv channels where the receivers are located more than 30 miles from a tv transmitter. The site survey engineer should note the tv channels being used

by tv receivers in the vicinity of the marker site and further ascertain if these receivers are operating under weak signal conditions. Tall and elaborate tv receiving antennas are a sure indication that the tv signals in the area are not very strong. In some instances, the possibility of tv receiver interference may justify the location of a marker site to a point more distant from the tv receiving antennas. Inasmuch as the frequency of tv channel 5 (76-82 MHz) is adjacent to the 75 MHz marker frequency transmitted, tv channel 5 is most likely to experience interference from the marker transmitter caused by nonlinear distortion products produced in the receiver when the marker signal mixes with a weak television signal. There can be no firm rule for siting that would avoid interference entirely, since variable factors such as the strength of the signal being received and the orientation of the antennas would have to be considered. If practical, locations approximately 1,000 feet away from tv receiving antennas should be selected, particularly where the tv transmitting stations are located more than 30 miles away.

(5) Aesthetic considerations may be a requirement in some residential areas, recreational areas, schools, or public parks. The site survey engineer should make note of the possible impact of a facility located in such areas.

(6) Special zoning restrictions regarding antenna structures and utility type buildings exist in some residential areas. The site survey engineer should determine if the proposed facility is compatible with present land use.

(7) Chemical vegetation control agents, e.g., Hyvar, are commonly applied to gravel or crushed rock roadways and walkways. Situations may arise, however, in which use of such agents should be avoided. Two broad classes of such situations are:

(a) Danger of killing nearby valuable vegetation.

(b) Danger of polluting ground and surface waters.

(8) Construction and installation requirements that would divide or disrupt established communities; sever access to residential, recreational, or commercial areas; and significantly contribute to increased vehicular traffic near the proposed site.

(9) Construction debris disposal should be arranged for at a site meeting all state and local governmental requirements, and in observance with all Federal, state, municipal, and airport safety regulations.

(10) Inconvenience to taxiing aircraft and/or vehicular traffic during periods of facility construction (e.g., when cable ducts are installed under taxiways or public roadways).

99. GENERAL CONSTRUCTION CONSIDERATIONS.

a. General. The site survey engineer should obtain certain general information regarding the construction that will have to be performed both on and off the airport. During the discussions with the airport manager, airport civil works authority, or other organizations responsible for the equipment facilities on the airport, the site survey engineer should determine if there are special requirements or standards for construction on the airport.

b. Buried Cables. Some airport civil works authorities have special requirements for the placing of buried cables in ducts and/or for encasing ducts in concrete. In some instances, there are specific requirements regarding distances between manholes or pull-boxes. Refer to paragraph 93f for construction details.

c. Zoning and Building Codes. In addition to the normal requirements for construction, which includes compliance with existing electrical codes, the construction of facilities off the airport property may be in areas subject to unusual building codes. Typical of such requirements may be construction of markers in residential areas or parks. The site survey engineer should ascertain if such special codes do exist and determine what consideration should be given to the requirements in the later ILS documentation. Most municipal construction work will require certain permits and certificates. These are generally handled by the contractor performing the construction.

d. Insurance Requirements. The airport requirements for construction liability and surety insurance should be obtained in writing from the proper airport operating authority. Some airport authorities require much higher contractor insurance requirements than contractors are normally familiar with for construction off the airport. These requirements should be included in the ILS documentation.

e. Unusual Working Conditions. The site survey engineer should determine if the airport requires special working conditions to be met, such as work at unusual hours (other than 7:00 AM to 5:00 PM), the posting of special guards at access gates, or prohibits on-airport construction during heavy traffic or holiday periods. He should also determine if special driver's licenses and/or escort requirements are necessary for vehicles operating on the airport for construction purposes.

f. Restrictions on Heavy Equipment. Where the location of proposed ILS facilities are such that heavy construction equipment may have difficulty gaining access to the site, as in the case of road and bridge

restrictions or unsuitable soil conditions, the ILS documentation should so state.

g. Clearing and Construction Information. The site survey engineer should obtain that information necessary to plan the clearing needs, construction requirements, and provide a good estimate of the required construction. This information should detail the cut and/or fill earthwork requirements, the nature of vegetation to be cleared and an estimate of the trees that will have to be removed. Clearing around the antennas should be in accordance with the requirements of Order 6750.16A. Consideration should be given to the proximity of tall trees located on properties adjacent to those on which the marker and/or COMLO plot is to be located. Rather than remove some trees, it may be cost effective to provide a higher marker antenna mounting. Both the value of timber to be cleared and the cost of removal should be considered. The site survey engineer should consult with the project engineer regarding the possibility of considering a higher than normal marker antenna.

h. Site Terrain. A detailed survey of a site for construction purposes should be made where the site terrain is such that it will require earthwork, landfill, extensive roadway and parking construction, and drainage facilities. Contour information at one-foot intervals should be provided over the area of shelter and parking where the terrain is steep and earthwork is required. Where the area is relatively flat and only normal surface grading will be required for the construction, it may not be necessary to perform a detailed contour survey. In any event the site survey engineer's report and/or field sketches should indicate the lay and character of the land over which the work is to be performed.

i. Seismic Considerations. Where facilities are to be constructed in an area likely to experience seismic activity, the ILS documentation should so state.

j. High Winds. Areas known to experience frequent high winds should be noted and called to the attention of those responsible for the antenna design and construction.

100. FREQUENCY INTERFERENCE SURVEY. Frequency interference caused by fm radio stations broadcasting in the vicinity of the airport has caused problems to ILS localizer and glide slope equipment. In many cases, the regional frequency management officer (FMO) can solve this interference problem by discriminatingly assigning the operating frequencies to the ILS equipment. In order to identify any potential problems, the site survey engineer should coordinate with the regional FMO through the project engineer to determine the location, call letters, assigned frequency, and power output of any fm radio stations within interference range of the ILS approach aids; if already determined during the feasibility study, the site survey engineer should update the data as appropriate. Actual flying of the ILS approach should be considered where deemed desirable by regional Flight Standards and Airway Facilities personnel.

101. OBSTRUCTIONS.

a. Airport Obstruction Surveys, Order 8260.16. The site survey engineer should determine to what extent the obstruction data has been obtained for the proposed ILS approach and to what extent he is expected to verify this data. Where so required, the site survey engineer should identify all obstructions to be removed (e.g., extent of tree groups and ground penetrations to be cleared). Order 8260.16 states that, when existing OC charts are used, Airway Facilities personnel are to confirm the obstruction slope (TERPS paragraphs 932 and 933) by sweeping the final approach area by instrument. It is to be noted that a surveying instrument with an elevated telescope sweeps a conical surface rather than the planar approach surface; consequently, the instrument should be relocated in order to accurately check the edges of the surface in the near field.

b. Nonstationary Obstructions. Where moving vehicles pass under the approaches to runways, 17 feet should be added to the elevation of the surface of an interstate highway and 15 feet should be added to the elevation of the surface of other roadways. Twenty-three feet should be added to the elevation of railway tracks. In some instances, such as railway switch tracks, the traffic is limited and operation through the affected airport area is coordinated with the ATCT. These arrangements should be investigated and included in the later ILS documentation. There are some instances where ship channels pass across the approach to the runway and ships with masts exceeding the obstruction limitations penetrate the approach surface.

c. Discussion. Discussion regarding obstructions with organizations other than FAA personnel should be restricted to the technical aspects of obstructions such as the location and the degree of penetration.

d. Approach Surfaces. Figure 5-3 depicts runway obstruction surfaces.

102. DETERMINATION OF RUNWAY THRESHOLD. The location of the ILS antenna(s) with respect to the runway threshold is important. In some instances, the actual location of the runway threshold is difficult to determine. Generally, the civil survey personnel who establish the runway centerline stations for construction and resurfacing, actually survey in and designate the threshold point. Where the actual point is not identifiable, the site survey engineer should advise the airport manager of his inability to identify the threshold point and request that a positive identification of the threshold be made.

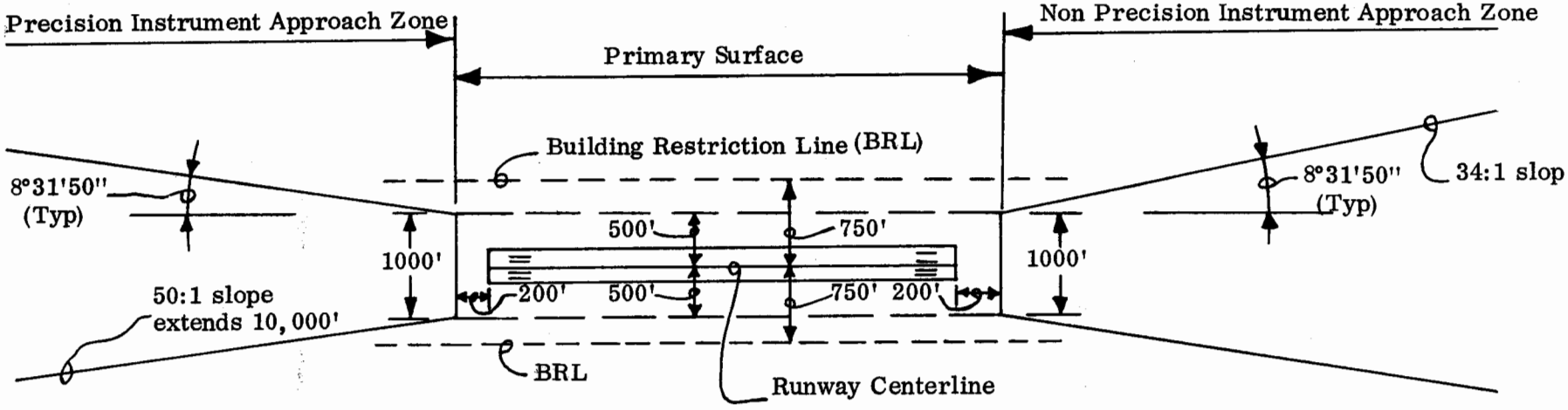
103. MULTIPLE OWNERSHIP AND JOINT-USE RUNWAYS. The site survey engineer should determine if the runway being considered for an ILS is a runway jointly used with the military. Such runways often have overrun areas and may have automatic cable barriers. Cable barriers usually use automatic actuating mechanisms, and the details regarding the facility should be included in the later ILS documentation. In some instances, land within the airport security fence but outside of normal aircraft operations is

FIGURE 5-3. PRECISION INSTRUMENT RUNWAY OBSTRUCTION SURFACES

Primary Surface - This is a surface longitudinally centered on a runway. No obstacle, including the ground, may penetrate above the elevation of the runway centerline opposite that point, or above the runway threshold elevation within the limits of the primary surface and the 1,000-foot total width.

Transitional Surface - This is a 7:1 imaginary plane starting at sides of primary surface and at sides of approach surfaces and extending to limits of intercept with airport surface base plane (150 feet above elevation of airport reference point.)

Building Restriction Line - This is a limit established for proximity of obstructions not fixed by function. ILS components are exempt. Overhead power lines should not be within this area for length of primary surface. In some instances, the building restriction line is extended to the limits of airport property.



used by other governmental agencies, such as a flood control district or for agricultural purposes. If agreements with governmental agencies other than the airport authority is required, the name, address, and telephone contact should be recorded as well as the substance of any discussion or agreement regarding the proposed ILS.

104. YEAR-ROUND SITE CONDITIONS. The probable year-round site conditions should be investigated by the site survey engineer. Areas that stand under water a portion of the year but are "high and dry" at the time of the investigation should be noted. Local airport maintenance and construction personnel as well as local Airway Facilities and Air Traffic personnel generally are knowledgeable of the conditions of specific areas throughout the year. Areas subject to long periods of snow cover should be noted. Portions of airports adjacent to rivers and streams may be subject to flooding. The elevation of the high flood stage should be recorded.

105. USE OF PHOTOGRAPHS. Photographs of the areas, surfaces, and existing structures involved with the ILS are desirable as they will give management and other reviewing personnel a better conception of the existing terrain and structural features which may be problem areas. They can assist the engineer in evaluating and documenting his survey and design effort and should be incorporated in the site survey report when available. Particular attention should be given to photographs of power termination, ducts, conduits, cable and road routings, and congested areas. Photographs will help the site survey personnel to fill in information gaps that may exist after they return from the field. Photographic equipment ranging from the small film pocket type of camera to the larger 35 mm and fast development cameras will give satisfactory results. Color prints will be most useful.

106.-120. RESERVED.

SECTION 3. DETAILED ILS SITE SURVEY REQUIREMENTS

SUBSECTION 1. LOCALIZER

121. FACTORS TO BE CONSIDERED. The investigation and survey of the localizer antenna, equipment shelter and associated access road, and utility requirements should consider factors including but not limited to:

a. Siting Criteria. Selection of an antenna location so as to achieve satisfactory approach path geometry and electronic performance. These requirements are given by Order 6750.16A, and the operation will generally be satisfactory if these requirements can be met.

b. Illumination Over Threshold. Determination of the localizer antenna illumination of the ILS runway approach threshold and antenna mounding or platform requirements.

c. Obstruction Criteria. Examination of obstruction criteria with reference to the location and elevation of the antenna and equipment shelter.

d. Availability of Space. Determination of suitable space for locating the antenna and equipment shelter.

e. Derogations. Consideration of derogating terrain or surfaces.

f. Locations of Antennas and Shelter. Determination of the location of the antenna and equipment shelter within the siting criteria.

g. Access Road. Determination of routing and construction requirements for the access road.

h. Power and Cable Requirements. Determination of source, routing, and construction requirements for power.

i. Monitoring and Control Requirements. Determination of requirements for monitoring and/or remote control, cable routing, and construction (including circuit availability in existing cables).

j. Interface with Other Systems. Interface with other systems, such as proposed and existing ILS, lighting, and other navigational aid systems.

k. Construction Factors. Consideration of factors impacting construction costs, such as terrain, contour surveying, and soil conditions.

l. Land Survey. Survey work that may be required to prepare a legal plot description for the area to be used.

m. Security Requirements. Examination of security and fencing requirements.

n. Environmental Considerations. Environmental considerations regarding establishment of localizer.

o. Special Requirements. Determination of special construction requirements and year-round working conditions as outlined in paragraphs 99 and 104.

p. Ground Check points. Survey of the optimum location of the localizer ground check points.

122. TYPES OF LOCALIZER ANTENNAS. The principle localizer antenna systems in use by FAA are the:

a. V-Ring. The V-ring localizer antenna consists of 15 radiating elements aligned perpendicularly to the approach path centerline, extending approximately 52 feet on either side of the centerline extended, for a total width of approximately 104 feet. Two monitoring antennas are placed in front of the array. Typical foundation layouts for the V-ring antenna is shown on Drawings D-5849-1, -2,and -3.

b. Traveling Wave (TWA). The traveling wave localizer antenna consists of a set of radiators comprising an element approximately 15 feet long and 2-1/2 feet wide. They are arranged in an array of either 8 or 14 elements, extending perpendicularly to each side of the runway centerline extended. Arrays consisting of 8 elements are narrow aperture arrays and are approximately 46 feet wide, not including obstruction lights. Arrays consisting of 14 elements are wide aperture arrays and are approximately 86 feet wide, not including obstruction lights. Monitoring elements are integral with the array and a misalignment detector is built into the antenna support structure. Drawings D-6032-4 and -5 and D-6073-1 and -2 show the foundation layout for the traveling wave antennas.

c. Log Periodic Dipole (LPDA). The log periodic dipole localizer antenna array consists of a set of radiators comprising an element approximately 9 feet long and 50 inches wide, arranged in an array of 8 or 14 elements similar to the traveling wave antenna. Similarly, monitoring elements are integral with the array and a misalignment detector is used. Drawings D-6054-2 and -3 show the foundation layout of the log periodic dipole antenna.

d. AN/GRN-27 (V). The AN/GRN-27 (V) localizer antenna consists of a set of radiators comprising elements arranged in two arrays. The front array consists of 14 elements and is known as the course array. The rear array, spaced 200 feet behind the course array, consists of 6 elements, and is known as the clearance array. The arrays are aligned perpendicularly to the runway centerline extended. The course

array extends approximately 43 feet on each side of the runway centerline extended, not including obstruction lights. The clearance array extends approximately 16 feet on each side of the runway centerline extended, not including obstruction lights. Each of the antenna elements that make up the array is 20 feet long. Integral monitoring and a misalignment detector of both arrays is used. A far field monitor is located in the vicinity of the middle marker. Drawings D-40652 and D-6073-1 and -2 show the typical foundation layouts. Drawing D-46046 shows the typical layout of the far field monitor.

123. LOCALIZER ANTENNA LOCATION. The criteria for siting the localizer antenna is given in Order 6750.16A. Figure 2-6 of Order 6750.16A indicates the zones in which the antenna may be located and defines the preferred areas of location. The type of antenna that will be used will also have a bearing on the selection of the antenna site, e.g., multiple array antennas will require more space than the single array antennas.

a. The optimum antenna location will be an on-centerline location placed 1,000 feet beyond the stop end of the ILS runway.

b. The minimum distance from the stop end of the runway is 300 feet for a Category I ILS where jet powered aircraft are operating and 600 feet between the stop end of the runway and the nearest antenna array for a Category II system, or that distance that precludes penetration of the approach surface plane by any portion of the antenna system or equipment shelter, whichever is greater. Where jet powered aircraft are not operating, the minimum distance for the Category I antenna is governed by the nonpenetration requirement.

c. The maximum standard distance from the stop end of the runway to the localizer array shall be 2,000 feet. Locations of the antenna beyond the standard 2,000 feet from the stop end of the runway shall not exceed 13,300 feet from the approach threshold of the runway.

d. Tailored course widths of 700 feet at the runway threshold are required for all localizers. The course width range is 3^{o} minimum and 6^{o} maximum. Where problems are anticipated in obtaining this course width on short runways, Airway Facilities electronic engineering personnel should be consulted through the project engineer.

e. Limited terrain, because of space or rugged surface, may prevent the localizer antenna from being positioned on the runway centerline extended. Where this occurs, consideration may be given to the investigation of an offset localizer antenna array with its increased landing minima. The criteria applicable for siting an offset localizer facility are given by paragraph 13i and figure 2-5 of Order 6750.16A. Offset localizers are limited to Category I operation.

f. The location of the antenna is further influenced by the clear areas available, suitable space for the equipment shelter, the elevation of the ground, reasonable construction costs, access and utility requirements, and obstruction considerations. These factors are further considered in the following paragraphs.

g. The geographical coordinates for a two-array antenna system shall be those for the center of the course array.

124. ELEVATION OF LOCALIZER ANTENNA.

a. Factors Determining Elevation. The elevation of the antenna radiating elements is governed by the elevation of the ground, the degree of visibility to the runway threshold, derogating surfaces, and obstructions, and the relationship of the antenna to the approach surface plane and other navaids.

b. Accuracy of Elevation. The engineer must determine the elevation of the ground at the proposed antenna location. An accurate survey of the ground elevation should be made and the elevation of the antenna radiating elements added thereto. The elevation of the proposed antenna radiating elements should be determined to the nearest tenth of a foot (±0.1 foot).

c. Platform Requirements. If it is necessary to raise the antenna radiating elements above that elevation provided by the normal foundation supports, it will be necessary to plan for an earth mound or a platform. Generally, an earth mound will be most economical for raising the antenna less than 5 feet above natural grade. Beyond this height the platform should be considered. The availability of fill material, moving distances, and material costs should be considered by the engineer in choosing the means of support. If elevated mounting appears to be necessary, consult the project engineer regarding the probable electronic performance.

d. Rising Ground Locations. In those instances where rising ground beyond the stop end of the runway may cause the antenna to become an obstruction, alternate locations will generally have to be selected. Where the approach surface plane penetration is only a fraction a foot, consideration may be given to placing the foundation slightly below grade. However, regional Airway Facilities electronic engineering personnel should be consulted through the project engineer regarding the possible affect on the performance. There should be no drainage or standing water problems within the vicinity of the antenna array(s).

e. Penetration of Approach Light Plane. If it is necessary for the antenna system to penetrate the approach light plane in order to properly perform the designed function, the antennas shall not shield any of the lights. The antennas may not penetrate the 50:1 obstacle approach surface.

125. DME COLLOCATED WITH LOCALIZER. Where a DME is to be collocated with a localizer, the height of the DME antenna mast must be considered in selecting a location for the mast and the shelter. Drawing D-6078-1 shows the location of the DME antenna mast with relation to the equipment shelter.

126. LOCATION OF EQUIPMENT SHELTER(S).

a. Relative to the antenna array. The location of the equipment shelter should be in accordance with Order 6750.16A. Generally, the shelter will be located approximately 250 feet from the runway centerline extended. The equipment shelter for a system using an offset localizer antenna may be located behind the antenna, provided it does not violate obstruction criteria nor derogate the performance of the antenna system. In the event that rising ground creates problems in finding an equipment shelter location at which the building does not penetrate the approach surface plane, consideration may be given to locating the shelter more than 300 feet from the antenna array. In such instances Airway Facilities electronics engineering personnel should be consulted through the project engineer to evaluate the expected performance of the system because of the longer-than-normal coaxial cables that will be required.

b. Other Factors. In addition to the performance and obstruction criteria noted above, consideration should be given to the cost of providing an access road and utility services to the equipment shelter. Electrical power, control and/or monitoring, and the interface cable run from the shelter to the antenna array will also affect the location of the shelter.

c. Terrain Conditions. The site survey engineer should obtain that terrain information necessary to perform an accurate cost estimate of the construction required for the equipment shelter installation. Generally, the more nontypical terrain features require more thorough survey work. Equipment shelter locations situated on steep slopes or locations involving drainage or foundation problems will require thorough contour survey and soil investigation in order to arrive at a final design and meaningful cost estimate.

127. OBSTRUCTION CRITERIA. The site survey engineer should investigate the approach surface plane over the opposite end of the runway to ensure that the proposed antenna and equipment shelter locations comply with the minimum obstruction criteria. This will require an accurate determination of the elevation of the top of the equipment shelter and the antenna, as well as their proposed locations. The obstruction surface to be considered in siting the localizer antenna and shelter is that obstruction criteria for the landing approach over the localizer antenna, (i.e., the landing approach opposite to that for which the ILS is being surveyed.) Air Traffic and Flight Standards personnel (local and in the regional office) can provide information regarding the existing designated approaches and the required obstruction clearance (ROC).

128. TYPICAL LOCALIZER PLOT SIZES AND LAYOUTS. An index of national standard drawings showing typical plot layouts of the ILS localizer antenna array and equipment shelter for the various types of localizer system is given in appendix 13. A summary of ILS localizer construction requirements are contained in appendix 8, figure 2.

129. ELECTRICAL POWER AND CABLE. Paragraph 93 provides information regarding the selection and routing of power.

130. ACCESS ROADS, TURNAROUNDS, AND PARKING AREAS. Access road routing and turnaround or parking areas, where required, should be determined by the engineer during the survey. Paragraph 94 provides information regarding the survey and routing of access roads. Where the localizer equipment will require an emergency powerplant with its associated fuel tank, consideration should be given to providing sufficient roadway surface and turnaround area for a fuel truck.

131. MONITORING. Radio monitoring is usually provided for Category I ILS localizers where it is the most economical method of monitoring. Direct wire line monitoring is required for Category II ILS localizers. Order 6750.13, describes the monitoring equipment to be used and gives methods for determining the suitability of the radio path from the localizer to the monitoring point. Where wire line monitoring is to be used, paragraph 95 provides information regarding the selection and routing of monitoring cables.

132. REMOTE CONTROL.

a. A Category I ILS localizer does not require wire line remote control unless dual facing or parallel runway ILS systems are involved and interlocking is necessary (e.g., two ILS's use a common frequency channel). In the event remote control of the localizer is required, the routing of the cable may be planned along with the remote monitoring system. Order 6750.35 gives the number and type of wiring required for the remote control and interlocking of ILS localizers. It is not necessary to provide interlocking controls between the localizer and the glide slope.

b. Category II ILS localizers require wire line remote control. This generally involves a status display/control panel in the ATCT and a status display in the tower equipment room.

c. Control line construction criteria will be the same as for monitoring cables or wire lines as described in the foregoing paragraph.

133. FAR FIELD MONITOR (FFM). Some localizer installations will require a FFM located in the vicinity of the middle marker (i.e., Category II systems), as indicated in appendix 11, figure 1. Where a FFM is to be used, consideration should be given to sharing the costs of providing power, access, and monitoring cables with the middle marker or other facilities in the area. A typical FFM site layout is illustrated on Drawing D-46046.

134. GROUND CHECKPOINTS. Reference points are established at the time of the localizer installation to enable verification of the facility operating parameters. The number and location of the ground checkpoints will vary with respect to the type of localizer system being employed and the terrain and siting conditions. Order 6750.16A, paragraph 17, figure 2-9, illustrates the preferred location for localizer ground checkpoints. The ground checkpoints are normally surveyed and marked by the use of paint, driven pipe, driven spike (asphalt), or chiseled mark (pavement). It may not always be possible to locate the markers the same distance from the antenna array because of inaccessibility or real estate limitations.

135.-150. RESERVED.

SUBSECTION 2. GLIDE SLOPE

151. FACTORS TO BE CONSIDERED. The investigation and survey of the glide slope antenna, equipment shelter, and associated access road and utility requirements should consider factors including but not limited to:

a. Location for Performance. Selection of an antenna location that will achieve the category of ILS performance desired.

b. Location for Proper TCH. Selection of an antenna site that will be compatible with the desired TCH.

c. Obstruction Criteria. Consideration of obstruction criteria with reference to the location and elevation of the antenna and equipment shelter.

d. Derogations. Consideration of derogating terrain and surfaces.

e. Impact on Ground Traffic. Consideration of possible impact on ground traffic movement. (Example: Locating glide slope between runway and parallel taxiway requires taxiway hold lines.)

f. Coordinates and Elevations. Determination of the geometry (i.e., the geographical coordinates and elevations).

g. Access Road. Determination of routing and construction requirements for the access road.

h. Power and Cable Requirements. Determination of source, routing, and construction requirements for power.

i. Monitoring and Control. Determination of requirements for monitoring and/or remote control, cable routing, and construction (including circuit availability in existing cables).

j. Interface with Other Systems. Interface with other systems such as proposed and existing ILS, VASI, and other navigational aid systems.

k. Construction Factors. Consideration of factors impacting construction costs such as terrain, drainage, relocation of public roads, soil conditions, etc.

l. Land Survey. Survey requirements that may be required to prepare legal plot description for the area to be used.

m. Security Requirements. Examination of security and fencing requirements.

n. Environmental Considerations. Environmental considerations regarding establishment of glide slope.

o. Special Requirements. Determination of special construction requirements and year-round site working conditions.

152. TYPES OF GLIDE SLOPES.

a. Image Type Systems. There are three types of conventional image type glide slopes available for installation: null reference, sideband reference, and capture effect. The type of system selected is based upon the condition of the ground plane existing in front of the antenna. The Airway Facilities electronics engineers should be consulted through the project engineer with regard to the type of system that should be used. Sometimes, concessions are made to the ideal terrain criteria in order to make construction feasible. Order 6750.16A, chapter 3, gives a thorough discussion on the applicability of the various types of glide slopes. To aid the site survey engineer in determining the type of glide slope best suited for the site in question, refer to figure 5-4.

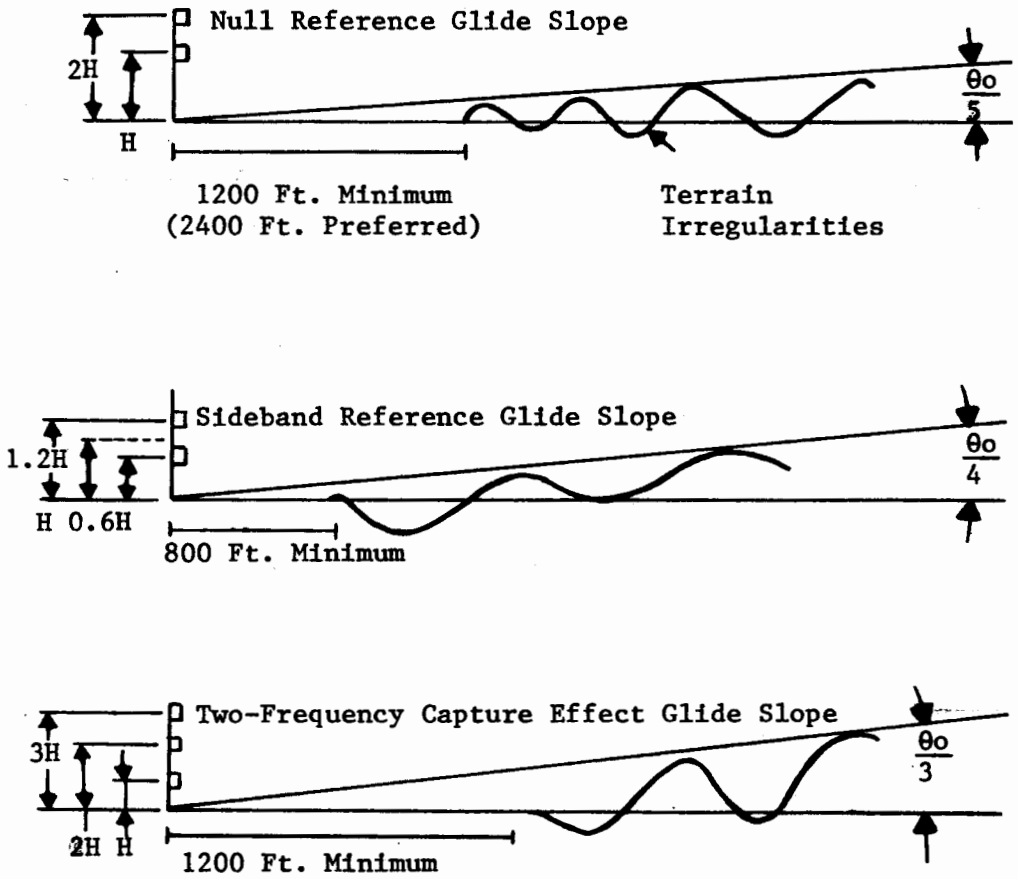
(1) Null Reference (NR). The null reference configuration, using two antennas, is the most commonly employed system. This system can provide excellent results at well-cleared airports meeting the siting criteria for terrain irregularities, but is susceptible to interference caused by reflected radiation from low angle obstructions such as rising terrain. The upper antenna height for the null reference antenna system may extend to a maximum of 40 feet above ground level.

(2) Sideband Reference (SBR). The SBR system can be used effectively at sites where low angle reflection sources are present. The upper antenna height for a SBR antenna system may extend to a maximum of 35 feet above ground level. This feature allows the system to be located closer to the runway centerline than possible with a null reference system. Additionally, the SBR antenna system will require a ground counterpoise screen to be installed in front of the antenna.

(3) Capture Effect. The capture effect system is sited at difficult sites where obstacles and terrain irregularities in the far field (beyond the runway threshold) exceed 25 percent of the desired glide angle. The capture effect system reduces the primary course signal illumination of the reflective sources and compensates for the lack of primary signal in this area by radiating a smaller amplitude clearance signal. In order to provide this effect, three antennas are required. The upper antenna height for a capture effect antenna system may extend to a maximum of 55 feet above ground level.

b. Non-Image Type System. The FAA has developed a slotted waveguide glide slope antenna that has been used where a stable image forming surface is not available (e.g., an approach over tidal waters) and where constructing a satisfactory image surface is not practical or

FIGURE 5-4. TYPICAL GLIDE SLOPE SITING CONDITIONS



θo = glide angle

is prohibitively expensive. The maximum height of this antenna structure is approximately 83 feet and it occupies a larger area than the other types of antennas. It is more expensive than the other types of antennas and would be considered to obviate the need for costly site preparation where a glide slope is to be established.

153. DETERMINATION OF SITE LOCATION.

a. General. The glide slope antenna shall be sited in accordance with Order 6750.16A. The glide slope plot typically consists of an antenna mast, equipment shelter, monitor detector mast(s), engine generator (where auxilliary power supply is required), and interconnecting cables. Although the equipment type to be employed dictates the orientation of the equipment shelter with respect to the antenna, the shelter will be sited behind and adjacent to the antenna for all of the system types. When siting an ILS glide slope, initial consideration must be given to the side of the runway that will be most desirable. The variables that affect this decision include:

(1) Extent of available smooth terrain.

(2) Extent of available lateral terrain.

(3) Presence of potential signal interference sources such as hangars, other navaids, buildings, etc.

(4) Existence of taxiways, aircraft holding aprons, parking ramps, etc.

b. Glide Slope Angle. In accordance with Order 6750.16A, chapter 3, paragraph 21, the optimum glide slope angle is 3 degrees. However, if site selection dictates, an angle as low as 2.75 degrees or as high as 3.04 degrees may be established without a siting waiver, provided the TCH remains within allowable limits.

c. Lateral Distance. The lateral distance of the antenna from the runway centerline is governed by Order 6750.16A, paragraph 28d. In general, the minimum allowable distance for the glide slope antenna mast is 250 feet (400 feet for Category II ILS) from the runway centerline. The maximum allowable distance is 650 feet for both Category I and II ILS. Locations between the minimum and maximum distance are based upon the height of the antenna mast to be employed. Figure 3-16 of Order 6750.16A, depicts the allowable antenna mast height as a function of lateral distance from runway centerline. If a previous site study has not been made, it will be necessary for the site survey engineer to collect enough data to enable knowledgeable personnel to make the determination of equipment and earth-work requirements. In order to determine if the proposed glide slope complies with the lateral distance obstruction criteria, it is necessary to know:

(1) Proposed glide slope location.

(2) Existing antenna ground elevation.

(3) Runway centerline elevation at point opposite from glide slope.

(4) Type of glide slope to be installed.

(5) Slope of terrain in front of antenna.

Appendix 12 contains a description of the method used to determine if the lateral offset distance is within the siting criteria.

d. Longitudinal Distance. The optimum longitudinal distance from the the runway threshold (or displaced threshold) is a function of the desired glide angle, TCH, runway gradient, extent of smooth terrain in the site area and beyond threshold, and the required obstruction clearance criteria. Detailed longitudinal distance requirements are contained in Order 6750.16A, paragraph 28e. If the desired longitudinal distance has not been determined by prior feasibility or office studies, the site survey engineer should determine the desired location in the field. Appendix 12 contains a discussion concerning the various types of glide slope sites which may be encountered.

e. Antenna Offset Distances. The Airway Facilities electronic engineers require the glide slope site topographic information in order that they may be able to specify the heights above grade at which the antennas are to be mounted, and the distances at which the antennas must be offset from the antenna mast centerline. These elevations and offsets must be included in the construction specifications or shown on the site construction drawings.

154. FIELD SURVEY. The types of surveying information that the site survey engineer should obtain at the glide slope site include:

a. Sufficient ground survey work to establish the topography in the glide slope area and/or to verify topography on existing drawings. The area of coverage required should include at least that area indicated as Area "A" on figure 5-5, but should include Areas "B" and "C" where dictated by the extent of the terrain roughness.

b. The elevation of the existing ground at the antenna site to the nearest tenth of a foot ($\pm$0.1 foot).

c. The elevation of the runway centerline at the point opposite from the glide slope antenna to the nearest tenth of a foot ($\pm$0.1 foot).

d. All relevant man-made features, e.g., navaids, manholes, catchbasins, cable markers (record inscriptions), runway or taxiway lights, which may interfere with new roads, and all other objects that conflict with construction.

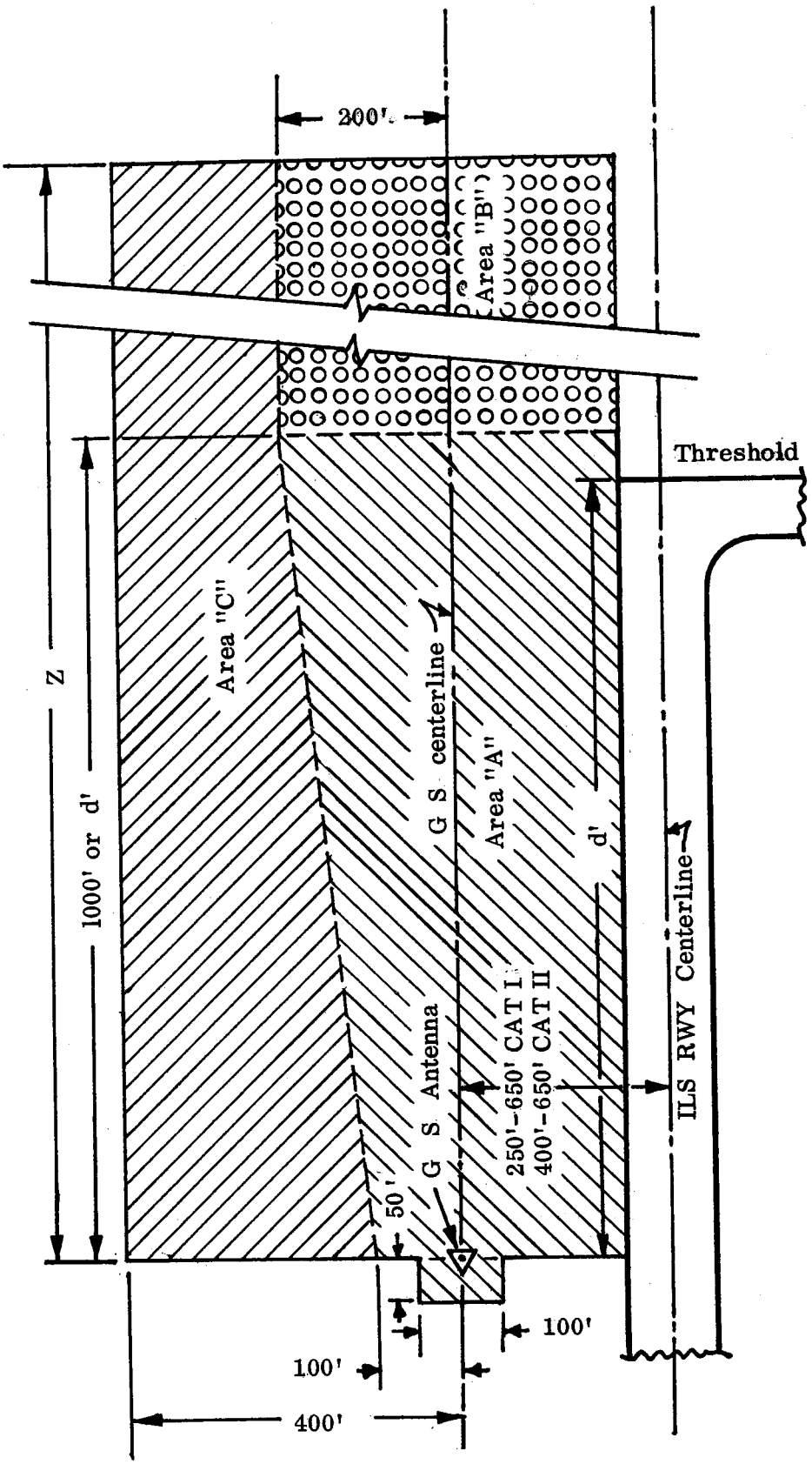


FIGURE 5-5. GLIDE SLOPE SURVEY AREA

Area "A" -- Primary area for obtaining topography.
Areas "B" and "C" -- Indicate possible derogations in these areas.

Z = The least of: (a) 3000 feet
(b) Airport property line.
(c) Termination of smooth terrain.

e. Elevation data necessary to establish the runway gradient.

f. Survey of proposed access road route.

g. Description of all metal objects that may create derogations to the glide slope signal, e.g., hangars, fences, water towers, power lines, etc. It is difficult to determine accurately in the field which objects are likely to create interference. Therefore, determine the location and dimensions of prominent metal objects located in Areas "A", "B", and "C" of figure 5-5. Regional Airway Facilities electronics engineers should be consulted through the project engineer regarding the expected performance.

h. Survey the highest point in the TDZ to the nearest tenth of a foot (±0.1 foot), provided that the threshold is not the highest point.

155. SPECIAL SURVEY WORK FOR COMPUTER MODELING. Where the site investigation indicates that a non-image surface radiating system may be used and/or a computer analysis of the possible system performance may be desired, the site survey engineer should obtain sufficient information for the analysis. In the computer modeling of any antenna site, contour maps provide the primary information. This information is required in varying degrees of accuracy depending upon the location of the area. One of the areas that requires detailed information about its contents extends from 2,500 feet in front of the runway threshold to 1,000 feet behind the threshold, and from 800 feet on one side of the runway centerline to 200 feet on the other side of centerline. The area behind the threshold should have contour detail in five feet or less increments, and the area in front of threshold should have contour detail in ten feet or less increments. The area is not symmetrical about the runway centerline, since a preferred side for the antenna location is usually known beforehand. If it is not known, then maps should be generated to include 800 feet on each side of the runway centerline. In addition to contour data, information on the location and height of trees and brush should be indicated on the map. Also, it is important to include the location and description of various types of ground (e.g., swamp, peat, sand, dirt, solid rock, etc.); this can be a major factor in the cost of antenna installation. This additional information is only necessary for the area behind the threshold. The location and size of buildings and metal fences should be noted. The terrain outside this area can be adequately described by USGS maps; however, the size and location of any potentially significant scatterers (such as bridges, storage tanks, radio towers, large buildings, etc., that lie within an azimuthal region ±20 degrees about centerline and within two miles of threshold) should be indicated.

156. MONITOR DETECTOR. The exact location of the monitor detector may not be determined until after the ILS flight check; however, approximations can be made in order to determine a probable location for construction

purposes. This will enable the site survey engineer to investigate the site conditions where the monitor is likely to be located and to estimate the length of cable run that will be required. Calculations used to approximately locate the monitor antenna are contained in appendix 12. The area between the glide slope antenna mast and the monitor detector mast should not pond water. The area should be designed to eliminate local pools and flooding caused by restrictions to drainage. If a crushed rock walkway is required between the antenna mast and the monitor detector mast, it must be constructed flush with the surrounding grade.

157. GROUND MATTING. A ground matting approximately 15 to 30 feet in width, approximately 50 to 100 feet in length, and mounted approximately 0 to 2 feet above the ground surface is sometimes used to stabilize the glide slope monitor indications. The use of this reflective ground matting is a requirement for the SBR glide slope system. The matting usually begins as near as 5 feet in front of the antenna tower and extends forward toward the monitor mast. The exact height above ground and the type of construction will be determined by snowfall, local conditions, and materials available. Order 6750.6, paragraph 17, thoroughly discusses the use of ground matting to stabilize the monitoring indications. The site survey engineer should be aware of the fact that a SBR glide slope system requires this matting, and should investigate the surface for any construction conflicts (cables, pipes, etc.).

158. TYPICAL GLIDE SLOPE PLOT SIZES AND LAYOUTS. The layout of the glide slope equipment plot is dependent on the type of equipment that will be used. The design of plot layouts should take into consideration such factors as obstruction clearance, maintainability, and accessibility. Appendix 13 provides an index of national standard drawings showing the plot size for the various types of glide slopes. A summary of ILS glide slope construction requirements is contained in appendix 8, figure 2.

159. ELECTRICAL POWER AND CABLE. Paragraph 93 provides information regarding the selection and routing of power for the glide slope.

160. ACCESS ROADS, TURNAROUNDS, AND PARKING AREAS. The access road routing and turnaround or parking area should be determined after the glide slope antenna location has been established. Paragraph 94 provides information regarding the survey and routing of access roads. In the interest of safety, an access road extending to the glide slope from a runway should not be crowned above the normal grade more than 1 inch. The roadway should not be in front of the antenna, and the parking area shall not be placed in front of the antenna or between the glide slope area and the runway.

161. MONITORING. Radio monitoring is usually provided for Category I ILS glide slopes where it is the most economical method of monitoring. Direct wire line monitoring is required for Category II ILS glide slopes. Order 6750.13 describes the monitoring equipment to be used and gives methods for determining the suitability of the radio path from the glide slope to the monitoring point. The site survey engineer should examine

the site to ensure that a satisfactory path does exist and determine the location of the antennas and the status monitoring equipment. Paragraph 95 provides the information regarding the selection and routing of monitoring cables.

162. REMOTE CONTROL.

a. A Category I ILS glide slope does not require wire line remote control unless dual facing or parallel runway ILS systems are involved and interlocking is necessary (e.g., two ILS's use a common frequency channel). In the event remote control of the glide slope is required, the routing of the cable may be planned along with the remote monitoring system. Order 6750.35 details the number of conductors and type of wiring required for the remote control and interlocking of ILS glide slopes. It is not necessary to provide interlocking controls between the localizer and the glide slope.

b. Category II ILS glide slopes do require wire line remote control. They generally involve a status display/control panel in the ATCT and a status display in the tower equipment room.

c. Control line construction criteria will be the same as for monitoring cables or wire lines as described in paragraph 95.

163.-180. RESERVED.

SUBSECTION 3. MARKER BEACONS

181. GENERAL. The markers associated with an ILS are listed in tabular form in appendix 8. In general, a Category I ILS will use both an outer marker and a middle marker. A Category II ILS also requires an inner marker. A compass locator is sometimes collocated with the outer marker.

a. The outer marker location is ideally on the ILS runway centerline extended and, in most instances, will be on land located from 4 to 7 nautical miles away from the ILS runway threshold. Consequently, arrangements will be required for leasing or purchasing the land needed. The search for, and the selection of, an outer marker site should occur early during the ILS field survey because of the time needed to negotiate the required lease or purchase agreements. It is important for the site survey engineer to consult with Logistics division personnel through the project engineer before beginning the field investigation. It may be possible for Logistics division personnel to visit the site or they may choose to arrange for Airway Facilities personnel to talk to the property owner for access or feasibility purposes.

b. The middle marker location is ideally on the ILS runway centerline extended at the point that provides a glide slope path intercept that is 200 feet above the highest point of the runway centerline within the first 3,000 feet from the runway threshold or at the specified DH. Figure 5-6 is an example of a middle marker located with respect to a runway where the highest point is 1,800 feet from the threshold. Order 6750.16A, paragraph 34, figure 4-1 gives the siting criteria associated with the siting of the middle marker. The actual intercept altitude should be discussed with the Flight Standards division as the middle marker will mark the decision height point for a Category I ILS system and other factors may affect the desired intercept altitude.

c. The inner marker, also ideally on the ILS runway centerline extended, marks the 100 foot decision height for an approach using a Category II ILS. This decision height shall be 100 feet above the highest elevation on the ILS runway centerline in the touchdown zone (which is within 3,000 feet from the threshold of the ILS runway). Order 6750.4 defines the siting criteria. Figure 5-7 is an example of an inner marker located with respect to a runway high point 1,800 feet from the threshold.

d. The back course marker is located along the back course of the localizer. It is used to obtain full operational benefits of bidirectional localizers (e.g., V-ring arrays) in order to provide navigational information for a nonprecision approach. The back course marker is located and sited as an outer marker and operates at the same power output as a front course marker.

FIGURE 5-6. OPTIMUM MIDDLE MARKER LOCATION

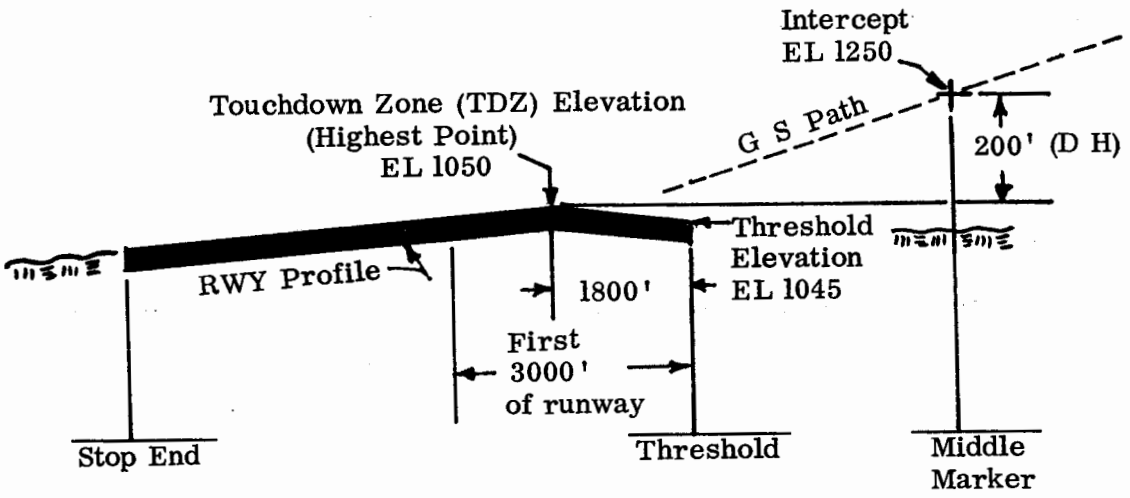
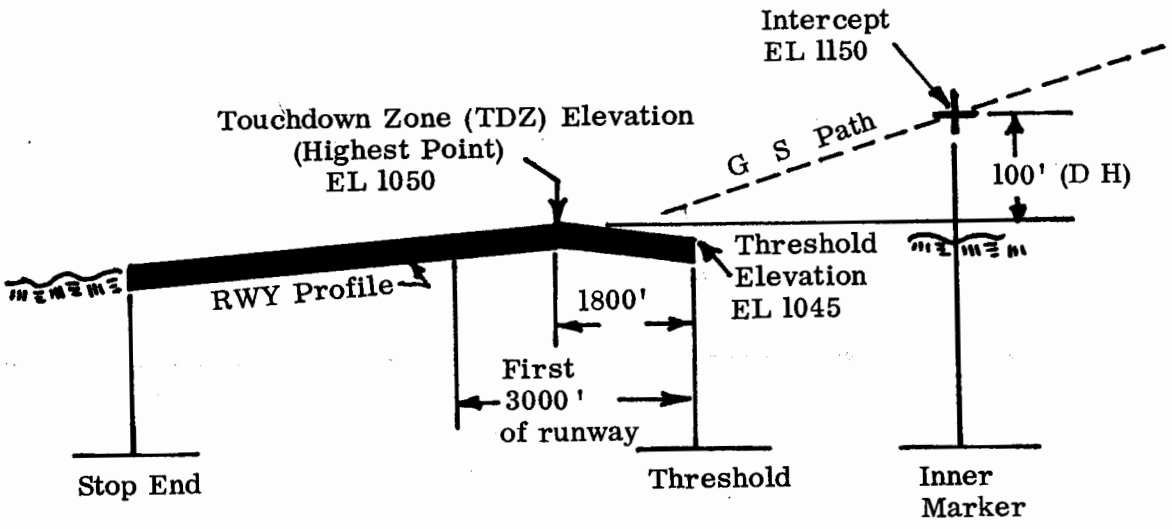


FIGURE 5-7. OPTIMUM INNER MARKER LOCATION



182. FACTORS TO BE CONSIDERED. Factors to be considered in the survey of marker beacons include but are not limited to:

a. Siting Criteria. Select sites that provide marker indications at satisfactory points along the ILS approach path. These requirements are broadly defined by Order 6750.16A, chapter 4. Specific locations will require the concurrence of the Flight Standards division.

b. Site Acquisition or Use. Select locations that can be established at reasonable cost. This will require consultation with and assistance from the Logistics division (real estate personnel) as early as the general location of the markers can be determined. A determination of the property owner and sufficient land survey work to locate and describe the required plot will also be required.

c. Power and Cable Requirements. Determine the source, routing, and construction requirements for power.

d. Access Road. Determine the type, routing, and construction requirements for an access road.

e. Clearing and Construction. Determine the extent of clearing and earth work required. Examine and note those factors that may have an unfavorable impact on construction costs.

f. Environmental Considerations. Environmental considerations regarding establishment of a marker.

g. Interface with Other Navaids. The marker interface with other navaid facilities, obstruction criteria, and requirements for other systems should be examined.

183. EXAMINATION OF SEARCH AREA.

a. Outer Marker. Using a USGS topographic chart, photogrammetric, or suitable municipal street or subdivision map upon which the search area has been plotted, the site survey engineer should visually search the area for likely sites on which to locate the marker. The search area will consist of that nominal area 4 to 7 nautical miles from the ILS runway threshold as defined by Order 6750.16A, chapter 4, or specific areas designated or previously agreed upon with personnel in the Flight Standards division. Since an outer marker site cannot be selected with certainty until such time as the negotiation for a lease or purchase has been concluded, it may be desirable to investigate and obtain information on more than one site. The site survey engineer must use personal judgement in evaluating the probable availability of the prospective sites and request the Logistics divison real estate personnel through the project engineer to arrange for access and property negotiations. The site survey engineer should examine the prospective site or sites with respect to power availability, access, clearing, and

construction required, and environmental considerations. Low powered markers should be within 300 feet of the runway centerline extended if at all possible; however, locations within 800 feet of the runway centerline extended are allowable. Figure 5-8 depicts the general search area that should be considered.

b. Middle Marker. The nominal location for the middle marker is that location on the runway centerline extended as noted in paragraph 181b. Available space, access, construction requirements, antenna obstruction criteria, power availability, or interference with the approach light system may prevent the placing of the antenna in the ideal location.

(1) General Location Tolerances. The location tolerances for the middle marker with respect to the desired glide slope intercept point is given by Order 6750.16A and shown in figure 5-9. If the middle marker cannot be placed at the ideal point, locations greater than the optimum and not less than 2,600 feet from the runway threshold are preferable. This minimum of 2,600 feet will reduce interference with the establishment of the approach lighting system.

(2) Location within Approach Lighting System. Where the middle marker location lies within an existing or planned approach lighting system, the exact location of the marker should not interfere with the light system nor should any of the structures obscure the approach lights as viewed from an approaching aircraft. The obstruction plane for a MALSR is contained in Order 6850.2.

(3) Other Factors. Other considerations for siting the middle marker location include access, suitable terrain for construction, and the availability of power and/or monitoring cables.

(4) Collocation with FFM. Where a localizer FFM is to be installed in the vicinity of the middle marker, consideration should be given to having the two facilities share a common access road, power source, monitor cable, and cable trench.

(5) Concurrence of middle marker location. If the location for a middle marker site has not previously been agreed upon during the initial feasibility study and office planning, the site survey engineer should obtain a tentative concurrence from the Flight Standards division through the project engineer before proceeding with a detailed survey of the site.

c. Innew Marker.

(1) Nominal Location. The nominal location of the inner marker, which marks the 100 foot DH, will generally lie approximately 800 feet to 1000 feet from the threshold of the ILS runway.

FIGURE 5-8. OUTER MARKER SEARCH AREA AND LOCATION TOLERANCE OF DESIRED POINT

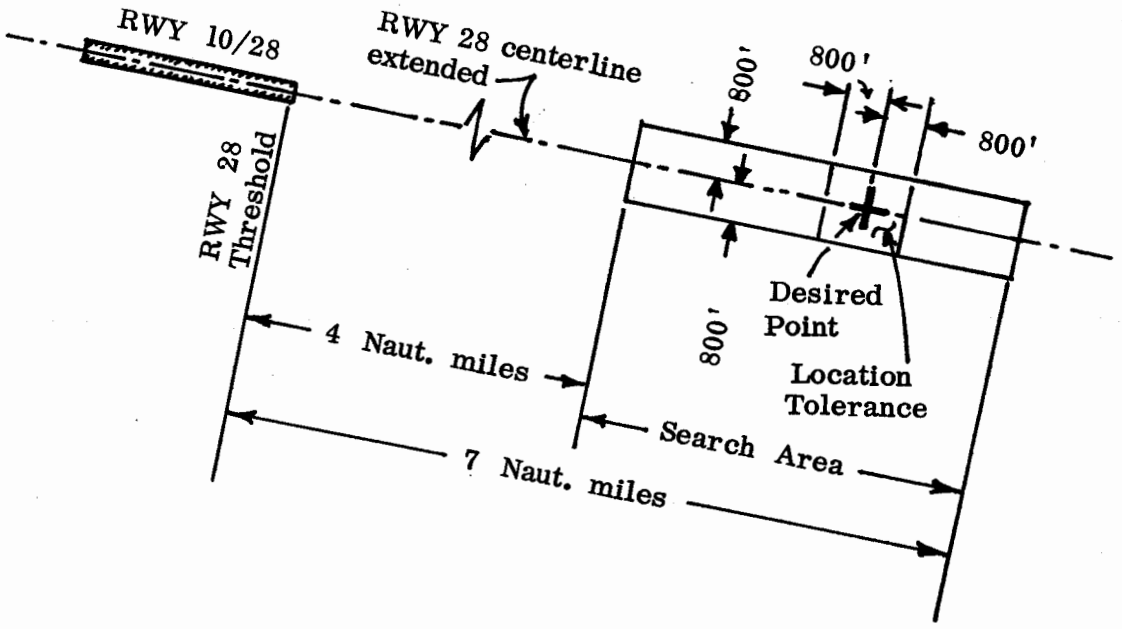
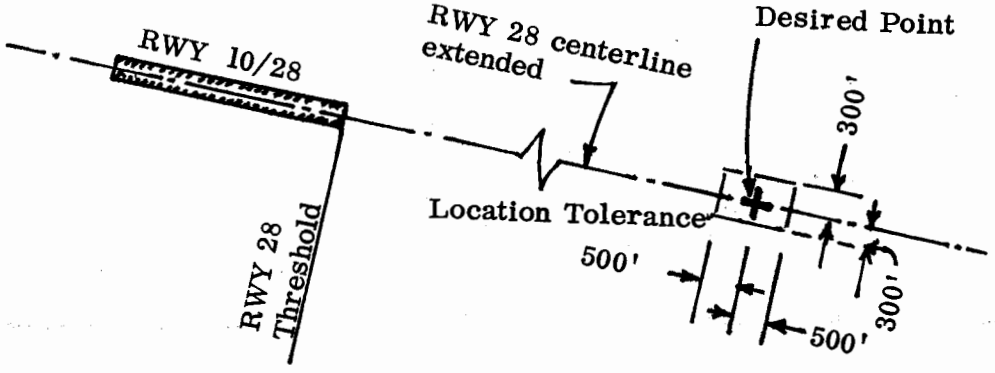


FIGURE 5-9. MIDDLE MARKER LOCATION TOLERANCE OF DESIRED POINT



Inasmuch as this location will fall within the approach lighting system, and the 50:1 approach surface will probably be less than 20 feet high at this point, the site survey engineer must plan a location that is compatible with the existing system and meets the obstruction criteria.

(2) Tolerances. The inner marker antenna must be located within 25 feet of the 100 foot DH point. No part of the installed equipment (except the antenna itself) shall penetrate the approach light plane. The inner marker antenna and support (because of its size and orientation) is not likely to obstruct a pilot's view of any portion of the approach lighting. Consequently, the inner marker antenna may penetrate the light plane, but it shall not penetrate the 50:1 approach surface as specified in FAR Part 77. There are two instances for which a waiver may be obtained if it is not possible to locate the inner marker at the desired location. They are:

(a) If the desired location falls within a paved overrun area, a location on the edge of the runway may be considered.

(b) If a displaced threshold is established for the runway, the inner marker location shall not prevent aircraft from landing or taking off in the opposite direction, or from the displaced threshold for takeoff.

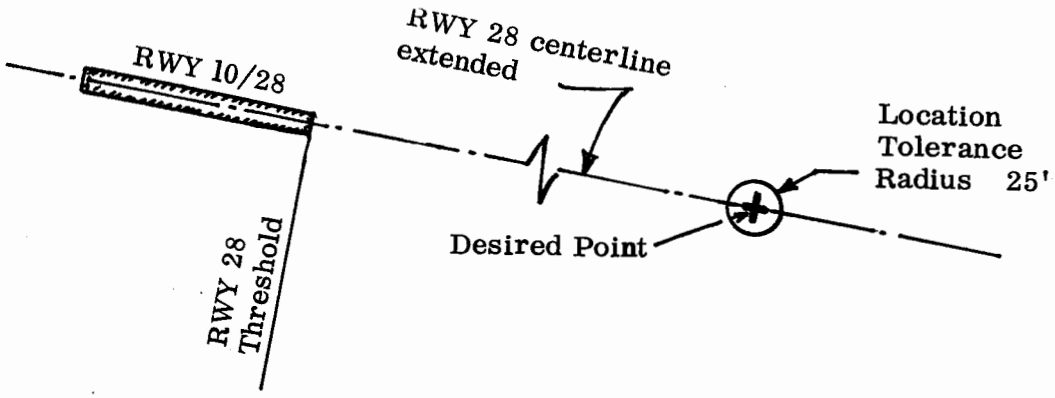
In both cases, the Flight Standards division and Air Traffic division should be consulted through the project engineer to determine the final location before proceeding with the request of a waiver. If the runway has an existing ILS system for approaches from the opposite end of the runway, its effect upon the signal from the associated localizer antenna array should be considered when locating the inner marker equipment. Figure 5-10 shows the tolerance about the desired DH point.

184. LOCATION SURVEY OF MARKERS.

a. Outer Marker. The outer marker location shall be determined to an accuracy of 40 feet in horizontal location as prescribed in paragraph 91. A ground traverse from the airport to the outer marker can be expensive and time consuming; consequently, the site survey engineer should make an effort to find reliable local data or accurate large scale maps. The distances and coordinates should be recorded to those tolerances indicated in paragraph 91e.

b. Middle Marker. The middle marker location shall be determined to an accuracy of 1 foot in horizontal location as prescribed in paragraph 91. It is to be noted that the location accuracies required can only be obtained by actual survey traverse from the ILS runway threshold or other reliable data. The distances and coordinates should be recorded to those tolerances indicated in paragraph 91e.

FIGURE 5-10. INNER MARKER LOCATION TOLERANCE OF DESIRED POINT



c. Inner Marker. The inner marker location shall be determined to an accuracy of 1 foot in horizontal location as prescribed in paragraph 91. It is to be noted that this accuracy can only be obtained by actual survey from the ILS runway threshold or other reliable data. The distances and coordinates should be recorded to those tolerances indicated in paragraph 91e.

185. ELEVATION OF MARKERS. The determination of the ground elevation at the markers and the glide path intercept elevations is discussed in paragraph 91.

186. REAL ESTATE CONSIDERATIONS. Paragraph 92 provides information regarding the conduct of a property survey and ownership determination. Since the middle and inner markers are in the vicinity of the airport, consideration should be given to using the same real estate arrangement that may have been made for the approach lighting system. Marker sites situated within the boundaries of the airport will usually require a license, lease, or use permit rather than an outright purchase.

187. TYPICAL PLOT SIZE AND LAYOUT. Appendix 13 provides an index of national standard drawings showing typical plot layouts for various types of markers. Appendix 8, Figure 2, ILS Equipment Construction Requirements, indicates the size of the plots generally associated with the various types of marker beacon equipment. Where a COMLO is to be collocated with the outer marker, the site survey engineer should consider the larger plot size that will be required to accommodate the COMLO antenna and its associated ground radial system.

188. ELECTRICAL POWER AND CABLES. The site selection of the markers should consider the cost of bringing power to the markers. Paragraph 93 provides information regarding the power requirements and the routing and installation of cables. The site survey engineer should consider the practicality of using the marker access road right-of-way for providing a burial path for the power cable. Inasmuch as the tolerances for the location of the middle marker are more stringent than those for the outer marker, selecting a location in order to accommodate the availability of power and monitoring cables is secondary to locating a site that provides the desired flight information. Since the middle marker may be located in the vicinity of an existing or planned approach light system or other navaid systems, it may be possible to obtain power from an existing airport service. In some instances, it may be necessary to plan for a separate metered service from the local commercial power company.

189. ACCESS ROADS, TURNAROUNDS, AND PARKING AREAS. The requirements for marker access roads, turnarounds, and parking areas are discussed in paragraph 94. The costs associated with providing an access road to the outer marker, and sometimes the middle marker, will have a bearing on determining the selection of a site. The middle and inner markers, being near the airport, may make use of existing airport perimeter and equipment access roads. Where it is necessary to plan for the design and construction of a new road, the necessary topography should be obtained by survey.

190. MONITORING. The Category I ILS outer and middle markers are normally not monitored unless located at an airport designated as an alternate for another airport serving aircraft operating under IFR rules. Order 6750.7 states that the Category II ILS outer, middle, and inner markers will be monitored. Because of the low power used by the marker transmitters, radio monitoring is usually not used. Paragraph 95 provides information regarding the routing and installation of monitoring cables.

191. REMOTE CONTROL. Remote control of Category I marker beacons is not required. Remote control of all Category II marker beacons is required. The instructions to the site survey engineer should specify the cable requirements for each marker site.

192. FENCING AND SECURITY. Paragraph 96 provides information regarding the fencing that should be used for a marker beacon site. The site survey engineer should make a note of marker locations that may be in an area subject to high vandalism or other factors that may require special security. Marker facilities located within an airport secured fenced area generally will not require separate fencing.

193.-210. RESERVED.

SUBSECTION 4. ANCILLARY AIDS

211. COMPASS LOCATORS (COMLO) AND NONDIRECTIONAL BEACONS (NDB).

a. General. The requirement for the location of nondirectional beacons and compass locators used as ancillary navigational aids to the instrument landing system are determined by the Flight Standards division and the Air Traffic division to meet the needs of air traffic in the area. A nondirectional beacon that is collocated with a marker is known as a compass locator. When located separately, it is known simply as a nondirectional beacon. The power output of COMLO equipment is under 25 watts. NDB equipment radiates higher power output. The site survey for the planning, siting, and documentation of nondirectional beacons and compass locators will be very similar to that for the ILS outer marker.

b. Siting Criteria. The location of nondirectional beacons and compass locators, when associated with an ILS, is contained in Order 6750.16A, paragraph 36.

c. Plot Size and Layout. The equipment associated with nondirectional beacons and compass locators is shown in Appendix 8, Figure 2, ILS Equipment Construction Requirements. The plot size and layout for nondirectional beacons and compass locators are determined to a considerable extent, by the antenna and antenna ground system requirements. Appendix 11, Figure 2, ILS Surveying Data, shows a typical COMLO layout. National standard Drawing D-6054-8 provides a plot layout when used with the Mark Id marker beacon.

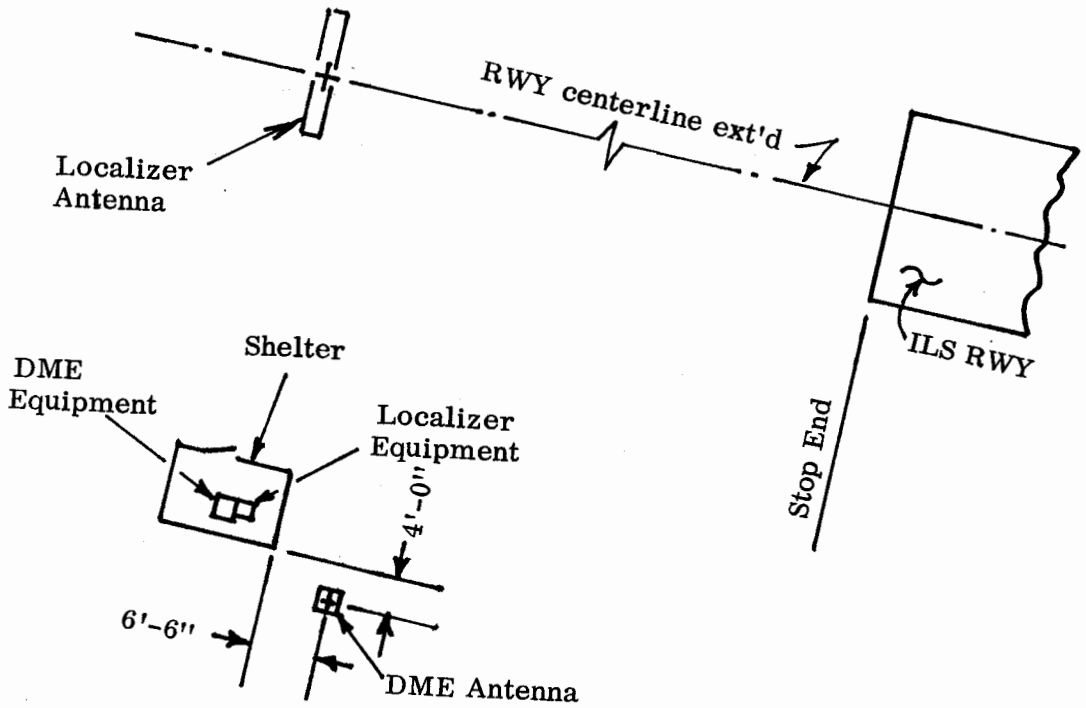
d. Location Survey of COMLO or NDB. The horizontal location of the COMLO or NDB shall be determined to an accuracy of 40 feet as prescribed in paragraph 91. A ground traverse from the airport to a COMLO or NDB can be expensive and time consuming; consequently, the site survey engineer should make an effort to find reliable local data or large scale maps. The distances and coordinates should be recorded to those tolerances indicated in paragraph 91e.

e. Elevation of COMLO or NDB. The determination of the ground elevation at the COMLO or NDB antenna location is discussed in paragraph 91.

f. Electrical Power and Cable. Site survey requirements for the power source and cable routing are similar to those for an outer marker and are described in paragraph 93.

g. Access roads, Turnarounds, and Parking Areas. The site survey requirements for access roads, turnarounds, and parking areas are similar to those for the outer marker, and are described in paragraph 94.

FIGURE 5-11. TYPICAL LAYOUT FOR DME AT MARK Id LOCALIZER



h. Real Estate Considerations. Whether a nondirectional beacon facility is located alone or collocated with a marker, the real estate procedures are similar to those of the marker and are described in paragraph 92.

i. Voice Modulation. When voice modulation of the COMLO or NDB is to be used, a landline to the ATCT or FSS will be required. A single pair line is sufficient for voice modulation. The routing of the line will be the same as for monitoring and/or control lines, which are described in paragraph 95.

212. DISTANCE MEASURING EQUIPMENT (DME).

a. General. Although the DME is not presently considered an integral component of an ILS, it may be used in conjunction with an ILS. The DME provides the aircraft with distance to the touchdown point, runway threshold, or other reference point as may be desired. A DME will usually be planned where an OM facility is not practical.

b. Location. The equipment will generally be installed at the localizer site for the approach being planned. The exact location of the DME antenna should be determined and noted in feet to the nearest foot. The same data consisting of geographical coordinates, distances, and elevations should be provided as for the localizer facility.

c. Equipment. Drawing D-6078 series listed under appendix 13, provides a typical detailed installation of a DME at a localizer. Figure 5-11 illustrates a typical layout for DME equipment at a Mark Id localizer.

d. Power and Construction Requirements. The site survey engineer should determine the method of interfacing the DME power requirements with the localizer equipment. The localizer power panel should have spare circuits available for use by the DME. The same construction criteria as described for the localizer will apply to the DME.

e. Monitoring and/or Control. The monitoring and/or control requirements for DME is the same as those for the outer marker (see paragraph 190 and 191). Since the DME equipment is collocated with the localizer transmitting equipment, sufficient spare control cables should be specified at the localizer in order to accommodate the DME requirements.

213.-220. RESERVED.

SECTION 4. REVIEW OF FIELD DATA

221. DATA EVALUATION. Prior to departing the field site, the engineer performing the ILS survey and investigation should thoroughly examine the information, sketches, and documentation that he has acquired and developed. Based upon the checklist in appendix 4, the engineer should verify that he actually has the information that should be obtained. This will ensure the completeness of the data that will be required for the final documentation. The engineer should develop those sketches necessary to ascertain that the components of the ILS interface properly with other systems, provide the construction data that will be needed, and meet the obstruction and siting criteria.

222. FIELD DRAWINGS. The site survey engineer should make an effort to prepare basic field drawings for the siting of each of the components of the ILS before departing from the site.

a. Drawing Costs. In addition to preparing field drawings, which will present the desired information for office use, the site survey engineer should recognize that final engineering drawings will have to be prepared. He should consider preparing field drawings that will minimize the cost of replotting new layouts for finished documentation.

b. Type of Field Drawings. The site survey engineer should prepare vicinity and plot plan drawings for each component of the ILS. The vicinity and plot plans may generally be placed on the same drawing for each marker. Special information that may be required (e.g., detailed information on a long access road, unique terrain conditions, long buried cable runs, and special property maps) may be placed on separate drawings sheets. Where photogrammetrics are available, the vicinity drawing information may be placed directly on the photogrammetric.

c. Modification of Existing Drawings and Plans. The initial layout of ILS facilities can often be plotted on existing airport drawings such as the airport general plan, construction drawings similar to air navigation facilities plan drawings, approach lighting system drawings, or other drawings used for prior construction. Where the site survey engineer has some choice of drawings, he should select those that will provide a basis for later direct tracing by a draftsman, thereby saving the drafting costs of replotting. Care should be taken to field-verify information contained on existing FAA drawings (including as-builts) covering ILS sites and appurtenances, whether in the contract drawing set or not.

d. New Field Drawings. Where there is no existing drawing or map embracing the area on which the ILS component is being planned, the site survey engineer will have to prepare a new drawing. The

engineer shall make an effort to plot his survey notes and prepare the new drawing on a scale that may later be used for direct tracing or incorporation into the final drawings. The engineer should not expend valuable field time preparing a precisely lettered, finished drawing. The presentation should be planned in a manner that will minimize the costs of preparing the field documentation. It is recognized that drawing skills vary between individuals and for this reason it is impossible to expect all site survey engineers to prepare site drawings in finished form. In any case, the engineer should reduce and plot the notes, draw contours, verify, correct, and (if necessary), supplement the topographic coverage on site.

e. Scales. The drawing scale employed should generally be the largest scale practical for presenting the information on the size "D" drawing sheet. A size "D" drawing sheet has 32 inches by 20-7/8 inches of drafting space including the title block. The general layout drawing for large airports with full ILS systems at each end of the runway may require a scale of 1 inch equal 600 feet. Smaller airports, with 5 or 6 thousand foot runways, can be plotted on a scale of 1 inch equal 400 feet. The selection of a scale for the vicinity and plot plan drawings should consider that the drawings will often be reduced to one-half size (11" x 17") for distribution and filing. Consequently, the scales should remain as large as practical. The engineer should exercise judgement in the selection of scales for all drawings, keeping in mind the requirements for a good presentation on the finished drawing, which may be reduced in reproduction. All scales on the final drawings should be shown in bar scales.

223. EXAMINATION OF PROBLEM AREAS. The site survey engineer should evaluate the information and drawings he has developed for areas of planned work or later construction that may present serious problems. Typical of the areas he should be concerned with are:

a. Delay or Inability to Locate Marker Sites. The inability to obtain access to a marker site or the inability to find a suitable location in the search area may require a return trip to the field after the Logistics divison has had time to accomplish the real estate arrangements.

b. Potential Performance Problems. Existing derogating surfaces or terrain may make the desired performance of the system questionable. Airway Facilities division electronic engineers should be consulted through the project engineer regarding such problems before the site survey engineer departs from the site.

c. Obstruction Criteria Violations. Where space or terrain does not permit the location of equipment in compliance with clearance criteria, the project engineer should be contacted and the probability of approval of a waiver request should be examined and the necessary detailed information obtained BEFORE leaving the site.

d. Construction Problems. The need for exceptionally long access roads, costly cable runs, expensive drainage or bridge requirements, and earthwork should be evaluated carefully; the project engineer should be contacted regarding possible alternate solutions.

e. Alternate Solutions to Problems. Where it is evident that the equipment cannot be installed at reasonable expense, or the required performance may not be met, the site survey engineer should contact the project engineer and consider alternate solutions to the problem. As an example, the inability to obtain a suitable outer marker location may suggest that the Air Traffic division or the Flight Standards division be consulted regarding an alternate approach aid, such as the use of a DME. Insufficient area for a suitable glide slope installation without extensive and costly land fill preparation may require the consideration of a glide slope located between a taxiway and runway, even if it requires undesirable aircraft holding on the taxiway; it may also warrant consideration of other types of glide slope equipment as discussed in paragraph 152. In any event, the site survey engineer should obtain the information needed to enable a decision regarding the alternate solution.

224. FIELD DATA CHECKLIST. The site survey engineer should consult a checklist and data sheet relating to the information developed and required for the completion of the ILS site survey and investigation. This checklist should include the important geometrical data required such as locations, elevations, intercept altitudes, and obstruction clearances. Appendix 4, should be used as a checklist by the engineer.

225. FIELD NOTES. The records of an engineer's field survey work and discussions regarding arrangements for the proposed ILS system should be maintained for future use in arriving at the final design, property and material requests, and preparation of the final documentation. The type of survey notes expected should be determined by the regional Airway Facilities division and included in the project file. Appendix 14 provides sample sheets from a field notebook involving field survey work at an outer marker. Of particular importance are:

a. Notes of transit and level survey work, including reduction of raw survey data.

b. Field calculations regarding system geometry, i.e., glide path intercept altitudes, altitudes of critical objects under the approach surfaces, and similar data.

c. Notes regarding power availability, such as kVA rating, fuse requirements, and cable lengths required.

d. Record of discussions or correspondence regarding property, use arrangements, cable routing, utility availability, and similar information. This should include names, titles, dates, times, places, addresses, and phone numbers.

e. Notes regarding real estate information such as property owners, deed and tax book records, and similar information.

f. Notes pertaining to environmental information.

226. PROGRAM CHANGES. The site survey engineer should consult the project engineer upon completing the review of the data prior to departing from the site, to ascertain if there may have been changes or information affecting the survey. This may include updated information on the availability of the specific equipment programmed for the proposed ILS, interfacing information on other systems that may modify the planning (e.g., the availability of power or access), funding changes, or changes in the system requirements.

227. CONTRACTED SURVEY AND CONSULTING SERVICES.

a. Registered Property Surveying. The requirement for contracted survey or other engineering services may not be known until after the site survey engineer has begun the investigation in the field. In some areas, particularly where property is very valuable or property lines are ill defined, it may be desirable to use a registered land surveyor to perform plot surveys for the markers. The site survey engineer should ensure that the contracted surveyor understands what work and documentation is required.

b. Contracted Construction Surveying. Where the lack of time or equipment does not allow the site survey engineer to perform construction surveying for roadways, foundations, etc., or obtaining certain information desired for contours, elevations, and similar data, a commercial consulting engineering firm may have to be engaged to accomplish the work. The site survey engineer should ensure that the contracted survey engineer understands what work and documentation is required.

c. Arranging for Contracted Services. Paragraphs 45 and 46 provide guidelines for the procedures and documentation necessary to arrange for contracted engineering and survey services.

228.-240. RESERVED.

CHAPTER 6. SITE FINALIZATION

SECTION 1. PRELIMINARY FINDINGS

241. ANALYSIS OF DATA. Upon return to the office following the site survey investigation, the site survey engineer should compile the data obtained in a logical sequence suitable for use by the project engineer. (It is recognized that in some regions the site survey engineer's full time involvement with the project ends upon turning over the field notebook and field sketches to the project engineer; however, for the purpose of this document, it is assumed that the site survey engineer follows the project to completion.)

a. Debriefing. The site survey engineer should provide the project engineer with a verbal briefing concerning the findings in the field as soon as practicable. This briefing will serve to highlight any problem areas that require immediate attention and cannot wait until a written report is generated by the site survey engineer.

b. Preliminary Sketches and Data. Following the debriefing session, drawing and report preparation should begin using the field data.

242. DISCUSSIONS WITHIN THE REGIONAL OFFICE. During the final design stages of an ILS establishment, close coordination with all interested regional elements is essential. The following is a list of some of the FAA organizations with whom close interface should be made.

a. Airway Facilities Division. Engineering, drafting, construction, installation, environmental assessment, control line leasing, program and planning.

b. Air Traffic Division. Concurrence of facility locations, and submission of airspace action request (FAA Form 7460-1, or comparable documentation).

c. Flight Standards Division. Concurrence of facility locations, particularly markers.

d. Airports Division. Status of ADAP projects concerning site preparation and land acquisition, and impact of project on future airport development.

e. Logistics Division. Real property acquisition and utility contract requests.

243. DISCUSSIONS WITH NON-FAA OFFICIALS. When developing the final design for the ILS establishment, additional coordination with organizations and individuals contacted in the field is often required.

a. Power Company. Sometimes power companies require drawings detailing the planned construction and layout in order to assess whether a given power takeoff point is acceptable. This time-consuming confirmation must often be obtained even prior to requesting a quotation for recurring and nonrecurring costs. A sample procurement request (PR) for power service is contained in appendix 15.

b. Telephone Companies. If telephone company representatives are not available to visit the site during the time of the onsite survey, arrangements must be made with them for leasing landlines by means of telephone conversations, drawings, and/or letters.

c. Property Owners. Contact by the site survey engineer with the property owner of a potential ILS site, either directly or by way of correspondence, should be made only at the direction of the Logistics division.

d. Airport and/or Public Works. Verification of inconsistencies found on "as-built" construction drawings will have to be obtained from airport engineering departments. To avoid problems such as this, when using existing airport layout drawings for ILS siting data, field-verify as much information as possible.

244. DISCUSSIONS WITH FAA PERSONNEL ASSOCIATED WITH AIRPORT. Coordination of the preliminary ILS engineering drawings with the Airway Facilities sector responsible for maintaining the facility is encouraged. Potential maintenance problems can often be identified and eliminated at this early stage before they become actual problems. In addition, sector maintenance personnel should be contacted for further verification of the condition of existing cables planned for use with the new installations.

245.-250. RESERVED.

SECTION 2. SITE SURVEY REPORT

251. GENERAL. The data compiled in the field should be analyzed and a report should be prepared that summarizes the results of the field survey. In order for FAA management to make appropriate decisions relative to an ILS establishment, the information contained in the site survey report should be presented in a concise and logical form. It is recognized that an FAA report may not be as detailed as one required of a site survey contractor. This section describes the type of information that should be included in the report. Appendix 7 contains a complete sample report.

252. SITE SURVEY REPORT CONTENT.

a. Section I - Introduction.

(1) General. Describe the scope of the project. Detail what is intended to be installed, when, and under what authorization.

(2) Agencies and Personnel. List names, titles, addresses, and phone numbers of the personnel and agencies contacted in connection with the project:

(a) FAA Personnel.

1 Airway Facilities sector manager.

2 ATCT chief.

3 Airports division/ADO chief.

4 Airway Facilities maintenance personnel.

(b) Airport sponsor and manager.

(c) Airport engineering consultant.

(d) Electrical utilities.

(e) Telephone service.

(3) Insurance Requirements. Indicate the limits of liability required for construction work at that facility.

(4) Special Code or Construction Requirements. Special requirements necessary for that airport (e.g., concrete duct bank, etc.).

(5) Air Traffic (if required).

(a) List published approach plates.

(b) Scheduled commercial carriers.

(c) Number of operations, total.

(d) Number of operations for the designated ILS runway.

(6) Reference Data. Indicate the drawing numbers and dates for all drawings used during the survey and referenced in the report including:

(a) ANF general plan.

(b) Airport master plan.

(c) Obstruction chart.

(d) USGS topographic maps.

(e) Airport electrical plans.

(f) Airport drainage plans.

(g) Local maps and deeds.

(h) Soil boring drawings and geological maps.

(7) Waivers. Identify any areas of the ILS establishment that will require a waiver.

b. Section II - Discussion. This section of the report should detail the recommendations, rationale, and requirements for installing each facility component of the proposed ILS system. Each component should be discussed separately. Describe alternate site locations. Where applicable, include advantages and disadvantages. The topics listed below should generally be covered in the report.

(1) Localizer.

(a) Equipment type.

(b) Antenna location (distance and elevation platform requirements).

(c) Coordinates.

(d) Expected sources of signal derogation.

(e) Equipment shelter location and site description.

(f) Access road, parking, and turnaround area.

(g) Power requirements.

(h) Monitoring and interlocking.

(i) Security requirements.

(j) Proposed construction affecting site.

(k) Soil conditions.

(l) Site clearing and grading.

(m) Property owner.

(n) Far field monitor (if required).

(o) Environmental factors.

(p) Intervening utilities.

(q) Ground checkpoint locations.

(2) Glide Slope.

(a) Equipment type.

(b) Antenna location (distance and elevation), TCH, glide angle.

(c) Coordinates.

(d) Runway elevations.

(e) Expected sources of signal derogation.

(f) Equipment shelter location and site description.

(g) Access road, parking and turnaround area.

(h) Power requirements.

(i) Monitoring and interlocking.

(j) Security requirements.

(k) Proposed construction affecting site.

(l) Soil conditions.

(m) Site clearing and grading.

(n) Property owner.

(o) Near field monitor.

(p) Environmental factors.

(q) Intervening utilities.

(3) Outer Marker.

(a) Equipment type.

(b) Antenna location, intercept, distance, coordinates.

(c) Discussion of coordination with Flight Standards personnel.

(d) Real property - owner, description.

(e) Site clearing.

(f) Obstructions.

(g) Access road, parking, and turnaround area.

(h) Power requirements.

(i) Monitoring and remote control.

(j) Plot description.

(k) Security requirements.

(l) Soil conditions.

(m) Environmental factors.

(n) Intervening utilities.

(o) Requirement for compass locator.

(4) Middle Marker.

(a) Equipment type.

(b) Antenna location - DH, distance, coordinates.

(c) Discussion of coordination with Flight Standards personnel.

(d) Real property - owner, description.

(e) Site clearing.

(f) Obstructions.

(g) Access road, parking, and turnaround area.

(h) Power requirements.

(i) Monitoring and remote control.

(j) Plot description.

(k) Security requirements.

(l) Soil conditions.

(m) Environmental factors.

(n) Intervening utilities.

(5) Inner Marker.

(a) Equipment type.

(b) Antenna location - DH, distance, coordinates.

(c) Discussion of coordination with Flight Standards personnel.

(d) Real property - owner, description.

(e) Site clearing.

(f) Obstructions.

(g) Access road, parking, and turnaround area.

(h) Power requirements.

(i) Monitoring and remote control.

(j) Plot description.

(k) Security requirements.

(l) Soil conditions.

(m) Environmental factors

(n) Intervening utilities.

(6) Obstructions. Indicate in the report if an obstruction survey to the final approach area was made and denote the nature of the obstructions found. Order 8260.16 discusses airport obstruction surveys relating to ILS installations.

(7) Waivers. If any of the recommendations previously listed depart from siting, installation, construction, or procedures criteria, they should be identified. In addition, any alternative solutions that would avoid a waiver of criteria should be described. (All formal waiver requests shall be in accordance with Order 6000.20.)

(8) Preliminary Drawings. Include a list of the site construction drawings that will serve as the basis for the siting recommendations. These drawings may consist of the nearly completed site construction drawings or field sketches drawn on letter size paper.

(9) Photographs. Photographs should be included as part of the siting report to assist the reader. Photographs should be marked and dated so as to identify the area under consideration. Sufficient prints should be made in order that each copy of the report contains a full set of clear photographs.

c. Section III - Enclosures. Enclosed with the site survey report should be copies of any correspondence relative to the project. This could include:

(1) Insurance and bond requirements.

(2) Wage rates (where requested).

(3) Soil investigation report.

(4) Site photographs.

(5) Airspace procedure study request letter (where requested).

(6) Correspondence with utility companies.

(7) Correspondence with property owners.

(8) Correspondence with airport management.

(9) Drawings and sketches.

253.-260. RESERVED.

SECTION 3. REVIEW OF SITE SURVEY REPORT

261. REGIONAL COORDINATION. The site survey report and associated field sketches or drawings should be forwarded for review and approval to the involved organizations. The cover letter to the report should fully identify the status of the ILS project as being in the final design stages and should solicit a concurrence or negative reply from the reviewing organization. The project engineer should be identified in order that any questions that may arise in the report and/or drawings may be resolved.

262. REVIEW CYCLE. Since the organizational makeup of FAA regions vary, it is not practical to include a suggested flow chart for review and approval in this document. However, each region should develop such a flow chart to ensure that full formal concurrence with the ILS project is obtained.

263. FEEDBACK FOR REQUIRED CHANGES. During the concurrence cycle for the drawings and the written report, communication channels should remain open between the organization generating the site survey report and the reviewing organizations. Reviewing organizations should be asked to provide the rationale for requested changes to the drawings. If changes made to drawings are of a major nature, such as the relocation of an ILS component, the review cycle may have to be reinitiated. Once all concurrences have been received, the drawings can be completed, waiver requests initiated, and the environmental assessment completed. The changes suggested during the review process should be included (if appropriate) as an amendment to the site survey report.

264. REPORTING OF ILS DATA TO THE NATIONAL FLIGHT DATA CENTER (NFDC). Appendix 16 contains a sample of the information necessary to file a report with the NFDC.

265.-270. RESERVED.

CHAPTER 7. SITE CONSTRUCTION DRAWINGS

SECTION 1. DRAWING STANDARDS AND SELECTION

271. FAA-STD-002. All site construction drawings that become part of contract documents shall be drawn in accordance with FAA-STD-002. This standard reflects the practices of the American National Standards Institute. Uniformity of drawing practices will help to establish effective and efficient development, utilization, and control of engineering drawings.

272. SELECTION OF DRAWINGS FOR CONSTRUCTION. The type of drawings that make up a construction plan package can be placed into three categories:

a. Site Drawings. These drawings detail the specific construction requirements for the particular facility location in question. The information required on these drawings is detailed in chapter 7, section 2.

b. National Standard Drawings. These drawings can be directly inserted into the construction plan package without any modifications or changes made to the drawings. National standards are generated by the Washington office. These drawings are further discussed in chapter 7, section 3.

c. Regional Standard Drawings. Certain standard drawings have been developed within the regions, such as terminal pole drawings, which reflect the use of certain construction practices and materials peculiar to those regions. These drawings may be national standard drawings that have been modified, or entirely new drawings. These types of drawings are further discussed in chapter 7, section 4.

273.-280. RESERVED.

SECTION 2. SITE DRAWINGS

281. GENERAL. The design and construction of FAA facilities should be in accordance with the national standard drawings and specifications issued by the Airway Facilities Service. As indicated in Order IM 6030.9, exceptions to this policy are sometimes necessary to meet specific site requirements and should be made only on an as-required basis. Also see chapter 7, sections 3 and 4. Site construction drawings should be prepared for each site based upon typical layout drawings and design standards issued by the Washington headquarters. Accurate, clear, and complete drawings will help to minimize the need for costly change orders during the construction phase of an ILS establishment. It is the purpose here to indicate, to the greatest extent possible, the types of information that should be included on the various site construction drawings.

282. GENERAL DRAWING PRACTICES. Site drawings, some of which may have been begun in the field and finalized in the office with the intent of being retraced by drafting personnel, should reflect the following practices.

a. Titles. Titles of newly prepared drawings should describe their contents and identify the applicable site location. Titles of existing general ANF drawings should not be changed, but they should be revised to reflect changes in structures, property lines, cable runs, contour data, and runway elevations. Titles of other existing drawings should be revised as necessary when used to detail new facilities.

b. Dates. Initially, give all new and newly revised drawings for the same project the same date.

c. Drawing Clarity. Avoid making drawings congested to the point where clarity is lost. The use of numbered legends cross referenced to circled numbers on the drawing can eliminate much congestion and confusion caused by note crowding and intersecting leaders. Appendix 6, Drawings CN-D-0006 and CN-D-0007, illustrate the difference in the two techniques. Be sure that the notes contain an indication as to who will be responsible for the work to be performed. One method to ensure this is to prefix all numbered notes with one of the following: EXISTING, INSTALL, or BY OTHERS.

d. Scales. At least one view of each facility site should be of small enough scale to show the entire site without break lines. All site views should have bar scales.

e. Abbreviations. Avoid abbreviations on drawings. If they must be used on the drawing to conserve space, define the abbreviation somewhere on the drawing, e.g., Contractor-Installed (CI). Refer to the ANSI Standard Y1.1 for the correct use of abbreviations.

f. Coordinates and North Arrow. Always indicate the coordinates of the navigational aid facility proposed. Orient the drawing so that north is towards the top of the sheet.

g. Elevations. Indicate existing and proposed ground elevations at the facility location. In addition, always indicate elevations at the runway threshold and stop end. Identify a bench mark whenever construction will involve specific original and/or finished elevations.

h. Foundation Depths. All foundation depths must be specified, either on the site layout or detail drawings. The specified depth should conservatively exceed the maximum frost penetration depth.

i. Intervening Utilities. Indicate the location and depth or elevation of all utilities affecting the project. Provide names, city and state, and phone numbers for utility companies to be contacted before construction begins. It can be dangerous and costly if a contractor damages a utility.

283. GENERAL PLAN DRAWING. The first drawing in the construction package should be a general airport plan. This drawing should indicate the location of the proposed work sites. A suitable drawing for this purpose is the airport ANF general plan. A typical general plan drawing is shown on Drawing CN-D-0001 in appendix 6. The types of information that should be included are:

a. Runway and taxiway layout, and apron areas.

b. Runway length and width with true azimuth.

c. True north and magnetic declination.

d. Proposed and existing ILS equipment locations.

e. Proposed and existing roads.

f. Proposed and existing buildings.

g. Airport property lines.

h. Construction restriction lines.

i. Proposed airport expansion plans.

j. Proposed and existing cable routes.

k. Area map, detailing airport location.

1. Bar scale for usability when the drawing is photographically reduced in size. The scale should be suitable for layout on either a "D" or "E" size drawing.

284. LOCALIZER SITE DRAWINGS. The number of drawings required for the localizer site is dependent upon the complexity of the design. The localizer site construction details may be contained on one or more drawings.

a. Localizer Vicinity Drawing. A typical localizer vicinity drawing is shown on Drawing CN-D-0002 in appendix 6. The vicinity drawing should contain:

(1) Location of antenna, shelter and associated equipment with respect to the stop end of the runway.

(2) Location of site access road to be constructed.

(3) Clearing requirements, with an indication of the limits of tree and brush clearing including density and diameter. Indicate tree diameter up to 6 inches as light, up to 10 inches as medium, and up to 16 inches as heavy. Trees greater than 16 inches in diameter may require special removal methods; therefore, the exact number and approximate location of these trees should be indicated on the drawing.

(4) Grading Plan with both existing and proposed contours shown. Extensive contours should be indicated when major earthwork is involved and final ground elevations are critical. Do not indicate the major earthwork covered under ADAP projects, but do show the finished grades.

(5) Centerline ground profile along the runway centerline extended in the direction of the localizer.

(6) Relevant elevations, including proposed ground elevations at antenna(s), equipment shelter, and along access road centerline. Also, indicate the elevation of the top of foundations.

(7) Cable routes, including profile of duct runs where possible. Indicate number, diameter, and length of cable ducts. Show all routes of cable to be direct earth buried.

(8) Access road design details. Roads should be wide enough and with a large enough turning radius and turnaround and/or parking area to accommodate the equipment. Use Order 6940.2 and Drawings D-5980-1 and -2 as design guidelines. Provide roadway cross sections on the site construction drawings.

(9) Soil boring/bearing information. Indicate the location of soil borings taken. Where compaction tests have been made, record this data on the drawing.

(10) Localizer ground check points. Indicate the location of the proposed ground check points.

(11) Property owner's name and address.

(12) Utility company's name and address.

b. Localizer Plot Plan Drawing. The plot plan should be drawn to a scale suitable for detailing all of the dimensions and work required for construction. This drawing should concern itself primarily with the proposed facility site layout. A typical localizer plot plan is shown on Drawing CN-D-0003 in appendix 6. The plot plan should include:

(1) Localizer antenna location(s) with existing and proposed ground elevations. Show original and proposed grades in a profile along the antenna array(s) centerline. If earth mounds for antenna mounting are required, extend the profiles out to the toes of the mound slope.

(2) Equipment shelter plot layout, fully dimensioning the locations for the shelter, transformer, meter post, guard posts, and other appurtenances.

(3) Cable locations and sizes.

(4) Access road, turnaround, and parking area dimensions and drainage requirements. Refer to Order 6940.2 and Drawings D-5980-1 and -2 for details.

(5) Walkway details.

(6) Fence location. Refer to standard drawings for details.

285. GLIDE SLOPE SITE DRAWINGS.

a. Glide Slope Vicinity Drawing. A typical glide slope vicinity drawing is shown on Drawing No. CN-D-0004, appendix 6. The vicinity drawing should contain:

(1) Location of antenna and equipment shelter with respect to runway centerline and threshold.

(2) Location of site access road to be constructed.

(3) Clearing requirements with an indication of limits of tree and brush clearing including density and diameter. Indicate tree diameter up to 6 inches as light, up to 10 inches as medium, and up to 16 inches as heavy. Trees greater than 16 inches in diameter may require special removal methods; therefore, the exact number and approximate location of these trees should be indicated on the drawing.

(4) Grading plan. In view of the stringent grading requirements associated with the glide slope site, a separate vicinity drawing may be needed detailing the existing and proposed contours.

(5) Relevant elevations, including existing and proposed ground elevations at antenna mast, equipment shelter, along acess road centerline, runway centerline opposite antenna mast, and the runway threshold. Also, indicate elevations of top of foundations.

(6) Cable routes, including profile of duct runs where possible. Indicate number, diameter, and length of cable ducts. Show all routes of cable to be direct earth buried.

(7) Soil boring/bearing information. Indicate the location of the soil borings taken. Where compaction tests have been made, record this data on the drawing.

(8) Access roads design details. Roads should be wide enough and with a large enough turning radius and turnaround and/or parking area to accommodate the equipment. Glide slope access roads are generally designed flush with the adjacent terrain.

(9) Property owner's name and address.

(10) Utility company's name and address.

b. Glide Slope Plot Plan Drawing. The plot plan drawing should depict the facility site layout. A typical glide slope plot plan drawing is shown on Drawing CN-D-0005 in appendix 6. The plot plan should include:

(1) Glide slope plot layout with dimensions for antenna, shelter, transformer, meter post, guard posts, and other appurtenances.

(2) Glide slope antenna mast location with existing and proposed ground elevations. Show the OSHA - required ladder and safety climbing device on the mast.

(3) Monitor detector mast location and cable requirements.

(4) Cable locations and types.

(5) Access road, turnaround, and/or parking area dimensions and drainage requirements. Refer to Order 6940.2 and Drawings D-5980-1 and -2 for details.

(6) Walkway details.

(7) Fence location. Refer to national standard drawings for details.

286. MARKER BEACON SITE DRAWINGS. The number of drawings required for the marker beacon site is dependent upon whether the facility is an outer, middle, or inner marker, and the complexity of the design. The inner marker, a Category II ILS component, is usually located on airport property. The middle marker may or may not be on airport property. The outer marker is rarely located on airport property. The marker beacon site drawings should depict the facility relationship with the ILS runway and runway centerline extended; however, it may be practical to provide both vicinity and plot layout information on the same drawing. At marker locations remote to the airport proper, an area map detailing directions to the site from the airport should be provided on the general plan drawing and/or the vicinity drawing. Certain details, such as grading and clearing, which would be shown on a vicinity drawing for a localizer or glide slope, may have to be indicated on the plot plan drawing for a marker beacon because of the smaller drawing scales required for marker drawings.

a. Marker Beacon Vicinity Drawing. Typical marker beacon vicinity drawings are shown on Drawings CN-D-0006 and CN-D-0007 in appendix 6. The following information should be shown on this drawing:

(1) Location of site, with respect to runway threshold and runway centerline extended.

(2) Location of site with respect to approach light system (inner and middle markers only). Show profile view of proposed antenna with respect to approach light plane.

(3) Location of the site access road including intersection with existing roads.

(4) Clearing requirements with an indication of limits of tree and brush clearing including density and diameter. Indicate tree diameters up to 6 inches as light, up to 10 inches as medium, and up to 16 inches as heavy. Trees greater than 16 inches in diameter may require special removal methods; therefore, the exact number and approximate location of these trees should be indicated on the drawing.

(5) Grading plan, showing existing and proposed contours. Extensive contours should be indicated when major earthwork is involved and final ground elevations are critical. Do not indicate the major earthwork covered under ADAP projects, but do show the finished grades.

(6) Topography of the area encompassing the marker beacon site and access road (both existing and proposed).

(7) Relevant elevations, including existing and proposed ground elevation at the antenna mast, equipment shelter, and along access road centerline.

(8) Power routing, including the location of utility company and FAA terminal poles.

(9) Soil boring/bearing information. Indicate the location of the soil borings taken. Where compaction tests have been made, record this data on the drawing.

(10) Property owner's name and address.

(11) Utility company's name and address.

(12) Access road, turnaround, and parking area dimensions and drainage requirements. Refer to Order 6940.2 and Drawings D-5980-1 and -2 for details.

b. Marker Beacon Plot Plan Drawing. The marker beacon plot plan should depict the facility site layout. It should be drawn to a scale suitable for labeling the equipment dimensions. Typical marker beacon plot plans are shown on Drawings CN-D-0006 and CN-D-0007 in appendix 6. The plot plan should include:

(1) Antenna support and equipment shelter plot layout, dimensioning antenna, shelter, fence, turnaround/parking area, transformer, meter post, guard posts, and other appurtenances.

(2) Access road centerline profile detailing drainage and construction requirements.

(3) Access road cross sections, designed in accordance with FAA Order 6940.2 and Drawings D-5980-1 and -2.

(4) Access road transitions to intersecting roads.

(5) Site preparation requirements, including grading, clearing, soil sterilization, gravel cover, etc.

(6) Obstruction penetrations to marker beacon restrictive zones, e.g., utility poles, structures, etc.

(7) Termination points for power and control cable.

(8) Conduit, duct, manhole, handhole etc., locations.

(9) Fence location. Refer to national standard drawings for details.

287. ELECTRICAL POWER DRAWINGS. Provide comprehensive and clear electrical power wiring and termination instructions. When using existing facility electrical drawings, be sure that they have been field-checked. Modifications may have been made without the record drawing being revised. Details are required for transformer, substations, terminal poles, surge protectors, service entrance switches, etc.

288. PROPERTY DESCRIPTION DRAWINGS. The property drawing, detailing the land acquisition area, may be a separate drawing from the plot plan, or the property description may be shown directly on the plot plan. The decision as to where to indicate the land acquisition area should be based upon how much detail is needed, and how much congestion will be created if it is shown on the site drawing. ILS components located on airport property usually require point descriptions only. Components located off airport property always require full legal descriptions. Information that all property description drawings should contain includes:

a. Exterior boundaries and property lines of ownerships affected (including adjacent properties where relevant).

b. Accurate plot of property to be acquired, showing location of proposed improvements.

c. Owner's name and address. Include those of adjacent properties where relevant.

d. Location of facility by means of a General Land Office description, if possible.

e. Approximate square footage and/or acreage involved.

f. Identification of a monument to which the metes and bounds property traverse is referenced. This monument must be acceptable to the political body (usually county) holding records of the property.

g. Information regarding direction to which bearings are referenced, e.g., to the centerline of a county road.

h. Metes and bounds description.

i. Indication of existing restrictive easements and public road rights-of-way.

j. Indication of true north and magnetic declination.

k. Existing utility easements.

l. Other pertinent information that would have a bearing on the property acquisition.

289. OBSTRUCTION DRAWING. Although it is not considered to be part of the construction plans, a drawing depicting obstructions to the final approach area should be included with the drawing package for review and concurrence. Order 8260.16, discusses the use of National Ocean Survey airport obstruction charts. When NOS obstruction charts are used, the ILS site survey engineer should CERTIFY on the drawing that penetrations of the obstruction slope have been confirmed by instrument. When updating existing OC charts, prepare a table detailing obstruction distance elevation and penetration data. Refer to Order 6750.16A, paragraph 31, for determination of the ILS required obstruction clearances.

290. COMLO/NDB SITE DRAWINGS. COMLO's collocated with marker beacons, or NDB's established as separate facilities, require drawings similar to the marker beacon vicinity and plot plan drawings. Typical COMLO site layouts are indicated in Order 6750.16A. Drawing CN-D-0007 in appendix 6 shows a COMLO site collocated with an outer marker.

291. DME SITE DRAWINGS. The location of the DME equipment should be indicated on the localizer site drawing. Drawings D-6078-1 through 4 depict the location of FA-8974 DME equipment at Mark Id localizers.

292.-300. RESERVED.

SECTION 3. NATIONAL STANDARD DRAWINGS/SPECIFICATIONS

301. GENERAL. The Airway Facilities Service has developed national standard drawings and specifications to be used in the construction of ILS facilities. Where there is no requirement for site adaptation, regions should use the standard drawings intact.

302. NATIONAL STANDARD DRAWINGS. Appendix 13 of this document contains an index of the national standard drawings detailing ILS plot layouts, antenna and equipment shelter foundations, elevated platforms, and electrical distribution systems. In addition, national standard drawings are available for the following (latest revision is applicable):

a. Access Roads.

(1) D-5980-1 Access Road Cross Sections for FAA Facilities.

(2) D-5980-2 Typical Drainage Details for FAA Access Roads.

b. Fences.

(1) D-566 Class 'C' and 'D' Fences.

(2) D-1048B Class 'E' fences.

(3) D-1048C Steel Fence Post Details.

(4) D-2051 Details for Electric Fences.

(5) D-2109 Class 'C' Fence with Steel Posts.

(6) D-2110 Class 'D' Fence with Steel Posts.

(7) D-4215 Fence and Gates, Wood Picket.

(8) D-4745 Board Fence and Gate.

(9) D-5597 Chain Link Fence (Class 'F'), Steel or Aluminum.

c. Electrical Service Terminal Poles.

(1) D-5747-5 Standard High Voltage Terminal Pole 2400/4160V with Load Interrupters and Fused Cut Outs.

(2) D-6044 Standard Low Voltage Terminal Pole 120/240V Overhead to Underground.

d. Engine Generators.

(1) D-562 515 Gallon Fuel Storage Tank.

(2) D-5816-1 Housing, Van Type Skid Mounted up to 65 kW Engine Generator, Plans, Elevations, and Details.

(3) D-5970-1 Van-Mounted Power Plant, 5-30 kW Engine Generator, Plan, and Elevations.

e. Electronic Installation. Single-line diagrams, wiring diagrams, and electronic schematic diagrams for ILS equipment are contained in Order 6750.19.

303. NATIONAL STANDARD SPECIFICATIONS. The following is a list of standard specifications, which may be used with ILS construction projects (latest revision is applicable):

a. FAA-E-113 Poles, Wood, Treated.

b. FAA-566 Concrete.

c. FAA-910 Structural Steel.

d. FAA-C-1217 Electrical Work, Interior.

e. FAA-C-1247 Erection of Self Supporting Towers.

f. FAA-C-1391 Installation and Splicing of Underground Cable.

g. FAA-E-2013 Cable, Electrical Power, 600V to 15,000V.

h. FAA-E-2065 Fences.

i. FAA-C-2256 Temperature and Humidity Control.

j. FAA-C-2454 Facility Site Preparation.

k. FAA-STD-003 Paint Systems for Structures.

1. RR-S-001301 Safety Climbing Equipment.

304.-310. RESERVED.

SECTION 4. REGIONAL SITE ADAPTATION

311. SITE CONSTRUCTION DRAWINGS AND SPECIFICATIONS. Deviations from the national standard drawings and specifications promulgated by the Airway Facilities Service are sometimes necessary in order to meet specific site requirements. Such changes should be held to a minimum, but they may be employed when dictated by site conditions and/or when it is possible to save time and money. Specifying materials (brick, metal panels, concrete block, creosoted poles, etc.) which are unavailable or time-consuming to obtain in a particular area, should be avoided if acceptable substitutes are more readily available. Occasionally regional site adaptation of standard FAA drawings has been necessary in the following areas:

a. Special Structures.

(1) Localizer antenna platforms and earthwork mounds.

(2) Unique antenna and equipment shelter foundation requirements (e.g., conditions where peat and permafrost are encountered).

(3) Construction over water.

(4) Construction in flood plains.

(5) Ground screens for glide slopes.

b. Special Landscaping Dictated by Zoning or Environmental Requirements.

c. Collocation of Facilities.

(1) Installing new marker beacons with existing navaid facilities.

(2) Installing far field monitor antennas on approach light towers.

(3) Installing status display panels in control tower cabs.

312. NEW CONSTRUCTION DRAWINGS. In some cases it may become necessary not only to modify the national standard drawings and specifications but to create new drawings and specifications for construction requirements not covered by existing standards, or where they are unavailable or outdated. Some examples are:

a. Terminal poles.

b. Meter posts.

c. Transformer installations.

d. Ground counterpoises.

e. Lightning surge protectors.

313.-320. RESERVED.

CHAPTER 8. ENVIRONMENTAL CONSIDERATIONS WHEN PLANNING ILS FACILITES

SECTION 1. THE SITE SURVEY ENGINEER'S ROLE IN THE ENVIRONMENTAL ASSESSMENT PROCESS

321. GENERAL. ILS establishments must consider environmental factors together with technical, operational, and cost requirements. Guidance is provided herein to enable the site survey engineer to assess potential environmental impacts and properly document them.

322. COLLECTING ENVIRONMENTAL DATA.

a. When to Collect Data. The data needed by the appropriate regional Airway Facilities division personnel to make the preliminary environmental review should be collected during the feasibility study (see chapter 2). The environmental investigation could determine whether to include the project in the budget or to consider alternatives. When environmental data cannot be collected during the feasibility study, it must not be neglected during the regular site survey.

b. Factors to be Considered.

(1) It is most desirable, when siting an ILS, to avoid areas where the equipment placement or required site preparation may create an environmental conflict. The site survey engineer should consider any possible environmental impacts that may occur as a result of the proposed ILS. The equipment should be sited to comply with Order 6750.16A, but all efforts should be made to avoid the following locations:

(a) Locations requiring the rerouting of public roads.

(b) Locations requiring extensive earth moving.

(c) Marker locations that will generate television interference.

(d) Locations that will appreciably affect the natural drainage of the area (particularly in areas designated as wetlands).

(e) Locations in public park land and recreational areas, wildlife or waterfowl refuges, historic sites, areas of archeological significance, or habitats of endangered species.

(f) Locations that may detract from aesthetics.

(2) It is not always possible to avoid these types of locations. It is, therefore, necessary for the site survey engineer to investigate and document all practical alternative sites in his site survey report. This will enable consideration of environmental factors together with technical, operational, and economic factors in determining siting decisions. The site survey report should contain photographs of those areas requiring environmental assessment.

c. Other Sources of Environmental Data. In addition to information gathered first-hand by onsite visits, other sources of information are available for environmental considerations. These include:

(1) Coordination with the Airports division/ADO for previous documentation of the environmental impacts at the airport. This type of documentation is sometimes included in environmental assessment reports prepared for a 20-year master plan.

(2) Maps and aerial photographs, such as those available from USGS, local land-use planners, and transportation and engineering agencies.

(3) Interviews with land-use planners, engineers, and local experts in forestry, fish and wildlife, agriculture, endangered species, historic preservation, and archaeology.

(4) Reference sources, such as the National Register of Historic Places, and similar state and local listings.

323. EXCEPTED PROJECTS. Certain siting and construction activities related to ILS installations do not require formal environmental consideration. These are:

a. Conversion of an existing Category I ILS to Category II or III performance standards.

b. Accessory onsite structures including storage buildings, garages, small parking areas, and signs and fences.

c. Grading on land with a slope of less than 10 percent, except where located near waterways in any wetland, in an officially designated (by Federal, state, or local government agency) scenic area, or in officially mapped areas of severe geological hazard.

d. Filling of earth into previously evacuated land with material compatible with the natural features of the site.

e. Minor trenching and backfilling where the surface is restored and the evacuated material is protected against wash and runoffs during the construction period.

f. Replacement of power and control cables for facilities located on airport property.

g. Demolition and removal of building and structures, except where they are of historical, archaeological, and architectural significance as officially designated by Federal, state, or local government.

324.-330. RESERVED.

SECTION 2. PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

331. GENERAL. DOT and FAA policy and procedures for meeting requirements of the National Environmental Policy Act of 1969 have been thoroughly established and are outlined in the following directives. These documents should be consulted for detailed procedures necessary to prepare an environmental impact statement or a negative declaration.

a. Order 1050.1, Policies and Procedures for Considering Environmental Impacts.

b. DOT 5610.1B, Procedures for Considering Environmental Impacts.

332. INITIATION OF ENVIRONMENTAL ASSESSMENT. The regional organization assigned the responsibility of preparing the environmental assessment should obtain environmental comments relating to the ILS project from all of the other involved organizations. These comments should be developed into a orderly format. It is essential that the environmental assessments be initiated with the beginning of the design or engineering effort since:

a. No PR's for construction or utility arrangements should be submitted to the regional Logistics division for action until the EIS or ND, as required, has been completed and filed.

b. Usually, no formal contact with property owners for the purpose of acquiring property can be made prior to filing a EIS or ND. The exceptions to this restriction are contained in Order 1050.1.

333. PREPARATION OF AN ENVIRONMENTAL IMPACT ASSESSMENT REPORT BY A NON-FEDERAL ENTITY. If the site survey is performed by a private contractor, the contractor shall prepare an environmental assessment report, to be submitted as part of the formal site survey report. This report is to be used by the FAA in the preparation of the EIS or ND.

334. PROPOSED OUTLINE FOR ENVIRONMENTAL ASSESSMENT. The environmental assessment can vary from a simple statement supported with pertinent facts, as may be appropriate for a negative declaration, to a comprehensive report which includes enough detailed data for the preparation of an environmental impact statement. The magnitude of the project, the complexity or degree of impact on the environment, and regional practices will dictate the formality and comprehensiveness required. Each assessment should thoroughly describe the project, environmental impact, alternatives, and conclusions. Formal assessment reports should reflect the objective consideration of the topics outlined below, and present them in a manner that will enable their use in the subsequent EIS or ND that must be prepared.

a. Description of Project. The description of the project shall contain the following information, but should not supply extensive detail beyond that needed for evaluation and review of the environmental impact.

(1) The precise location and boundaries of the proposed site(s) shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on an accompanying map.

(2) A statement of the objectives sought by the proposed project.

(3) A general description of the project's technical, economic, and environmental characteristics.

(4) A description of the ILS components involved. Appendix 18 contains a description for an ILS system.

b. Description of Environmental Setting. An assessment must include a description of the conditions in the vicinity of the project, as it exists before commencement of the project, from both a local and regional perspective. Thus, knowledge of the geographical setting is critical to the assessment of environmental impacts. Special emphasis should be placed on environmental resources that are rare or unique to that region. Specific reference to related projects, both public and private, both existent and planned, in the region should also be included for purposes of examining the possible cumulative impact of such projects.

c. Environmental Impact. All phases of a project must be considered when evaluating its impact on the environment - planning, acquisition, development, and operation. The following subjects shall be discussed, preferably in separate sections or paragraphs.

(1) The Environmental Impact of the Proposed Action. Describe the direct and indirect impacts of the project on the environment giving consideration to both the short-term and long-term effects. It should include specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced in population distribution, population concentration, the human use of the land (commercial and residential development), and other aspects of the resource base such as water, air, scenic quality, and public services.

(2) Any Adverse Environmental Effects That Cannot Be Avoided If the ILS is Implemented. Describe any adverse impacts, including those that can be reduced to an insignificant level but not eliminated. Where there are impacts that cannot be alleviated without imposing an alternative design, their implications and the reasons why the project is being proposed, notwithstanding

their effect, should be described. Do not neglect impacts on any aesthetically valuable surroundings, or on human health.

(3) Mitigation Measures Proposed to Minimize the Impact. Describe any mitigation measures written into the project plan to reduce significant environmentally adverse impacts to insignificant levels, and describe the basis for considering these levels acceptable. Where a particular mitigation measure has been chosen from among several, alternatives should be discussed and reasons should be given for the choice made.

(4) Alternatives to the Proposed Action. Describe any known alternatives to the project, and why they were rejected in favor of the proposed action. The specific alternative of "no project" must also always be evaluated, along with the impact. Attention should be paid to alternatives capable of substantially reducing or eliminating any environmental adverse impacts, even if these alternatives substantially impede the attainment of the project objectives and are more costly.

(5) Relationship between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity. Describe the cumulative and long-term effects of the proposed project that adversely affect the state of the environment. Special attention should be given to impacts that narrow the range of beneficial uses of the environment or pose long-term risks to health or safety. In addition, the reasons why the proposed project is believed by the sponsor to be justified now, rather than reserving an option for further alternatives, should be explained.

(6) Any Irreversible Environmental Changes that Would be Involved in the Proposed Action If Implemented. Uses of non-renewable resources during the initial and continued phases of the project may be irreversible since a large commitment of such resources makes removal or non-use thereafter unlikely. Primary impacts and, particularly, secondary impacts, generally commit future generations to similar uses. Also irreversible damage can result from environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

(7) The Growth-Inducing Impact of the Proposed Action. Discuss the ways in which the proposed project could foster economic or population growth, either directly or indirectly, in the surrounding environment. Included in this are projects that would remove obstacles to population growth. Increases in the population may further tax existing cummunity service facilities, so consideration must be given to this impact. Also discuss the characteristics of projects that may encourage and facilitate

other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.

d. Organizations and Persons Consulted. The identity of all Federal, state,or local agencies, other organizations and private individuals consulted in preparing the assessment, and the identity of the persons, firm, or agency preparing the statement by contract or other authorization must be given. Attachments to the assessment could include such items as:

(1) A map showing the airport site location as well as adjacent communities, bodies of water in the vicinity, land use patterns, and zoning.

(2) Copies of correspondence with the state department of fish and game, historical preservation offices, etc.

(3) A-95 clearinghouse correspondence.

(4) Summaries of public hearing and copies of the newpaper notice of the public hearing.

APPENDIX 1. GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AC	Advisory Circular.
ac	Alternating Current.
ADAP	Airport Development Aid Program.
ADO	Airports District Office.
AF	Airway Facilities (organizational reference).
AIA	Annual Instrument Approaches.
ALP	Airport Layout Plan.
ALS	Approach Lighting System.
amsl	Above Mean Sea Level.
ANF	Air Navigational Facilities.
ANSI	American National Standards Institute.
ARP	Airport Reference Point.
AS	Airports (organizational reference).
ASR	Airport Surveillance Radar.
AT	Air Traffic (organizational reference).
ATCT	Airport Traffic Control Tower.
AWG	American Wire Gauge.
BCM	Back Course Marker.
bm	Bench Mark.
brl	Building Restriction Line.
Btu	British Thermal Unit.
CPA	Continuous Power Airport.
COMLO	Compass Locator.
DEB	Direct Earth Buried.

DH	Decision Height, a specified height above the touchdown zone (TDZ).
DMAAC	Defense Mapping Agency Aerospace Center.
DME	Distance Measuring Equipment.
EIS	Environmental Impact Statement.
el	Elevation.
EOR	End of Runway.
FAA	Federal Aviation Administration.
FAR	Federal Aviation Regulation.
F&E	Facilities and Equipment.
FFM	Far Field Monitor.
FM	Fan Marker.
fm	Frequency Modulation.
FMO	Frequency Management Officer.
FS	Flight Standards (organizational reference).
FSNFO	Flight Standards National Field Office.
FSS	Flight Service Station.
GPI	Ground Point of Intercept.
GS	Glide Slope.
HAT	Height Above Touchdown Zone Elevation.
HIRL	High Intensity Runway Lights.
HV	High Voltage.
Hz	Hertz.
IFB	Information (or Invitation) for Bidders (or Bids).
IFR	Instrument Flight Rules.
ILS	Instrument Landing System.
IM	Inner Marker.

kVA	Kilovolt-amperes.
kW	Kilowatts
LG	Logistics (organizational reference).
LOC	Localizer.
LOM	Compass Locator at Outer Marker.
LMM	Compass Locator at Middle Marker.
LPDA	Log Periodic Dipole Antenna.
MALS	Medium-Intensity Approach Lighting System.
MALSF	Medium-Intensity Approach Lighting System with Sequenced Flashers
MALSR	Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights.
MDA	Minimum Descent Altitude.
MIRL	Medium Intensity Runway Lights.
MM	Middle Marker.
msl	Mean Sea Level.
NAVAIDS	Navigation Aids.
ND	Negative Declaration.
NDB	Nondirectional Radio Beacons.
NFDC	National Flight Data Center.
NFM	Near Field Monitor.
NGS	National Geodetic Survey.
nmi	Nautical Mile.
NOAA	National Oceanic and Atmospheric Administration.
NOS	National Ocean Survey.
NOTAM	Notice to Airmen.
NR	Null Reference.

OC	Obstruction Chart.
OM	Outer Marker.
OSHA	Occupational Safety and Health Act.
PA	Project Authorization, or Project Assignment.
PAR	Precision Approach Radar.
pob	Point of Beginning.
pos	Point of Start.
PR	Procurement Request.
psf	Pounds per square foot.
RAIL	Runway Alignment Indicator Lights.
RBN	Radio Beacon.
REIL	Runway End Identifier Lights.
rf	Radio Frequency.
RFP	Request for Proposals.
RFQ	Request for Quotations.
ROC	Required Obstruction Clearance.
r/w	Right of Way.
RPI	Runway Point of Intercept.
RTT	Radio Telemetering Theodolite.
RVR	Runway Visual Range.
rwy	Runway.
SBR	Sideband Reference.
SF	Standard Form.
SFO	Sector Field Office.
SSALS	Simplified Short Approach Lighting System.

T	Threshold.
TACAN	Tactical Air Navigation.
TAZ	True Azimuth.
TCH	Threshold Crossing Height.
TDZ	Touchdown Zone.
TERPS	U.S. Standard for Terminal Instrument Procedures (Handbook 8620.3).
tvi	Television Interference.
TVOR	Terminal Very High Frequency Omnirange.
tw	Traveling Wave.
uhf	Ultra High Frequency.
USGS	United States Geological Survey.
V	Volts.
VASI	Visual Approach Slope Indicator.
VFR	Visual Flight Rules.
vhf	Very High Frequency.
VOR	Very-High-Frequency Omnirange.
VORTAC	Very-High-Frequency Omnirange with TACAN.

APPENDIX 2. APPLICABLE FAA DOCUMENTS

Order 1050.1	Policies and Procedures for Considering Environmental Impacts.
Order 1200.21	Evaluation, Review, and Coordination of FAA Assistance and Development Programs and Projects.
Handbook 3900.19	Occupational Safety.
Order 4423.2	Lease Versus Purchase of Land for FAA Facilities.
Order 4660.1	Real Property.
Order 5100.26	Programming Criteria for Electronic Navigational Aids Under ADAP.
Order 6000.20	Waiver of Criteria for Establishment and Maintenance of Airway Facilities.
Order 6000.21	Runway Assignment Changes for Category I ILS/ALS, VASI, REIL, and RVR Projects.
Order 6010.4	Engineers Cost Estimate for Construction of FAA Facilities.
Order 6011.3	Typical F&E Cost Estimates.
Order 6030.1	FAA Policy on Facility Relocations Occasioned by Airport Improvements or Changes.
Order 6030.8	Underground Installation of Cable.
Order 6030.9	Reduction of Maintenance Costs through Co-Location of Existing Facilities.
Order 6030.19	Implementation of Standard FAA-STD-002A, Engineering Drawings.
Order 6030.20	Provision of Electrical Power for National Airspace System Facilities.
Order IM 6030.9	Design and Construction of FAA Facilities.
Order 6750.4	Siting Criteria for ILS Inner Marker.
Order 6750.6	Installation Instructions for Category I and Category II ILS Glide Slopes.
Order 6750.7	Category II ILS Program.

Order 6750.13	ILS Remote Receiver Monitoring.
Order 6750.16A	Siting Criteria for Instrument Landing Systems.
Order 6750.19	ILS Installation Drawings.
Order 6750.20	Guidelines for Standard and Non-Standard Siting of ILS Facilities.
Order 6750.22	National ILS Establishment Contracts.
Order 6750.24	ILS and Ancillary Electronic Component Requirements.
Order 6750.28	Installation of Far Field Monitor at All AN/GRN-27(V) Category II Facilities.
Order 6750.35	Installation Instructions for Category I ILS Localizer, Marker Beacon, and Compass Locator Facilities.
Handbook 6850.2	Visual Guidance Lighting Systems.
Order 6940.1	Access Roads to FAA Owned and Operated Facilities.
Order 6940.2	Access Road Cross Sections and Typical Drainage Details for FAA Facilities.
Order 6950.2	Power Policy Implementation at National Airspace System Facilities.
Order 6950.11	Reducing Electrical Power Interruptions at FAA Facilities.
Order 7031.2	Airway Planning Standard Number One - Terminal Air Navigation Facilities and Air Traffic Control Services.
Order 7900.2	Reporting of Navigation Aids and Facilities Data to the National Flight Data Center.
Handbook 8260.3	United States Standard for Terminal Instrument Procedures (TERPS).
Order 8260.16	Airport Obstruction Surveys.
Order 8260.24	Category I ILS Threshold Crossing Height.
Order DOT 5610.1	Procedures For Considering Environmental Impacts.
FAR Part 77	Objects Affecting Navigable Airspace.
AC 70/7460-1	Obstruction Marking and Lighting.

AC 70/7460-2	Proposed Construction or Alteration of Objects that may Affect the Navigable Airspace.
AC 120-29	Criteria for Approving Category I and II Landing Minima for FAR 121 Operators.
AC 150/5100-9	Engineering Services Under the Airport Development Aid Program.
AC 150/5300-2	Airport Design Standards-Site Requirements for Terminal Navigational Facilities.
AC 150/5300-6	Airport Design Standards - General Aviation Airports - Basic and General Transport.
AC 150/5320-5	Airport Drainage.
AC 150/5320-6	Airport Pavement Design and Evaluation.
AC 150/5340-1	Marking of Paved Areas on Airports.
AC 150/5370-10	Standards for Specifying Construction of Airports.

NOTE: The latest revision of the documents referenced in this directive is applicable; due to the unique relationship of this publication to the ILS siting criteria, Order 6750.16A is cited specifically. Refer to the directives checklist for the latest revision.

APPENDIX 3. TECHNICAL REFERENCES

1. The following references are suggested for surveying and plot descriptions:

   a. Civil Engineering Handbook
      L.C. Urquhart, Editor
      McGraw-Hill Book Co.

   b. Surveying and Introduction to Engineering Measurements
      A.R. Legault, N.M. McMaster & R.R. Marlette
      Prentiss Hall, Inc.

   c. Elementary Surveying
      C.B. Breed and G.L. Hosmer
      John Wiley & Sons, Inc.

   d. Standard Land Office Handbook

2. The following references are suggested sources of cost data for preparing cost estimates:

   a. "Building Construction Cost Data"
      R.S. Means Co., Inc.
      Duxbury, Mass. 02332

   b. Walker, "Building Estimators' Reference Book"

   c. Engineering News-Record, Cost Indexes published in Engineering News-Record, McGraw Hill Book Co.

   d. Order 6010.4, Engineers Cost Estimate for Construction of FAA Facilities.

3. The following references are suggested for sources related to electrical power design:

   a. National Electrical Code
      National Fire Protective Assn.
      Boston, Mass.

APPENDIX 4. ILS PROJECT DATA CHECKLIST

1. GENERAL.

a. AIRPORT INFORMATION

(1) Airport Name _____ Ident _____

(2) City _____ State _____

(3) County _____

(4) Owner _____

(5) Operating Agency _____

(6) Airport Manager _____

Address _____

City and State _____

Phone _____

(7) ARP Latitude _____

Longitude _____

b. ILS DATA

(1) Proposed ILS Rwy _____

(2) Equipment to be installed

Localizer _____

Glide Slope _____

Outer Marker _____

Middle Marker _____

Inner Marker _____

DME _____

Compass Locator/NDB _____

(3) Category I. _____ II. _____ III. _____

c. LOCAL PERSONNEL CONTACTS

(1) Local FAA

AF Sector _____

Phone _____

ATCT _____

Phone _____

FSS _____

Phone _____

Other _____

Phone _____

(2) Airport

Public Works _____

Phone _____

(3) Engineering Consultants _____

(a) Firm _____

Address _____

City and State _____

Phone _____

(b) Firm _____

Address _____

City and State _____

Phone _____

(4) Power Utilities (On Airport)

Firm _____

Address _____

City and State _____

Contact _____

Phone _____

(5) Power Utilities (Off Airport)

Firm _____

Address _____

City and State _____

Contact _____

Phone _____

(6) Telephone Company

Firm _____

Address _____

City and State _____

Contact _____

Phone _____

d. REFERENCE DATA

(1) Airport Plan _____

_____

(2) Obstruction Chart _____

(3) Topographical Maps _____

_____

_____

(4) Approach Plates _____

_____

(5) Sectional Charts _____

_____

(6) Local Maps and Deeds _____

_____

_____

_____

(7) Aerial Photographs _____

_____

(8) Environmental Information _____

_____

_____

_____

2. LOCALIZER.

a. ANTENNA

(1) Coordinates Latitude _____

Longitude _____

Source _____

(2) Distance from Stop-End Rwy _____

(3) Distance from approach threshold _____

(4) Rwy centerline extended station _____

(5) Ground Elevation _____ msl

(6) 50:1 approach surface elevation at antenna location _____ msl

(7) Platform required _____

Height _____

(8) Course width (700-foot tailored) _____ degrees

(9) Interface with ALS System _____

(10) Contours required _____

Contour intervals _____

Source _____

(11) Derogating Surfaces _____

b. EQUIPMENT SHELTER

(1) Location _____

_____

(2) Type _____

(3) Size _____

(4) Ground Elevation _____ msl

(5) Contours required _____

Contour Intervals _____

Source _____

c. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate routing _____

_____

(3) Length _____

(4) Type _____

(5) Centerline info _____

(6) Cross sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

(8) Parking _____

(9) Guard posts _____

(10) Gate or cable barrier _____

_____

(11) ALS access road - relocation _____

_____

d. POWER

(1) Routing, general _____

_____

(2) Alternates _____

_____

(3) Power Cable _____

Type _____

Supplied by _____

Length _____

(4) kVA _____ Voltage _____

Source of cable _____

(5) Power Co. _____

(6) Trenching _____

Length _____

Trenching Specs _____

_____ _____

Conditions _____

(7) Existing ducts _____

_____

(8) New ducts _____

_____

(9) Transformer requirements _____

_____

(10) HV Pot Head _____

_____

(11) Metering _____

_____

(12) Engine generator set _____

Type _____

Size _____

Fuel _____

e. MONITORING AND/OR CONTROL

(1) Radio _____

Receiver location _____

(2) Hardwire line _____

FAA _____

Telephone Co. _____

Routing _____

_____

Length _____

_____

Existing Cable (pairs available) _____

_____

(3) Trenching _____

Length _____

Trenching Specs _____

_____

Conditions _____

Existing ducts _____

_____

New ducts _____

f. PLOT REQUIREMENTS

(1) License _____ Lease _____ Purchase _____

(2) Plot size _____

(3) Description _____

_____

(4) Plot survey required _____

(5) Access road r/w _____

_____

(6) Owner _____

Address _____

Telephone _____

(7) Power route easement _____

g. SECURITY

(1) Fence required _____

(2) Type _____

(3) Gates _____

(4) Line of sight to ATCT _____

_____

h. SITE PREPARATION

(1) Schedule completion _____

(2) Sponsor's plans _____

_____

_____

i. GENERAL CONSTRUCTION CONDITIONS

(1) Soil _____

Visual investigation _____

_____

Lab Analysis _____

Firm: _____

Address _____

Contact _____

Telephone _____

Water or flooding _____

Unique problems _____

Other construction _____

Underway _____

Planned _____

Clearing _____

Earthwork _____

(2) Year-round conditions _____

j. ENVIRONMENTAL CONSIDERATIONS

(1) Clearing _____

_____

_____

(2) Zoning _____

_____

_____

(3) Earthwork _____

_____

_____

(4) Water runoff and drainage changes _____

_____

_____

(5) Vegetation control (i.e., use of chemical agents) _____

_____

_____

(6) Debris disposal _____

_____

_____

(7) Disruption of wildlife and endangered species _____

_____

_____

(8) Other _____

_____

_____

k. FAR FIELD MONITOR (FFM)

(1) Location _____

Distance from threshold _____

Lateral distance from rwy centerline extended _____

_____

(2) Elevation of ground _____ msl

(3) Elevation of antenna _____ msl

(4) Power _____

FAA _____

Power Co. _____

(5) Monitoring and control _____

FAA _____

Telephone Co. _____

(6) Routing of cables _____

_____

(7) Line of Sight with Localizer _____

1. GROUND CHECK POINTS

(1) Location _____

(2) Accessibility _____

m. OTHER CONSIDERATIONS

(1) Overrun cable barrier _____

(2) Paved overrun _____

(3) Derogating surfaces _____

NOTES (LOCALIZER)

3. GLIDE SLOPE.

a. CRITICAL DATA

(1) Glide slope angle _____

(2) TCH _____

(3) Type _____

(4) Displaced threshold _____

(5) Ground screen _____

b. LOCATION

(1) Distance from Threshold

From threshold (longitudinal) _____

Threshold centerline station _____

GS centerline station _____

From runway centerline (Lateral) _____ Right ____ Left ___

(2) Coordinates (Antenna)

Latitude _____

Longitude _____

Source _____

(3) Ground Elevations

Glide Slope _____ msl

Rwy Threshold _____ msl

Rwy Centerline (Opposite GS) _____ msl

(4) Ground Plane Contours _____

Source _____

(5) Antenna tower height _____ feet

Top of tower _____ msl

(6) Upper antenna elevation _____ msl

c. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate _____

_____

(3) Length _____

(4) Type _____

(5) Centerline Info. _____

(6) Cross Sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

_____

(8) Parking _____

(9) Guard Posts _____

(10) Gate, Cable Barrier _____

d. POWER

(1) Routing, general _____

_____

(2) Alternate _____

_____

(3) Power Cable _____

Type _____

Length _____

Supplied by _____

(4) kVA _____ Voltage _____

(5) Source _____

(6) Trenching _____

Length _____

Trenching Specs. _____

(7) Conditions _____

(8) Existing Ducts _____

(9) New Ducts _____

(10) Transformer requirements _____

_____

(11) HV Pot Head _____

_____

(12) Metering _____

_____

(13) Engine Generator Set

Type _____

Size _____

Fuel _____

e. MONITORING AND/OR CONTROL

(1) Radio _____

Receiver location _____

(2) Hardwire line _____

FAA _____

Telephone Co. _____

Routing _____

_____

Length _____

_____

Existing Cable (spares available) _____

_____

New Cable _____

_____

(3) Trenching _____

Length _____

Trenching Specs. _____

_____

Conditions _____

(4) Existing ducts _____

_____

(5) New ducts _____

_____

f. PLOT REQUIREMENTS

(1) License _____ Lease _____ Purchase _____

(2) Plot size _____

(3) Description _____

_____

(4) Plot survey required _____

(5) Access Road r/w _____

(6) Owner _____

Address _____

Telephone _____

(7) Power route easement _____

g. NEAR FIELD MONITOR (NFM)

(1) Approximate location _____

(2) Counterpoise requirements _____

h. SECURITY

(1) Fence required _____

(2) Type _____

_____

(3) Within line of sight to ATCT _____

i. SITE PREPARATION

(1) Scheduled Completion _____

(2) Sponsor's Plans _____

_____

j. GENERAL CONSTRUCTION CONDITIONS

(1) Soil _____

Visual investigation _____

Lab analysis _____

Firm _____

Address _____

Contact _____

Telephone _____

(2) Water or Flooding _____

(3) Unique Problems _____

(4) Other construction _____

Underway _____

Planned _____

k. ENVIRONMENTAL CONSIDERATIONS

(1) Clearing _____

(2) Zoning _____

(3) Earthwork _____

(4) Water runoff and drainage changes _____

(5) Vegetation control (i.e., use of chemical agents) _____

(6) Debris disposal _____

(7) Disruption to wildlife and endangered species _____

_____

_____

_____

(8) Other _____

_____

_____

_____

NOTES (GLIDE SLOPE)

NOTES (GLIDE SLOPE) (CONTINUED)

4. OUTER MARKER.

a. LOCATION

(1) Distance from Threshold _____

Feet _____

Naut. miles _____

(2) Lateral distance from Rwy centerline extended

Feet _____ Right _____ Left _____

(3) Coordinates

Latitude _____

Longitude _____

Source _____

b. ELEVATIONS

(1) Ground elevation, antenna _____ msl

(2) GS Intercept elevation _____ msl

(3) Earth curvature correction _____ msl

c. MARKER EQUIPMENT

(1) Type _____

(2) Shelter size _____

(3) Antenna type _____

d. COMLO/NDB

(1) Collocated _____

(2) Type _____

(3) Antenna _____

e. REAL PROPERTY

(1) Plot size _____

(2) Plot description _____

_____

(3) Registered Survey required _____

Firm _____

Address _____

Contact _____

Phone _____

(4) Right-of-Entry required _____

(5) Owner _____

_____

Address _____

Phone _____

(6) Property Records _____

_____

(7) Tax Records _____

_____

(8) Access Road r/w _____

_____

(9) Power Cable Easement _____

_____

f. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate _____

_____

(3) Length _____

(4) Type _____

(5) Centerline info. _____

(6) Cross Sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

Bridges _____

(8) Parking _____

(9) More than one property involved _____

_____

(10) Special construction codes _____

_____

(11) Guard Posts _____

(12) Gate, Cable Barrier _____

g. POWER

(1) Routing, general _____

_____

(2) Alternates _____

_____

(3) Easement required _____

(4) Source _____

(5) Power Cable _____

Type _____

Length _____

Supplied by _____

kVA _____ Voltage _____

(6) Trenching _____

Length _____

Trenching specs. _____

(7) Ducts required _____

_____

(8) Metering _____

(9) New line construction _____

_____

(10) Power Co. specifications _____

_____

h. MONITORING

(1) FAA _____

(2) Telephone Co. _____

Address _____

Contact _____

Phone _____

(3) Routing _____

_____

(4) Length _____

_____

(5) Cable type _____

_____

(6) Trenehing _____

Length _____

Trenching Specs _____

(7) Conditions _____

(8) Ducts required _____

i. SECURITY

(1) Fence required _____

(2) Type _____

j. SITE PREPARATION

(1) Clearing _____

For equipment _____

For obstructions _____

(2) Survey work required _____

_____

(3) Earthwork _____

(4) Year-round conditions _____

k. GENERAL CONSTRUCTION CONDITIONS

(1) Soil _____

Visual investigation _____

_____

Lab analysis _____

Firm _____

Address _____

Contact _____

(2) Water or flooding _____

(3) Unique problems _____

1. ENVIRONMENTAL CONSIDERATIONS

(1) Tv antennas in area _____

(2) Tv channels _____

(3) Residential area _____

(4) Clearing _____

(5) Zoning _____

(6) Earthwork _____

(7) Water runoff and drainage changes _____

(8) Vegetation control (i.e., use of chemical agents) _____

(9) Debris disposal _____

(10) Disruption to wildlife and endangered species _____

(11) Other _____

NOTES (OUTER MARKER)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

5. MIDDLE MARKER.

a. LOCATION

(1) DH point distance from threshold _____ feet

(2) MM distance from threshold _____ feet

(3) Lateral distance from rwy centerline extended

Feet _____ Right _____ Left _____

(4) Coordinates _____

Latitude _____

Longitude _____

Source _____

b. ELEVATIONS

(1) Ground elevation, antenna _____ msl

(2) GS intercept elevation _____ msl

(3) Rwy threshold _____ msl

(4) Highest elevation in TDZ _____ msl

c. MARKER EQUIPMENT

(1) Type _____

(2) Shelter size _____

(3) Antenna type _____

d. REAL PROPERTY

(1) Plot size _____

(2) Plot description _____

_____

(3) Registered survey required _____

Firm _____

Address _____

Contact _____

Phone _____

(4) Right-of-Entry required _____

(5) Owner _____

_____

(6) Property records _____

_____

(7) Tax records _____

_____

(8) Access road r/w _____

_____

(9) Power cable easement _____

_____

e. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate _____

_____

(3) Length _____

(4) Type _____

(5) Centerline information _____

(6) Cross sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

_____

Bridges _____

_____

(8) Parking _____

(9) More than one property involved _____

(10) Designed for use by MALSR _____

_____

(11) Special construction codes _____

_____

Off airport property _____

_____

(12) Guard posts _____

(13) Gate, cable barrier _____

F. POWER

(1) Routing, general _____

_____

(2) Alternates _____

_____

(3) Easement required _____

(4) Source _____

(5) Power cable:

Type _____

Length _____

Supplied by _____

kVA _____ Voltage _____

(6) Trenching _____

Length _____

Trenching specs _____

(7) Ducts required _____

_____

_____

(8) Metering _____

(9) New line construction _____

_____

(10) Obtain power co. specifications _____

_____

g. MONITORING

(1) FAA _____

(2) Telephone co. _____

Address _____

Contact _____

Phone _____

(3) Routing _____

(4) Length _____ _____

_____

(5) Cable type _____

_____

(6) Trenching _____

Length _____

Trenching specs _____

(7) Conditions _____

(8) Ducts required _____

_____

h. SECURITY

(1) Fence required _____

(2) Type _____

(3) If on airport property, is there line of sight to the ATCT ___

_____

i. SITE PREPARATION

(1) Clearing _____

For equipment _____

For obstructions _____

(2) Survey work required _____

_____

(3) Earthwork _____

(4) Year-round conditions _____

j. GENERAL CONSTRUCTION CONDITIONS

(1) Soil _____

Visual investigation _____

_____

Lab analysis _____

Firm _____

Address _____

Contact _____

Phone _____

(2) Water or flooding _____

(3) Unique problems _____

k. ENVIRONMENTAL CONSIDERATIONS

(1) Tv antennas in area _____

(2) Tv channels _____

(3) Residential area _____

(4) Clearing _____

(5) Zoning _____

(6) Earthwork _____

(7) Water runoff and drainage changes _____

(8) Vegetation control (i.e., use of chemical agents) _____

(9) Debris disposal _____

(10) Disruption of wildlife and endangered species _____

(11) Other _____

NOTES (MIDDLE MARKER)

_____

_____

_____

_____

_____

_____

_____

NOTES (MIDDLE MARKER)

6. INNER MARKER.

a. LOCATION

(1) Distance from threshold to DH point _____ feet

(2) IM distance from threshold _____ feet

(3) Lateral distance from rwy centerline extended

_____ feet

(4) Coordinates

Latitude _____

Longitude _____

Source _____

b. ELEVATIONS

(1) Ground elevation, antenna _____ msl

(2) Elevation of antenna _____ msl

(3) Rwy to threshold _____ msl

(4) Highest elevation in TDZ _____ msl

(5) GS intercept elevation _____ msl

c. MARKER EQUIPMENT

(1) Type _____

(2) Shelter size _____

(3) Antenna type _____

d. REAL PROPERTY

(1) Plot size _____

(2) Plot description _____

_____

(3) Owner _____

_____

Address _____

Phone _____

e. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate _____

_____

(3) Length _____

(4) Type _____

(5) Centerline information _____

(6) Cross sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

_____

(8) Parking _____

_____

(9) Designed for use by MALSR _____

_____

(10) Guard posts _____

(11) Gate, cable barrier _____

f. POWER

(1) Routing, general _____

_____

(2) Alternates _____

_____

(3) Source _____

(4) Power Cable _____

Type _____

Supplied by _____

kVA _____ Voltage _____

(5) Trenching _____

Length _____

Trenching specifications _____

_____

(6) Ducts required _____

_____

(7) Metering _____

_____

g. MONITORING

(1) FAA _____

(2) Telephone co. _____

Address _____

Contact _____

Phone _____

(3) Routing _____

(4) Length _____

(5) Cable type _____

(6) Trenching _____

Length _____

Trenching specifications _____

(7) Conditions _____

(8) Duct required _____

h. SECURITY

(1) Fence required _____

(2) Type _____

(3) Line of sight to ATCT _____

i. SITE PREPARATION

(1) Clearing _____

For equipment _____

For obstructions _____

(2) Survey work required _____

_____

(3) Earthwork _____

(4) Year-round conditions _____

j. GENERAL CONSTRUCTION CONDITIONS

(1) Soil

Visual investigation _____

_____

Lab analysis _____

Firm _____

Address _____

Contact _____

Phone _____

(2) Water or flooding _____

(3) Unique problems _____

k. ENVIRONMENTAL CONSIDERATIONS

(1) Tv antennas in area _____

(2) Tv channels _____

(3) Residential areas _____

(4) Clearing _____

(5) Zoning _____

(6) Earthwork _____

(7) Water runoff and drainage changes _____

(8) Vegetation control (i.e., use of chemical agents) _____

(9) Debris disposal _____

(10) Disruption of wildlife and endangered species _____

(11) Other _____

NOTES (INNER MARKER)

_____

_____

_____

_____

_____

_____

_____

7. NONDIRECTIONAL BEACON (NDB).

(Not Collocated with a marker)

a. LOCATION

(1) Coordinates

Latitude _____

Longitude _____

Source _____

(2) Distance and bearing from ARP _____

b. ELEVATIONS

(1) Ground elevation, antenna _____ msl

(2) Elevation, antenna _____ msl

c. EQUIPMENT

(1) Type _____

(2) Shelters _____

(3) Antenna _____

d. REAL PROPERTY

(1) Plot size _____

(2) Plot description _____

_____

(3) Registered survey required _____

Firm _____

Address _____

Contact _____

Phone _____

(4) Right-of-Entry Required _____

(5) Owner _____

_____

Address _____

Phone _____

(6) Property records _____

_____

(7) Tax records _____

_____

(8) Access Road r/w _____

(9) Power cable easement _____

e. ACCESS ROAD

(1) Routing _____

_____

(2) Alternate _____

_____

(3) Length _____

(4) Type _____

(5) Centerline information _____

(6) Cross sections _____

(7) Drainage _____

Ditching _____

_____

Culverts _____

_____

Bridges _____

(8) Parking _____

(9) More than one property involved _____

(10) Special construction codes _____

_____

(11) Guard posts _____

(12) Gate, cable barrier _____

f. POWER

(1) Routing, general _____

_____

(2) Alternates _____

(3) Easement required _____

(4) Source _____

Power Co. _____

Address _____

_____

Contact _____

Phone _____

(5) Power Cable

Type _____

Length _____

Supplied by _____

kVA _____ Voltage _____

(6) Trenching

Length _____

Supplied by _____

(7) Ducts required _____

(8) Metering _____

(9) New line construction _____

(10) Power Co. specifications _____

_____

g. SECURITY

(1) Fence required _____

(2) Type _____

h. SITE PREPARATION

(1) Clearing _____

For equipment _____

For obstructions _____

(2) Survey work required _____

(3) Earthwork _____

(4) Year-round conditions _____

i. GENERAL CONSTRUCTION CONDITIONS

(1) Soil

Visual investigation _____

_____

Lab analysis _____

Firm _____

Address _____

Contact _____

Phone _____

(2) Water or flooding _____

(3) Unique problems _____

j. ENVIRONMENTAL CONSIDERATIONS

(1) Clearing _____

(2) Zoning _____

(3) Residential area _____

(4) Earthwork _____

(5) Water runoff and drainage changes _____

(6) Vegetation control (i.e., use of chemical agents) _____

(7) Debris disposal _____

(8) Disruption to wildlife and endangered species _____

(9) Other _____

NOTES (NDB)

8. DISTANCE MEASURING EQUIPMENT (DME).

(Collocated with Localizer)

a. ANTENNA LOCATION

(1) Coordinates

Latitude _____

Longitude _____

Source _____

(2) Longitudinal Distance from Threshold _____

(3) Lateral Distance from rwy centerline extended _____

_____

b. ELEVATIONS

(1) Ground elevation _____

(2) Antenna elevation _____

c. EQUIPMENT

(1) Type _____

(2) Antenna _____

(3) Shelter space _____

d. POWER

(1) kVA _____ , Voltage _____

(2) From Localizer _____

_____

(3) New Service _____

_____

Source _____

Cable type _____

Length _____

_____

e. MONITORING AND/OR CONTROL

(1) Localizer interface _____

_____

(2) Spares available _____

(3) New Cable _____

Cable type _____

Length _____

NOTES (DME)

9. OBSTRUCTIONS.

a. CRITICAL DATA

(1) OC Chart _____

Date _____

(2) Clearance required _____

50:1 _____ 34:1 _____

Other _____

b. SURVEY

(1) Sponsor survey _____

Firm _____

Date _____

(2) New survey required _____

_____

(3) FAA _____

(4) Subcontracted _____

Firm _____

Address _____

Contact _____

Phone _____

c. CLEARING

(1) Sponsor policy _____

_____

(2) Land owner _____

_____

(3) Growing vegetation _____

_____

(4) Permanent structures _____

_____

(5) Terrain _____

_____

d. WAIVER

Requirements _____

_____

_____

e. MISSED APPROACH

Clearance required _____

_____

_____

f. DATUM

Reference for elevations _____

NOTES (OBSTRUCTIONS)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

NOTES (OBSTRUCTIONS)

10. GENERAL CONSTRUCTION CRITERIA.

a. INSURANCE

Airport requirements _____

Authority _____

Vehicle requirements _____

b. AIR TRAFFIC

(1) Access limited _____

_____

(2) Holiday construction shutdown _____

_____

c. CONSTRUCTION PERMIT

Address _____

d. SECURITY AND SAFETY

(1) Escort requirements _____

_____

(2) Gate access _____

_____

(3) Radio requirements _____

_____

(4) Vehicle lighting/marking _____

_____

(5) Vehicular driver's license _____

_____

(6) Identification badges _____

_____

e. EQUIPMENT RESTRICTIONS

Heavy equipment road obstructions _____

_____

f. WAGE RATES

(1) Source _____

_____

(2) Rates _____

_____

_____

NOTES (GENERAL CONSTRUCTION)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

11. FREQUENCY INTERFERENCE SURVEY.

a. Location of fm radio station w/ respect to ILS Runway _____

b. Call letters of radio Station _____

c. Operating Frequency _____

d. Power Output _____

e. Owner _____

(1) Address _____

(2) Phone _____

NOTES

APPENDIX 5. SAMPLE FIELD WORK ORDER

TO: ACN-450	ENGINEERING BRANCH FIELD WORK ORDER
FROM: ACN-430	CHECK ONE: (X) In Charge DATE: _____ ( ) Assist
TYPE OF PROJECT: Final Field Survey for establishment of Rwy-34 ILS at Roanoke County Airport LOCATION: Salem, Va., Rwy 34	PROJECT CODE: 130/21856 WORK ORDER NO.: ACN-430-102 PROJECT ENGR.: Jim Connors, ACN-430

1. GENERAL INFORMATION.

   a. Rwy Identifier: 34

   b. Category of Operation: CAT I

   c. Glide Angle: 3^{o}

   d. Type of equipment programmed: Mark Id, see D-6054 series drawings for specific requirements of this equipment.

   e. Ancillary aids: COMLO to be located at Outer Marker.

   f. Drawings available: DWG. CN-E-1267, General Plan.
      DWG. CN-E-1238, Rwy 16 ALS Plan and Profile.

   g. Contact points:

      (1) Region ACN-430
      Jim Conners Proj. Eng.
      (717) 645-2183

      (2) Sector
      John Smith, Sector Mgr.
      (800) 765-6538

      (3) Airport
      William Underwood, Airport Mgr.
      (800) 761-2200

      (4) Power Utility On Airport:
      Virginia Electric Co.
      (800) 765-6000

h. Marker search area:

(1) Outer: 4 to 5.5 N miles from rwy 34 threshold.

(2) Middle: Within ±500 ft. of the 200 ft. DH point.

i. Ongoing construction projects: Glide slope ADAP Project.

j. Feasibility report: attached.

2. GENERAL WORK REQUIREMENTS.

a. Facility Locations. (see attached general plan CN-E-1267)

(1) Localizer antenna: 600 ft. past stop end of rwy 34 on rwy centerline extended.

(2) Glide slope antenna: 1300 ft. inbound from rwy 34 threshold and 310 ft. left (westerly) side of rwy 34 centerline.

(3) Middle marker: To be located in the field.

(4) Outer marker/COMLO: To be located in the field.

b. Land Availability. Determine property owner and contact Logistics division through project engineer when suitable location is found.

c. Plant Survey. Determine access road routes and cable runs to proposed facility locations. Determine approximate acreage of clearing and grading for all sites. Ground investigation by probing or boring should be performed for all construction.

d. Airport Safety. Obtain airport clearance through airport managers office. Radio equipped vehicle to be provided by sector manager.

e. Order of Accuracy. Survey accuracy requirements shall be in accordance with Order 6750.___ Site Survey, Selection, and Engineering Documentation of ILS and Ancillary Aids.

f. Environmental Assessment. Complete the environmental section of the attached ILS Project Data Checklist.

g. Photographs. Obtain photographs of proposed sites, access roads, and power take-off points.

3. SPECIFIC WORK REQUIREMENTS.

a. Localizer.

(1) Obtain topography for the localizer antenna(s) and equipment shelter locations. Equipment shelter should be located not less than 250 feet from the center of the antenna.

(2) Field stake center of antenna location.

(3) Determine clearing requirements in localizer restrictive zone.

(4) Obtain construction data for full right-of-way (30 ft.) width of access road.

(5) Coordinate power routings with the sector; power requirements are 120/240 V ac, 3-wire, 1Ø, 15 kVA.

(6) Coordinate control line routings with sector; control requirements are 1 pr. to ATCT.

b. Glide Slope.

(1) Obtain topography from the glide slope facility to 50 feet in back of the facility, 250 feet away from the runway, to the runway centerline, and to the end of the runway.

(2) Field stake the center of the antenna location.

(3) Determine clearing requirements in glide slope restrictive zone.

(4) Obtain topography data for full right-of-way (30 ft.) width of access road.

(5) Coordinate power routing with sector; power requirements are 120/240 V ac, 3-wire, 1Ø, 15 kVA.

(6) Coordinate control line routings with sector; control requirements are 1 pr. to ATCT.

(7) Obtain runway centerline elevation at point opposite glide slope antenna.

c. Middle Marker, Outer Marker/COMLO.

(1) Determine owner-of-record and owner's willingness to negotiate with FAA real property personnel.

(2) Coordinate with Logistic division, through project engineer, for right-of-entry permit in order to conduct survey on owner's land.

(3) Obtain topography at the middle marker and outer marker/COMLO facilities. Refer to drawings D-6054-7, and D-6054-8 for the required plot sizes.

(4) Obtain construction data for full right-of-way width (30 ft.) of access roads.

(5) Locate and indicate a clearly defined bench mark for each facility.

(6) Identify obstructions to marker beacon restrictive zone, and determine clearing requirements.

(7) Field stake center of antenna locations.

(8) Obtain property description by metes and bounds.

(9) Coordinate power requirements with power company; power requirements for middle marker are 120/240 V ac, 3-wire, 1Ø, 5 kVA; power requirements for outer marker/COMLO are 120/240 V ac, 3-wire, 1Ø, 10 kVA.

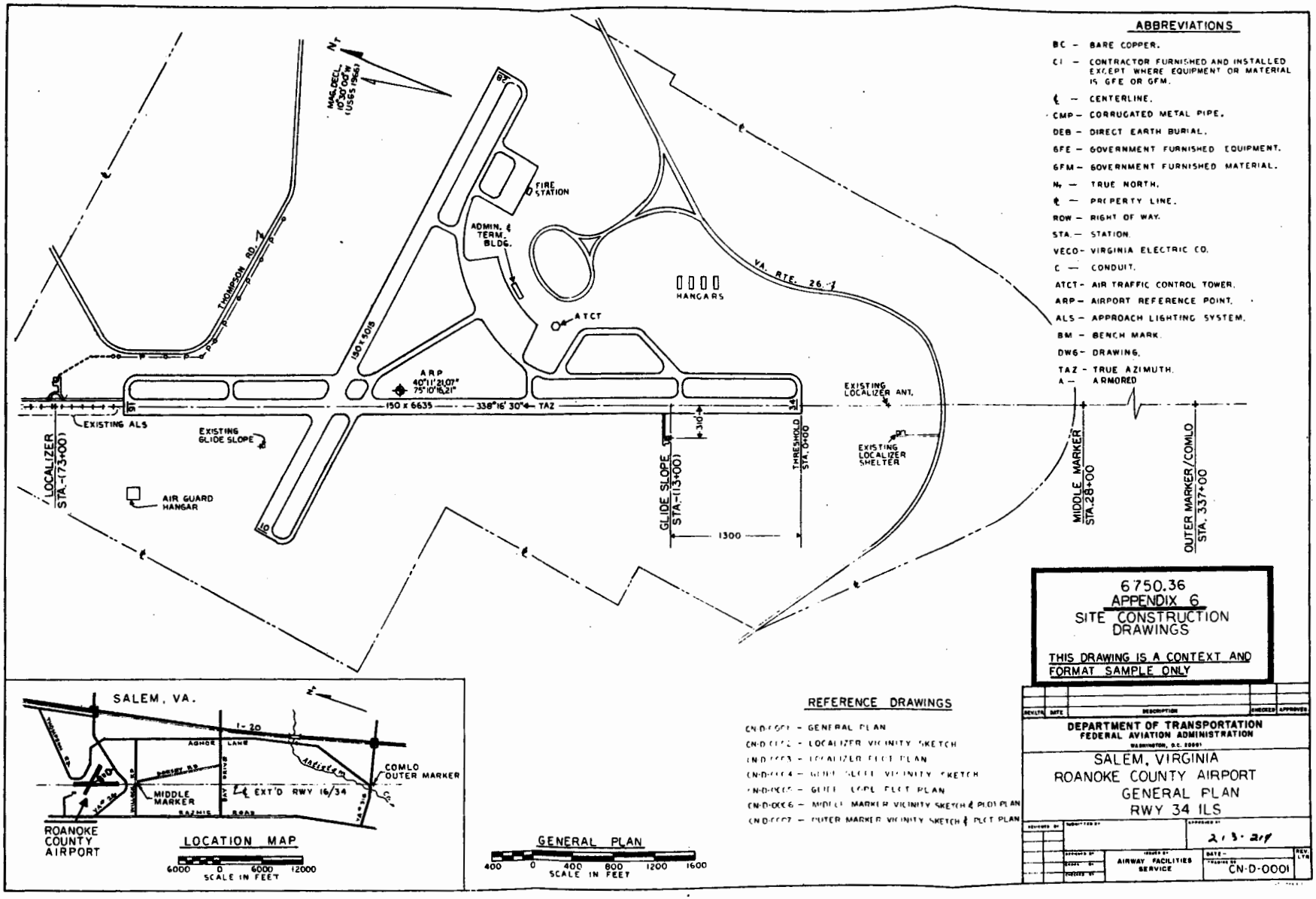
(10) Control requirements:

(a) middle marker: None.

(b) outer marker/comlo: 1 pr. to ATCT.

4. ENGINEERING REPORT AND DRAWINGS. Complete the attached ILS Project Data Checklist and prepare a site survey report indicating the proposed facility locations and construction requirements. Prepare vicinity drawings and plot plans for each facility location.

5. COORDINATION. Prior to beginning field survey work, establish liaison with sector office and airport management. Coordinate work efforts with the project engineer during the site survey investigation and prior to leaving the field.



ABBREVIATIONS

BC – BARE COPPER.
CI – CONTRACTOR FURNISHED AND INSTALLED EXCEPT WHERE EQUIPMENT OR MATERIAL IS GFE OR GFM.
℄ – CENTERLINE.
CMP – CORRUGATED METAL PIPE.
DEB – DIRECT EARTH BURIAL.
GFE – GOVERNMENT FURNISHED EQUIPMENT.
GFM – GOVERNMENT FURNISHED MATERIAL.
N_T – TRUE NORTH.
℄ – PROPERTY LINE.
ROW – RIGHT OF WAY.
STA. – STATION.
VECO – VIRGINIA ELECTRIC CO.
C – CONDUIT.
ATCT – AIR TRAFFIC CONTROL TOWER.
ARP – AIRPORT REFERENCE POINT.
ALS – APPROACH LIGHTING SYSTEM.
BM – BENCH MARK.
DWG – DRAWING.
TAZ – TRUE AZIMUTH.
A – ARMORED

REFERENCE DRAWINGS

CN-D-0001 – GENERAL PLAN
CN-D-0002 – LOCALIZER VICINITY SKETCH
CN-D-0003 – LOCALIZER PLOT PLAN
CN-D-0004 – GLIDE SLOPE VICINITY SKETCH
CN-D-0005 – GLIDE SLOPE PLOT PLAN
CN-D-0006 – MIDDLE MARKER VICINITY SKETCH & PLOT PLAN
CN-D-0007 – OUTER MARKER VICINITY SKETCH & PLOT PLAN

6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS

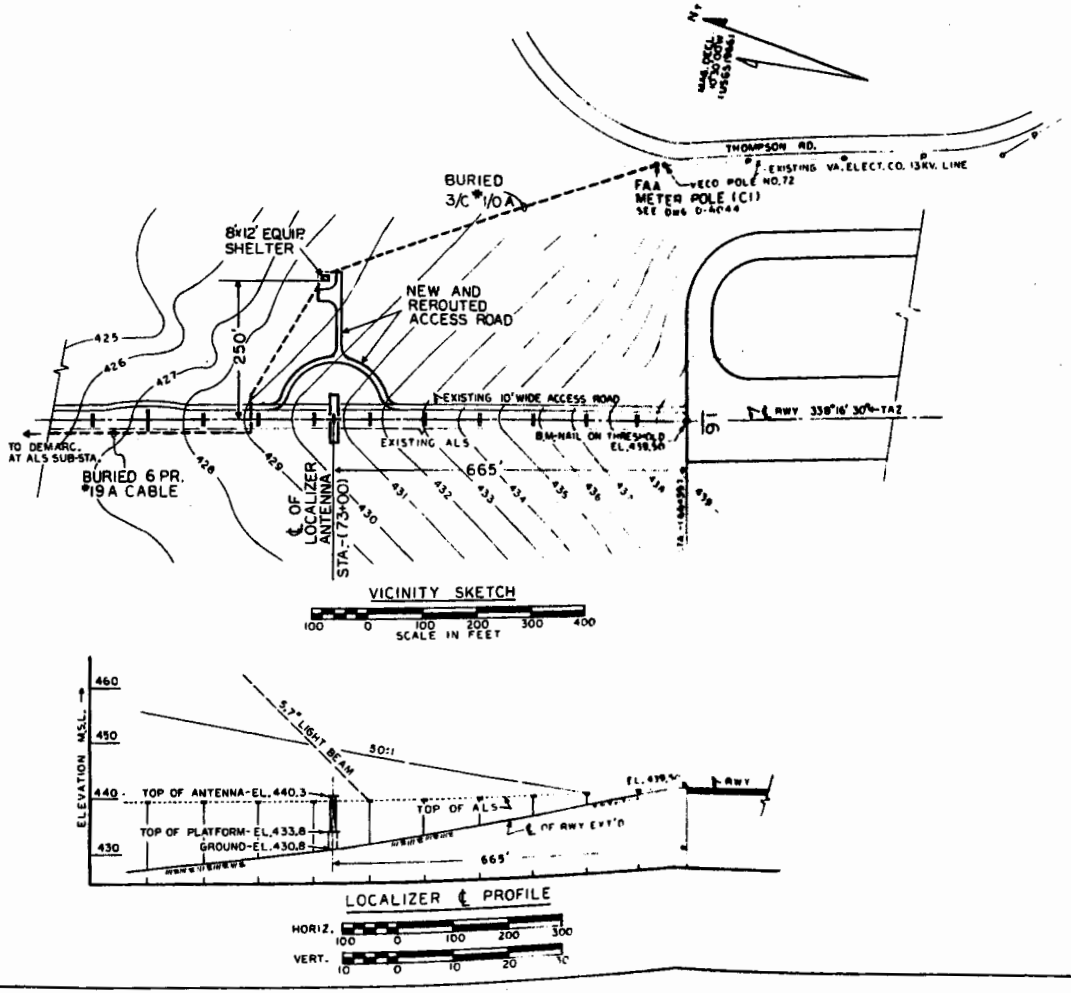
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REVISIONS				
REVTR	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
GENERAL PLAN
RWY 34 ILS

SUBMITTED BY		APPROVED BY	2·3·2[illegible]
APPROVED BY	ISSUED BY: AIRWAY FACILITIES SERVICE	DATE –	REV. LTR
DESIGNED BY		DRAWING NO. CN-D-0001	
CHECKED BY			



NOTES

1. ALL BEARINGS REFERENCED TO TRUE NORTH.
2. SEE FAA DWG D-5001-12F FOR REGULATOR SUBSTATION CONTROL CABLE CONNECTION.

REFERENCE DRAWINGS

D-6044 STANDARD LOW VOLTAGE TERMINAL POLE

OWNER: ROANOKE COUNTY AIRPORT AUTHORITY.

COOR'DS: LATITUDE: 40° 11' 52.34".
LONGITUDE: 75° 10' 30.44".

ELEVATION: TOP OF ANTENNA - 440.3'
TOP OF PLATFORM - 433.8'
GROUND AT ANTENNA - 430.8'

POWER: VIRGINIA ELECTRIC CO.
3584 PARKWOOD DR., SALEM, VA. 12345.

CONTROL: 6 PR. #19 FROM ALS SUBSTATION.

MONITOR: 6 PR. #19 FROM ALS SUBSTATION.

6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS

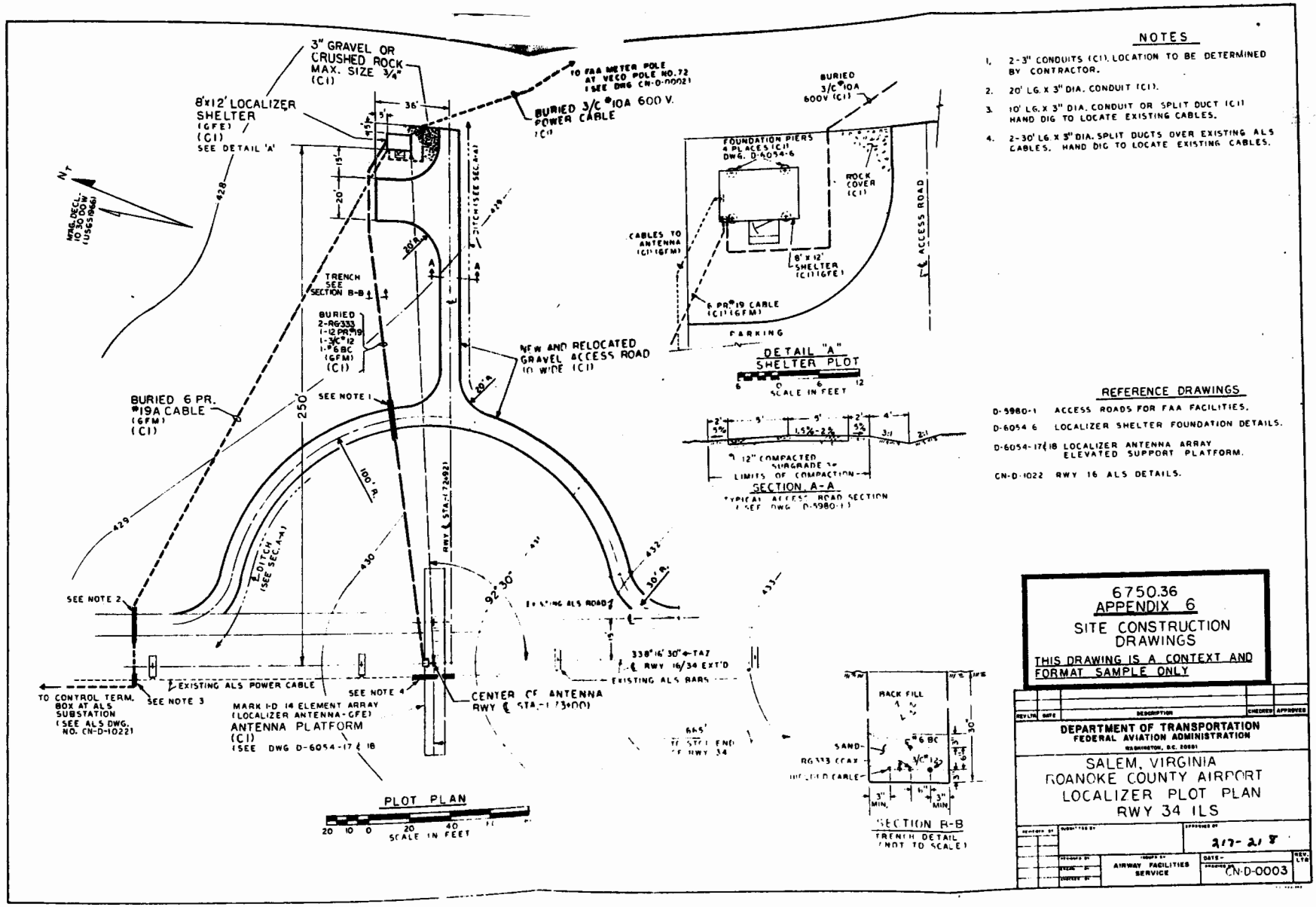
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REVISIONS	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
LOCALIZER VICINITY SKETCH
RWY 34 ILS

APPROVED BY	RECOMMENDED BY	APPROVED BY
		215-216
DESIGNED BY	PREPARED BY	DATE
DRAWN BY	AIRWAY FACILITIES SERVICE	DRAWING NO. CN-D-0002
TRACED BY		REV. LTR



NOTES

1. 2-3" CONDUITS (C1). LOCATION TO BE DETERMINED BY CONTRACTOR.
2. 20' LG. X 3" DIA. CONDUIT (C1).
3. 10' LG. X 3" DIA. CONDUIT OR SPLIT DUCT (C1) HAND DIG TO LOCATE EXISTING CABLES.
4. 2-30' LG. X 3" DIA. SPLIT DUCTS OVER EXISTING ALS CABLES. HAND DIG TO LOCATE EXISTING CABLES.

REFERENCE DRAWINGS

D-5980-1 ACCESS ROADS FOR FAA FACILITIES.

D-6054-6 LOCALIZER SHELTER FOUNDATION DETAILS.

D-6054-17 & 18 LOCALIZER ANTENNA ARRAY ELEVATED SUPPORT PLATFORM.

CN-D-1022 RWY 16 ALS DETAILS.

6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS

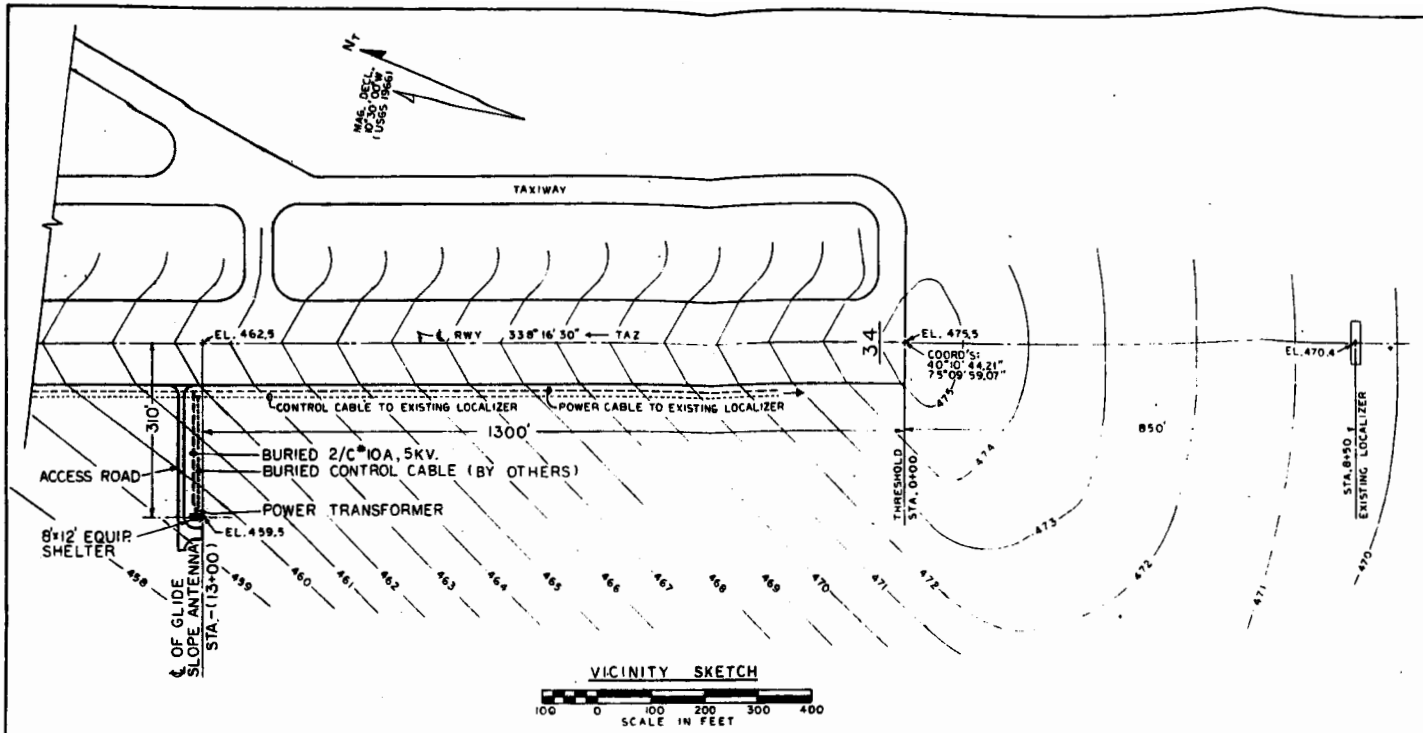
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REV. LTR	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
LOCALIZER PLOT PLAN
RWY 34 ILS

DESIGNED BY	SUBMITTED BY	APPROVED BY 2/7-21 8	
DRAWN BY	AIRWAY FACILITIES SERVICE	DATE	REV. LTR
TRACED BY		DRAWING NO. CN-D-0003	
CHECKED BY			



NOTES

1. ALL BEARINGS REFERENCED TO TRUE NORTH.

OWNER: ROANOKE COUNTY AIRPORT AUTHORITY.

COORD'S: LATITUDE: 40° 10' 55.00".
LONGITUDE: 75° 10' 09.01".

ELEVATION: TOP OF ANTENNA FOUNDATION - 460.0.
GROUND AT ANTENNA - 459.5.
RWY 34 THRESHOLD - 475.5.
RWY ℄ OPPOSITE 6.5 - 462.5.

TCH: 55'

G.S. ANGLE: 3°

POWER: VIRGINIA ELECTRIC CO.
3584 PARKWOOD DR., SALEM, VA. 12345

CONTROL: LEASED LINE.
INTERMOUNTIAN TELEPHONE CO.

MONITOR: LEASED LINE
INTERMOUNTIAN TELEPHONE CO.

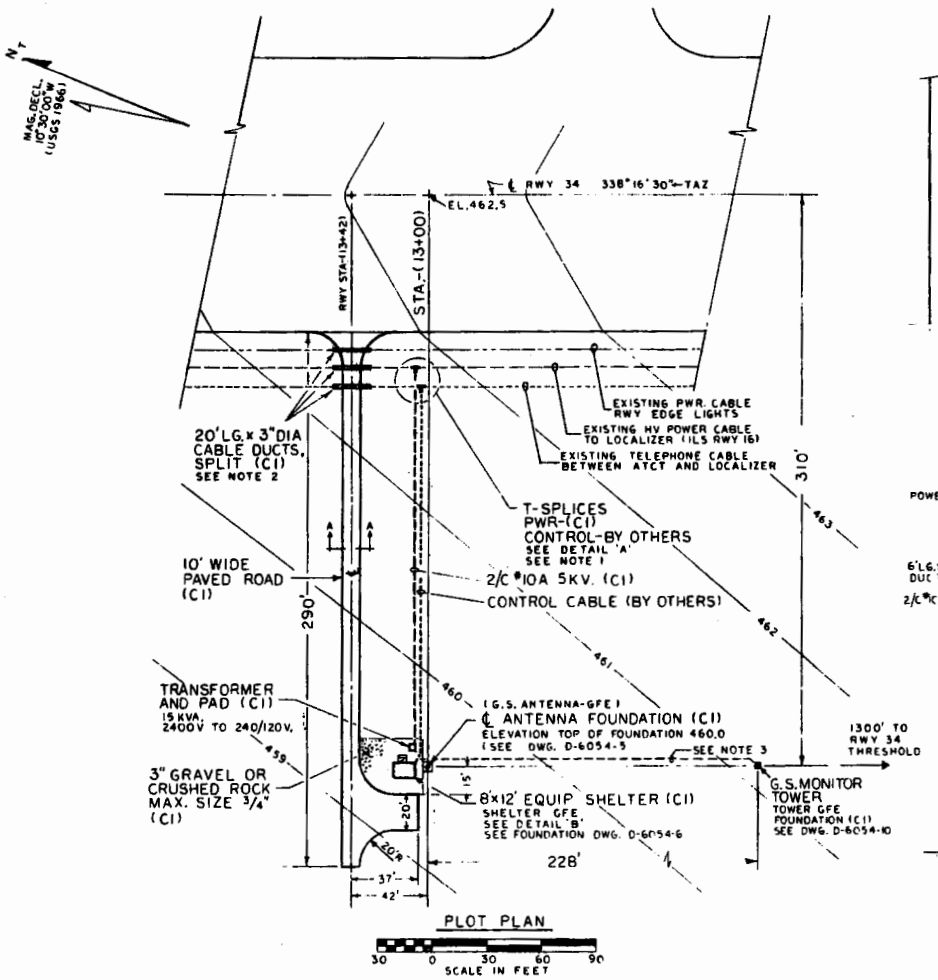
675036
APPENDIX 6
SITE CONSTRUCTION DRAWINGS
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REVISIONS			
REV. LTR	DATE	DESCRIPTION	CHECKED / APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

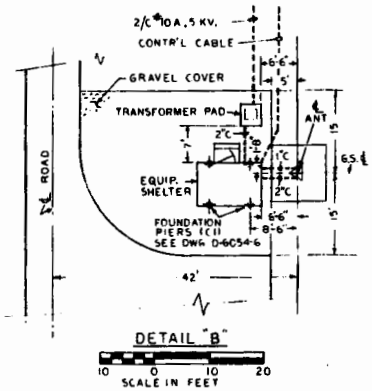
SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
GLIDE SLOPE VICINITY SKETCH
RWY 34 ILS

SUBMITTED BY: AIRWAY FACILITIES SERVICE
APPROVED BY: 219-220
DATE:
DRAWING NO. CN-D-0004
REV. LTR



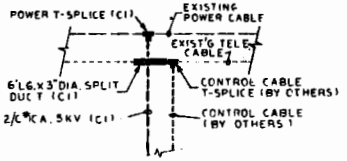
PLOT PLAN

SCALE IN FEET 30 0 30 60 90

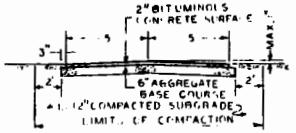


DETAIL "B"

SCALE IN FEET 10 0 10 20



DETAIL "A"



SECTION A-A

NOTES

1. CONTRACTOR SHALL HAND DIG TO LOCATE EXISTING BURIED CABLES AND INSTALL 6'LG. x 3"DIA. SPLIT DUCT.
2. HAND DIG TO LOCATE EXISTING CABLES.
3. CABLES TO G.S. MONITOR TOWER (C1).
   - 1 #6 BC (C1)
   - 1 3/C #12A, 600V. (C1)
   - 1 6 PR. 19A (6FM)
   - 1 RG 214/U (6FM)

REFERENCE DRAWINGS

D-6054-5 GLIDE SLOPE TOWER FOUNDATION.
D-6054-6 GLIDE SLOPE SHELTER FOUNDATION DETAILS.
D-6054-10 MONITOR TOWER FOUNDATION DETAILS.

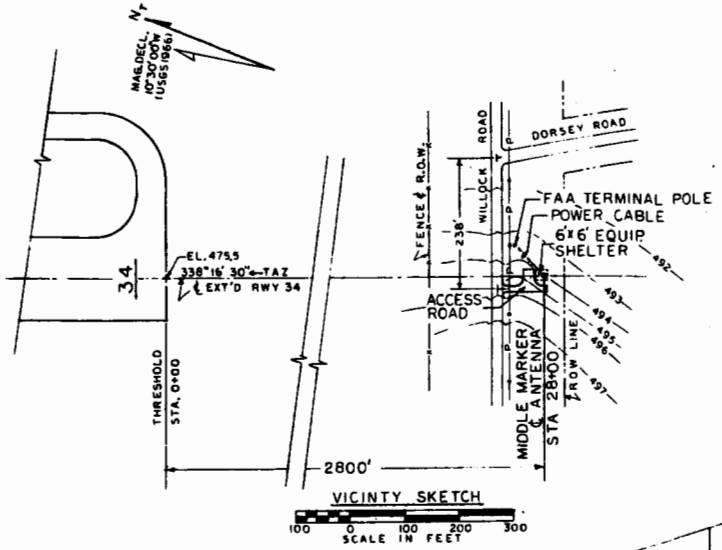
6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REVISIONS BY	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

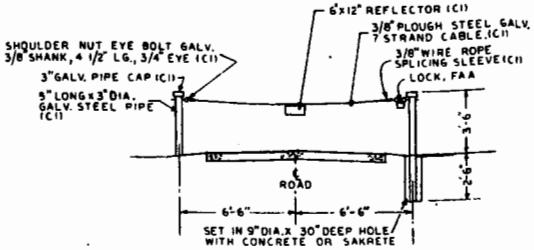
SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
GLIDE SLOPE PLOT PLAN
RWY 34 ILS

APPROVED BY 11-111			
DRAWN BY	AIRWAY FACILITIES SERVICE	DATE	REV. LTR
APPROVED BY		DRAWING NO. CN-D-0005	



VICINITY SKETCH

SCALE IN FEET 100 0 100 200 300



DETAIL "B"
CABLE BARRIER

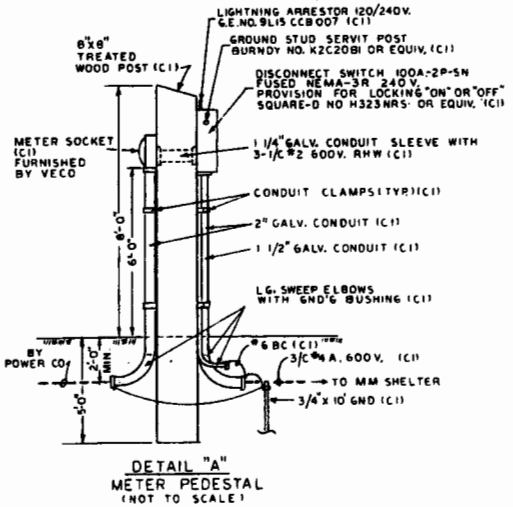
NOTES

1. INSTALL 2 RG-214 COAX. 6' ABOVE GRADE (GF,M)
2. INSTALL BURIED #6 B.C. (C1)

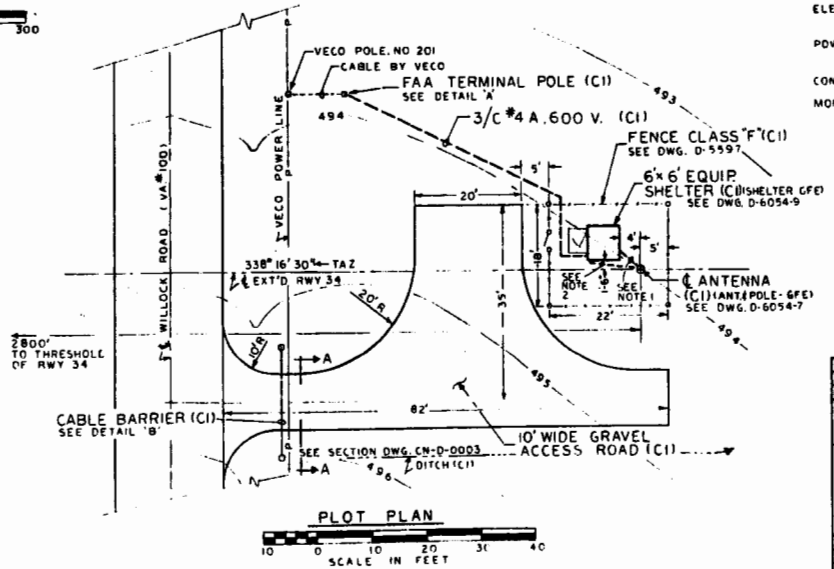
REFERENCE DRAWINGS

D-6054-9	MARKER SHELTER FOUNDATION DETAILS.
D-6054-7	TYPICAL MIDDLE MARKER PLOT LAYOUT.
D-5597	CLASS "F" FENCE DETAILS.

OWNER:	VIRGINIA DEPT OF TRANSPORTATION
COOR'DS:	LATITUDE: 40° 10' 18.53" LONGITUDE: 75° 09' 45.67"
ELEVATION:	GROUND AT ANTENNA 494.0 G.S. INTERCEPT ALT. 667.2
POWER:	VIRGINIA ELECTRIC CO. 3584 PARKWOOD DR., SALEM VA. 12345
CONTROL:	NONE
MONITOR:	NONE



DETAIL "A"
METER PEDESTAL
(NOT TO SCALE)



PLOT PLAN

SCALE IN FEET 10 0 10 20 30 40

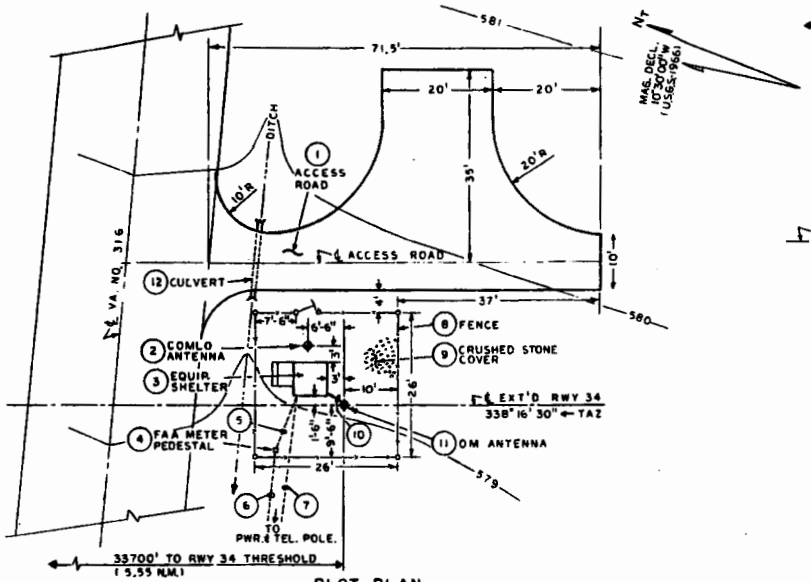
6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REVISIONS BY	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

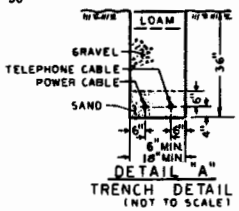
SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
MIDDLE MARKER
VICINITY SKETCH AND PLOT PLAN
RWY 34 ILS

DESIGNED BY	DRAWN BY	APPROVED BY 263-204	
APPROVED BY	ISSUED BY AIRWAY FACILITIES SERVICE	DATE -	REV. LTR
DRAWN BY		DRAWING NO. CN-D-0006	

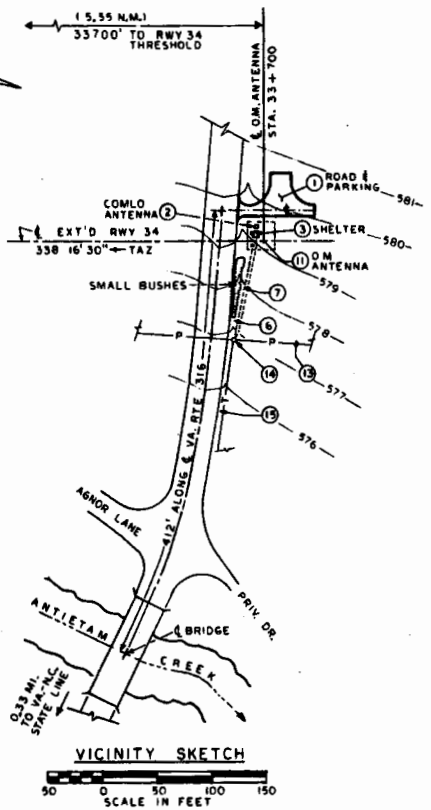


PLOT PLAN

SCALE IN FEET 10 0 10 20 30

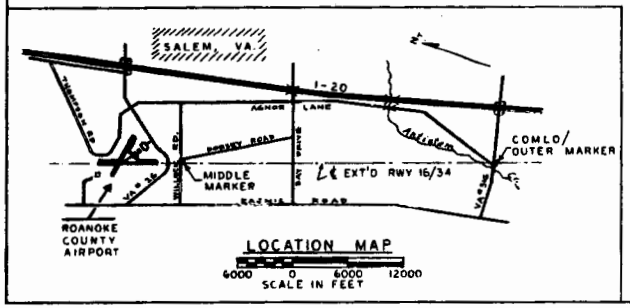


DETAIL "A"
TRENCH DETAIL
(NOT TO SCALE)



VICINITY SKETCH

SCALE IN FEET 50 0 50 100 150



LOCATION MAP

SCALE IN FEET 6000 0 6000 12000

NUMBERED LEGEND

INSTALL (1) GRAVEL ACCESS ROAD AND PARKING AREA DWG D-5980-1.
INSTALL (2) COMLO ANTENNA AND MAST (GFE).
INSTALL (3) EQUIP SHELTER, 6'x 6'. (GFE) DWG D-6054-9.
INSTALL (4) METER PEDESTAL. SEE DETAIL 'A' DWG CN-D-0006.
INSTALL (5) 3/C #4A, 600V. SEE TRENCH DETAIL 'A'.
INSTALL (6) TRENCH C1. SEE DETAIL. CABLE BY VECO.
INSTALL (7) TRENCH C1. SEE DETAIL. CABLE BY TELCO.
INSTALL (8) CLASS "F" FENCE 26'x 26' WITH 4' GATE DWG D-5597.
INSTALL (9) 4" COVER STONE OR GRAVEL INSIDE OF FENCE. MAX. SIZE 3/4".
INSTALL (10) MESSENGER CABLE (C1) WITH 2 RG-214/U (GFM).
INSTALL (11) MARKER ANTENNA AND MAST (GFE) DWG D-6054-8.
INSTALL (12) C.M.P 15" X 14' LG. DWG D-5980-2.
(13) VECO 13 KV OVERHEAD POWER LINE.
(14) UTILITY POLE. VECO #26 TELCO #A-49-C.
(15) TELCO OVERHEAD TELEPHONE LINE.

REFERENCE DRAWINGS

D-5597	CLASS "F" FENCE DETAILS.
D-6054-8	TYPICAL OM/COMLO PLOT LAYOUT.
D-5980-1&2	ACCESS ROADS AND DRAINAGE, FAA FACILITIES.
D-6054-9	MARKER SHELTER FOUNDATION DETAILS.

OWNER: WILLIAM C. AGNOR
COOR'DS: LATITUDE: 40° 05' 35.1"
LONGITUDE: 75° 07' 18.0"
ELEVATION: GROUND AT ANTENNA 579.0
G.S. INTERCEPT ALT. 2323
POWER: VIRGINIA ELECTRIC CO.
3584 PARKWOOD DR. SALEM, VA. 12345
CONTROL LEASED LINE
INTERMOUNTAIN TELEPHONE CO.
MONITOR: LEASED LINE
INTERMOUNTAIN TELEPHONE CO.

6750.36
APPENDIX 6
SITE CONSTRUCTION DRAWINGS
THIS DRAWING IS A CONTEXT AND FORMAT SAMPLE ONLY

REV. LTR	DATE	DESCRIPTION	CHECKED	APPROVED

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

SALEM, VIRGINIA
ROANOKE COUNTY AIRPORT
COMLO/OUTER MARKER
VICINTY SKETCH AND PLOT PLAN
RWY 34 ILS

APPROVED BY	MODIFIED BY	APPROVED BY 225-226	
DESIGNED BY	AIRWAY FACILITIES SERVICE	DATE —	REV. LTR
DRAWN BY		DRAWING NO. CN-D-0007	
CHECKED BY			

APPENDIX 7. SAMPLE SITE SURVEY REPORT

SITE SURVEY REPORT

ROANOKE COUNTY AIRPORT

SALEM, VIRGINIA

CATEGORY I INSTRUMENT LANDING SYSTEM

RUNWAY 34

PREPARED BY:

FEDERAL AVIATION ADMINISTRATION

CONTINENTAL REGION

ACN-440

This Document is a Context and Format Sample Only

TABLE OF CONTENTS

I. INTRODUCTION.

1.0 GENERAL.

1.1 This report concerns the proposed ILS installation at Roanoke County Airport, Salem, Virginia, which will serve rwy 34.

1.2 The airport is located approximately 3.0 miles southwesterly from Salem, Virginia.

1.3 The airport is owned by Roanoke County, Virginia, and is operated under the jurisdiction of the Roanoke County Airport Commission.

2.0 AGENCIES AND PERSONNEL.

2.1 FAA Facilities

a. Mr. John Smith, Sector Manager
Phone: (800) 765-6538

b. Control Tower
Mr. Fred Williams, Tower Chief
Phone: (800) 765-6543

c. Mr. Tom Davis, FAA Technician
Phone: (800) 765-4954

d. Mr. William Martin, ADO Chief
Phone: (800) 765-4849

2.2 Sponsor

Roanoke County Airport Commission
2250 Patterson St.
Salem, Virginia 12345

Mr. William Underwood, Airport Manager
Phone: (800) 761-2200

2.3 Airport Engineering Consultant

Harper and Rose, Inc.
65 Congress St.
Salem, Virginia 12345

(Prepared Master Plan)
Phone: (800) 765-1234

2.4 Utilities

a. Virginia Electric Co.
3584 Parkwood Drive
Salem, Virginia 12345

Mr. Steve Halpern
Service Representative
Phone: (800) 765-6756

b. Inter Mountain Telephone Co.
64 E. Main St.
Salem, Virginia 12345

Mr. Ralph Delpero
Field Engineer
Phone: (800) 765-8000

3.0 INSURANCE.

The limits of liability insurance for construction and installations contractors working on the Roanoke County Airport are $2,000,000/$3,000,000.

II. DISCUSSION.

1.0 AIR TRAFFIC.

1.1 There are presently 3 published approach plates for Roanoke County Airport. These plates include ILS rwy 16, NDB rwy 16, VOR rwy 10.

1.2 There were approximately 5100 operations during the month of November 1975. Columbia and Commuter Airlines are the two major commercial carriers at Roanoke County Airport.

2.0 REFERENCE DATA.

2.1 Airport Plan

a. Airport Layout Plan
Roanoke County Airport
ILS NW-SE RWY

b. ILS NW-SE RWY
General Plan

2.2 Obstruction Chart

a. OC 001 Obstruction Chart
Roanoke County Airport
Field Survey September 1973

2.3 Topographic Maps

a. USGS Abington, Va.

b. USGS Blacksburg, Va.

c. USGS Cromwell, Va.

2.4 FAA Approach Plate

a. AL-20 (FAA)

1. ILS RWY 16

2. NDB RWY 16

3. VOR RWY 16

2.5 Local Maps and Deeds

a. Assessment Plate 141-A
Town of Blacksburg, Va.

b. Assessment Plate 130
Town of Abington, Va.

c. Chamber of Commerce Area Map
Salem, Virginia

3.0 LOCALIZER.

3.1 A Mark Id 14-Element Traveling Wave Localizer Antenna is recommended for installation on the rwy 16/34 centerline extended 665 feet from the threshold of rwy 16. The location places the localizer in the rwy 16 ALS system between the light bar located 600 feet from the rwy 16 threshold and the light bar located 700 feet away. A 3-foot platform will be required in order to provide line of sight between the localizer antenna elements and the 55-foot threshold crossing height.

3.2 The recommended localizer location is 665 feet from the stop end of rwy 34 at Station - (73+00). This location situates the antenna in the rwy 16 light lane. The coordinates of the recommended antenna position are:

Latitude: 40° 11' 52.34" N
Longitude: 75° 10' 30.44" W

The ground elevation at the localizer antenna is 430.8 feet msl. The elevation of the rwy 16 threshold and the top of the rwy 16 ALS system is 439.5 feet msl. A platform height of 3.0 feet will place the localizer antenna at 440.3 feet msl. The elevation of the 50:1 approach surface at station -(73+00) is 448.8 feet msl. The adjacent ALS light bar is set at an angle of 5.7° and the elevation of the beam at the localizer point, station -(73+00), is 446.0 feet msl.

Locating the localizer antenna closer to the runway was also examined. Unsuitable soil for construction prevents the localizer from being located at a closer distance. The ALS light bars in this area have special foundations. Positioning the antenna at a further distance from the runway would require a high platform to be constructed because of the manner in which the terrain drops off.

3.3 The derogating sources at this localizer site are the ALS light bars and the Virginia Air National Guard hangar located approximately 1100 feet away on a line bearing 45° to the right of the front course centerline.

3.4 It is recommended that the electronic equipment shelter be located 250 feet from the centerline of the antenna on a line bearing 92.5° counterclockwise from the front course.

3.5 A gravel access road 10 feet wide and approximately 130 feet in length will be required from the rerouted ALS access road to the localizer equipment shelter. In addition, it will be necessary to reroute approximately 315 linear feet of the existing ALS access road in order that the road will clear the antenna. The construction (cross section and profile) and finished elevation of the relocated road should be the same as the existing road. This relocation is indicated on the Localizer Vicinity Sketch, Drawing CN-D-0003. A 3-inch gravel or crushed rock cover should be placed on the area under and around the shelter.

3.6 The primary power source for the localizer is from the Virginia Electric Co. pole number 72 located to the south side of Thompson Road. This is the closest power source available. Virginia Electric will provide a step-down transformer on their pole number 72 and provide 120/240 V ac, single-phase, 3 wire 15 kVA power. An FAA meter pole will be required 10 feet from the power company pole. From the FAA terminal pole to the localizer equipment shelter approximately 675 feet of 3/C, #1/0 600V armored cable will be required.

An alternate power cable routing would be from the rwy 16 ALS substation. This would require a cable run of greater than 1300 feet with transformers at both ends.

3.7 It is proposed that control and monitoring be maintained by multiconductor cable to the control tower. A 26 pair, #19 armored control cable exists between the equipment building at the ALS substation and the control tower. According to Mr. Tom Davis, FAA maintenance technician, there should be ten (10) spare control pairs available at the ALS substation. It is recommended that a 6-pair shielded #19 cable be buried from the ALS equipment building to the localizer shelter.

3.8 The localizer site will lie entirely on the property of Roanoke County Airport. Perimeter fencing currently exists along the airport boundary lines. Therefore, no special security requirements will be required at the localizer site.

3.9 Examination of the area reveals no subsurface rock formations or outcrop that would affect construction. The airport engineer indicated that soil conditions in this area are favorable, and no difficulty should be encountered during construction. He stated that the area consists of fill and that regular trenching methods can be employed.

An antenna platform with a top elevation of 433.8 feet msl should be constructed for mounting the localizer antenna. Foundations should be designed for a frost depth of 5 feet. Other site preparation will be limited to leveling of the shelter area and minor grading to divert water away from the foundation slabs.

3.10 There is no planned construction that would affect the performance of the localizer site.

3.11 The environmental factors at the localizer site have been considered. Construction should be limited to the removal of ground cover weeds and grass. No adverse effects on the ground water are anticipated. The project should provide for appropriate environmental safeguards during construction and adherence to state and local requirements as to air, water, and dust.

4.0 GLIDE SLOPE.

4.1 It is proposed that a null reference glide slope facility be installed to serve rwy 34. Extensive site preparation has been accomplished under the ADAP program for this project. The existing grading plan can be found on the glide slope vicinity sketch Drawing CN-D-0004. Smooth terrain exists forward of the glide slope antenna for 1300 feet. Obstruction

and traffic considerations prevent placing the proposed glide slope antenna on the opposite side of rwy 34.

A glide slope angle of 3^{o} and a threshold crossing height of 55 feet is recommended.

4.2 The glide slope facility antenna will be located 310 feet left (westerly side) of the rwy 34 centerline and 1300 feet inbound (opposite station -(13+00), from the rwy 34 threshold. The coordinates of the antenna position are:

Latitude: 40^{o} 10' 55.00" N
Longitude: 75^{o} 10' 09.01" W

The ground elevation at the antenna location is 459.5 feet msl. The elevation of the rwy 34 centerline at station -(13+00) is 462.5 feet msl.

4.3 The average runway centerline slope near the rwy 34 threshold end is +1.0%. Using equation 3-5 of Order 6750.16A (chapter 3, paragraph 28e(5)(d)), the longitudinal distance (d) which is the distance behind the runway threshold at which the glide slope should be located was computed as follows:

$$d = \frac{TCH}{\tan \theta - (S)} = \frac{55}{\tan 3^{o} - (.01)} = 1300 \text{ feet}$$

Using this distance, the required elevation difference at d is determined to be:

$$e = TCH - d \tan \theta = 55 - 1300\ (0.05241) = 13.1 \text{ feet}$$

From survey data of the runway the actual elevation difference is 13.00 feet and hence a distance of 1300 feet is recommended.

The lateral distance of 310 feet was chosen in order to accommodate the glide slope mast height and to provide adequate separation between the glide slope and the rwy 34 centerline. For a lateral distance of 310 feet, the allowable mast height is 37 feet. In addition there is a difference in elevation between the rwy 34 centerline at Station -(13+00) and proposed glide slope site after grading of 3 feet, thus a maximum mast height of 40 feet is allowable.

Since the lateral terrain is uniformally graded, conforming to the minimum grading criteria, correction for the lateral slope is not required. (Order 6750.16A, chap. 3, para. 28e(6)(a)).

The terrain directly in front of the glide slope site has a positive longitudinal slope of 1.0%. When the glide slope antenna is installed, it will be necessary to adjust the antenna element for 2.4° in order to correct for this positive slope.

Based on tabulated data found in "Installation Instructions for Category I and Category II ILS Glide Slopes" 6750.6B, table 2, chap. 2, paragraph 10, a 2.4° glide angle requires an upper antenna height of 35.3 feet. The additional 2 feet required in order to accommodate the obstruction lights will yield a total height of 37.3 feet, which is below the maximum allowable mast height.

Derogations can be expected in the form of changes in the path length and relative phase of the ground-reflected signal because of the terrain irregularities in front of the glide slope antenna at a distance in excess of 1300 feet. It is not economically feasible to grade further than the 1300 foot distance forward of the glide slope antenna.

4.4 The glide slope equipment shelter and a 15 kVA transformer pad should be located as shown by the Glide Slope Plot Plan Drawing CN-D-0005. A 21 feet x 32 feet area (exclusive of the paved access roadway and turnaround parking area) under and around the equipment shelter should be covered with 3 inches of gravel or crushed stone. The maximum size of the gravel or crushed stone should be 3/4 inches.

4.5 A 10-feet wide access road 244 feet in length and a 20-feet wide turn/around parking area will be required. The centerline of the roadway begins at the west edge of the rwy 34 pavement at the point opposite Station ÷(13+42), 1342 feet from the rwy 34 threshold, and extends perpendicularly from the rwy 16 edge a distance of 290 feet. Three, 3-inch diameter, 20-feet long split cable ducts will be required where the proposed access roadway will cross over existing cables. The location of these cable ducts is shown on Drawing CN-D-0005.

4.6 It is recommended that power for the glide slope equipment be taken from the existing FAA 2/C #10,5000V power cable using a "T" splice connection. From the "T" splice connection, it is recommended that 200 feet of 2/C #10, 5 kV, DEB cable be trenched to a 15 kVA transformer. Approximately 200 feet of trenching will be required. Hand digging is required to locate the existing cables. Other potential power sources are available on the east side of rwy 16/34. The disadvantages of this approach include excessive cable runs and the unavailability of cable ducts.

4.7 Control and monitoring of the glide slope facility will be required. A telephone cable extends from the terminal building to the rwy 16 localizer equipment shelter. Mr. Ralph Delpero of the Inter Mountain Telephone (IMT) Company indicated that 3 spare pairs of Number 22 cable are available in this line. The telephone company will install the required splice and cable in a trench layed open by the contractor to the proposed glide slope equipment shelter. The telephone company requires at least two months advance notice prior to installation. The required service should be ordered through:

Mr. Ralph Delpero
Field Engineering
Inter Mountain Telephone Co.
64 E. Main St.
Salem, Virginia

Phone: (800) 765-8000

4.8 The proposed glide slope facility is within the airport boundaries and does not require fencing.

4.9 Examination of the site and the previous work in the area of the airport indicates no hidden or outcrop rock that would effect the construction or trenching.

4.10 There are no known construction plans that would affect the operation of the proposed glide slope.

4.11 Approach surface penetrations are shown on OC 001. The 50:1 final approach surface to rwy 34 is clear of obstructions.

4.12 The environmental factors at the glide slope site have been considered. Construction should be limited to the removal of ground cover weeds and grass. No adverse effects on the ground water are anticipated. The project should provide for appropriate environmental safeguards during construction and adherence to state and local requirements as to air, water, and dust.

5.0 MIDDLE MARKER.

5.1 The recommended middle marker location is 2800 ft. from the rwy 34 threshold with the antenna located directly on the runway centerline extended. This location offers a decision height of 191.7 feet. (This is also the height above the touchdown zone). The coordinates of the middle marker location are:

Latitude: 40° 10' 18.53" N
Longitude: 75° 09' 45.67" W

5.2 The proposed middle marker is located in the right of way of Virginia State Route 100 (Willock Road). Mr. Thomas Jackson of the Virginia Department of Transportation was contacted regarding the availability of the site. Lease arrangements should be made through:

Mr. Thomas Jackson
Right of Way Office
Virginia Department of Transportation
Roanoke, Virginia

Phone: (800) 761-6432

The possibility of locating the middle marker on airport property was also investigated. The airport property line is approximately 200 ft. to the north of the proposed site. This area is less desirable for the following reasons.

5.2.1 There is severe terrain discontinuity in this area with evidence of rock outcrop.

5.2.2 Since the closest available power is located on the south side of Willock Road, electrical service would have to be poled over or jacked under this road in order to provide electric service to a site on airport property.

5.2.3 The highest decision height a site on airport property would offer is 191.2 feet.

5.3 The environmental factors at the middle marker have been considered.

5.3.1 The size and location for the site were chosen so as to occupy the least amount of land consistent with providing proper facility performance.

5.3.2 VHF channels 2, 4, 5, 9, 11, and 13 are transmitted in the area. The nearest home with a tv antenna is located approximately 500 feet southeasterly from the marker site. This is not considered a television fringe reception area.

5.3.3 No clearing or tree removal is required for the site.

5.4 The nearest obstruction to the middle marker site is an overhead power line approximately 25 feet high located 65 feet to the north of the middle marker antenna.

5.5 A 10-foot wide gravel or crushed stone access road approximately 82 feet in length will be required. The centerline

of the road will intercept Virginia State Route 100 (Willock Road) 238 feet west of the intersection of Willock Road and Dorsey Road. A 20-foot wide turnaround/parking area of the same construction as the access road will be required. The location and construction of this access road and parking area is shown on the Middle Marker Vicinity Sketch and Plot Plan, Drawing CN-D-0006. Before compaction of the roadway sub-base, the top soil should be removed and disposed of as directed by the FAA Technical Representative.

5.6 Power for the middle marker shall be obtained from a stub meter pole to be installed 10 feet to the south of the Virginia Electric Company pole Number 201, located on the south side of Willock Road. From the stub meter pole, approximately 70 feet of buried power cable will be required to the middle marker equipment shelter. The cable will be operated at 120/240 V ac, single phase.

The Virginia Electric Company will provide underground service from their pole number 201 to the stub meter pole, along with any high voltage connectors required. In addition V.E.C. will furnish and install the transformer, secondary cable from the transformer to the stub pole, and the meter.

The contractor will provide and install the stub meter pole per detail "A" on Drawing CN-D-0006, terminate the connections at the meter socket, and provide trenching, backfill and ducting. The contractor will extend service from the meter to the facility.

The power requirements for this site have been discussed with the power company and arrangements for service should be made through:

Mr. Steve Halpern
Virginia Electric Company
Service Representative
3584 Parkwood Drive
Salem, Virginia 12345

There are no intervening underground utilities that will conflict with power cable installation.

5.7 The location of the equipment shelter associated with the middle marker is shown on Drawing CN-D-0006. The type of system represented in this drawing is the Mark Id.

5.8 The marker site is located off of airport property. A class "F" chain link fence is recommended to secure the middle

marker. The location and length of fence required is shown on drawing CN-D-0006.

5.9 The 18 foot x 22 foot middle marker plot should be covered with 3 inches of gravel or crushed stone. This area embraces 396 square feet. The maximum size of the crushed stone should be 3/4 inch. The vegetation must be removed from the surface, the surface sterilized with Hyvar, and the placed gravel or crushed stone compacted.

5.10 Remote control or monitoring of the middle marker is not required.

5.11 Examination of the site does not reveal unusual soil conditions that would seriously impact construction. Ground probings were made at 25-foot intervals along the proposed cable run. Refusal was not encountered at a depth of three feet.

6.0 OUTER MARKER/COMLO.

6.1 The outer marker/compass locator (LOM) will be located 33,700 ft. (5.55 nautical miles) from the rwy 34 threshold. The marker antenna location is directly on the rwy 34 centerline extended.

The coordinates at the LOM site are:

Latitude: 40° 05' 35.1" N
Longitude: 75° 07' 18.0" W

This outer marker location will provide a glide slope intercept altitude of 2323 feet msl. The ground elevation at the site is 579 feet msl. This glide slope intercept elevation includes 26.3 foot correction for earth curvature. The site drawings are designed for use with a Mark Id outer marker and a compass locator. The OM/COMLO Vicinity and Plot Plan is shown on Drawing CN-D-0007.

6.2 The proposed OM/COMLO site is located in Norton, Virginia, on property owned by Mr. William Agnor. The site is situated on an undeveloped cleared tract of land. No other locations were investigated since this one offers an optimum glide slope intercept altitude and is situated directly on the rwy 34 centerline extended. Mr. Agnor is agreeable to discussing lease arrangements and can be contacted at:

RD #1 Norton, Virginia
Phone: (800) 761-8585

6.3 The environmental factors at the OM/COMLO have been considered.

6.3.1 The size of the plot (26 feet x 26 feet) has been selected as the minimum that would provide a properly performing OM/COMLO.

6.3.2 VHF television channels 2, 4, 5, 7, 9, 11, and 13 are transmitted in the area. The nearest home with a television antenna is that of the property owner, Mr. Agnor. It is located approximately 350 feet to the southwest of the OM/COMLO site. The area is not a television fringe reception area.

6.3.3 No removal of trees is required.

6.4 The nearest obstruction in the vicinity of the OM/COMLO site is an overhead telephone line approximately 30 feet high located 90 feet west of the outer marker antenna. Although the location of this line violates the siting guidelines of Order 6750.16A, regional electronics engineers indicate that the system will perform properly.

6.5 A 10 foot wide gravel or crushed stone access road approximately 71.5 feet in length will be required. The centerline of the proposed road will intersect Virginia State Route 316 at a point 412 feet east of the center of Antietam Bridge.

A 20 foot wide turnaround/parking area of the same construction as the access road will be required. The location and construction of this access road and parking area is shown on the OM/COMLO Vicinity Sketch and Plot Plan, Drawing CN-D-0007. Before compaction of the roadway sub-base, the top soil should be removed and disposed of as directed by the FAA Technical Representative.

6.6 Power for the OM/COMLO facility should be obtained from a stub meter pole to be installed on the corner of the OM/COMLO plot, approximately 89 feet from the existing Virginia Electric Company pole number 26 as shown on Drawing CN-D-0007. The contractor should provide and install the stub meter pole per detail "A" on Drawing CN-D-0006, orienting it so that the meter can be read from outside the security fence.

The Virginia Electric Company will provide underground service from pole number 26 to the stub pole, along with any high voltage connectors required. In addition V.E.C. will furnish and install the transformer, secondary cable from the transformer to the stub pole, and the meter.

The power requirements for this site have been discussed with the power company and arrangements for service should be made through:

Mr. Steve Halpern
Virginia Electric Company
Service Representative
3584 Parkwood Drive
Salem, Virginia 12345

There are no intervening underground utilities that will conflict with power cable installation.

6.7 The location of the equipment shelter associated with the OM/COMLO is shown on site construction drawing CN-D-0007. This equipment shelter will contain the transmitters for the outer marker and the compass locator.

6.8 The OM/COMLO site is located off of airport property. A class "F" chain link fence is recommended to secure the site. The location and length of fence required is shown on drawing CN-D-0007.

6.9 The 26 foot x 26 foot OM/COMLO plot should be covered with 3 inches of gravel or crushed stone. This area embraces 676 square feet. The maximum size of the crushed stone should be 3/4 inch. The vegetation must be removed from the surface, the surface sterilized with Hyvar, and the placed gravel or crushed stone compacted.

6.10 The OM/COMLO will be monitored via leased land lines from IMT. IMT will extend a control cable from their pole number A-49C to the OM/COMLO facility. The contractor will provide the cable trench and the backfill.

The telephone cable requirements for this site have been discussed with the telephone company. Arrangements for service should be made through Mr. Delpero.

6.11 Ground probings were taken along the proposed cable route to the OM/COMLO shelter. Refusal was not encountered at a depth of three feet.

7.0 REMOTE STATUS MONITORING EQUIPMENT.

Facility Name: FAA Airport Traffic Control Tower, Roanoke County Airport, Salem, Virginia.

Recommended Antenna Mount Locations: Antenna should be mounted on the control cab roof.

Recommended Receiver Locations: The receivers will be installed in the existing equipment racks located in the equipment room beneath the control cab (several "C" panels are available in the racks).

Recommended Status Indicator Unit Location: The status indicator should be installed in the existing console in the control cab.

Recommended Antenna/Receiver Cable Route and Approximate Length: The antenna cable should be routed through the cab roof and floor to existing cable racks in the equipment room. Approximately 75 feet of cable will be required.

Recommended Receiver/Indicator Cable Route and Approximate Length: The indicator cable should be routed from the cable racks up through the cab floor to the indicator unit location. Approximately 50 feet of cable will be required.

Recommended Power Source: Power is available at the equipment racks in the equipment room at 120 V ac.

8.0 WAIVERS.

8.1 Localizer

No waivers will be required.

8.2 Glide Slope

No waivers will be required.

8.3 Middle Marker

No waivers will be required.

8.4 Outer Marker/Compass Locator

No waivers will be required.

9.0 DESIGN DRAWINGS.

Drawing No.	Title
CN-D-0001	General Plan Salem Virginia, Roanoke County Airport.
CN-D-0002	Localizer Vicinity Sketch Rwy 34 Salem Virginia, Roanoke County Airport.

Drawing No.	Title
CN-D-0003	Localizer Plot Plan Rwy 34 Salem Virginia, Roanoke County Airport.
CN-D-0004	Glide Slope Vicinity Sketch Rwy 34 Salem Virginia, Roanoke County Airport.
CN-D-0005	Glide Slope Plot Plan Rwy 34 Salem, Virginia, Roanoke County Airport.
CN-D-0006	Middle Marker Vicinity Sketch & Plot Plan Rwy 34 Salem Virginia, Roanoke County Airport.
CN-D-0007	OM/COMLO Vicinity Sketch & Plot Plan Rwy 34 Salem Virginia, Roanoke County Airport.

APPENDIX 8. ILS EQUIPMENT REQUIREMENTS

FIGURE 1. CATEGORY I AND II ILS EQUIPMENT REQUIREMENTS

Equipment and Location Requirements	Category I Operation	Category II Operation
1. Landing Minimums.		
a. With approach light system installed.	Operations down to a minimum of 200 feet DH, 2400 feet RVR, and where authorized to 1800 feet RVR.	Operations down to a minimum below 200 feet DH and 2400 feet RVR, and to as low as 100 feet DH and 1200 feet RVR.
b. Without approach light system installed.	Operations down to a minimum of 250 feet DH and 3/4 mile.	Not authorized.
2. Localizer.	1 transmitter	2 transmitters required to commence operations. If one transmitter fails during Category II weather conditions, operation may continue.
a. Location.	Zone 1, 2, or 3 (see figure 2-6 Order 6750.16A.)	Zone 1 only.
b. Power Requirements.	Configuration A (continuous power airport (CPA) runway); Configuration C (non-CPA runway). SEE NOTE 1.	Configuration A (continuous power airport (CPA) runway): Configuration C (non-CPA runway and/or second Cat. II ILS on airport). SEE NOTE 1.
3. Far Field Monitor.	Not required.	Required, Category II not authorized if failure occurs.
4. Glide Slope.	1 transmitter	2 transmitters, required to commence operations (same as localizer above).

Equipment and Location Requirements	Category I Operation	Category II Operation
(Glide Slope Con't)		
a. Location.		
(1) Longitudinal.	Function of TCH, glide angle, and terrain.	Same as Category I.
(2) Lateral.	Min. 250 feet, max. 650 feet.	Min. 400 feet, max. 650 feet.
b. Power Requirement.	Same as localizer above.	Same as localizer above.
5. Near Field Monitor.	Required with all image type systems.	Same as Category I.
6. Inner Markers.	Not required.	Required for operations below 1600 feet RVR.
a. Location.	Not applicable.	At the 100 feet DH point. Within 25 feet radius from this point permitted without a waiver.
b. Power Requirement.	Not applicable.	Same as localizer above.
7. Middle Marker.	Required for lowest authorized Category I minimums.	Not required for Category II operation, but is required if system operated as Category I.
a. Location.	At the DH point; ±300 feet lateral; ±500 feet longitudinal deviation from this point permitted.	Not applicable.
b. Power Requirement.	Same as localizer above.	Same as localizer above.
8. Outer Marker.	Required, but may be substituted by radar or other final approach fix.	Same as Category I.

Equipment and Location Requirements	Category I Operation	Category II Operation
(Outer Marker Con't)		
a. Location.	At the glide slope intercept nominally 4 to 7 nautical miles from rwy threshold; ±800 feet longitudinal and lateral deviation permitted. Consult Flight Standards for each siting.	Same as Category I.
b. Power Requirement.	Same as localizer above.	Same as localizer above.
9. COMLO/NDB.	Installed if operationally required.	Same as Category I.
a. Location.	Collocated with outer marker (COMLO). Separate facility (NDB).	Same as Category I.
b. Power Requirement.	Same as localizer above.	Same as localizer above.
10. DME.	Used where outer marker site is unavailable.	Same as Category I.
a. Location.	At the localizer site.	Same as Category I.

NOTE 1. See Order 6030.20 for descriptions of power configurations.

FACILITY / EQUIPMENT TYPE	RECONFIGURED TUBE TYPE	MARK Ia	MARK Ib	MARK Ic	MARK Id	MARK Ie	AN/GRN-27-2B
1. LOCALIZER							
a. TYPICAL SHELTER PLOT SIZE.	50 FT. X 50 FT.	50 FT. X 50 FT.	50 FT. X 50 FT.	50 FT. X 50 FT.	50 FT. X 50 FT.		50 FT X 50 FT
b. SHELTER SIZE	8 FT. X 10 FT.	8 FT. X 12 FT.	8 FT. X 12 FT.	8 FT. X 12 FT.	8 FT. X 12 FT		8 FT. X 12 FT
c. POWER REQUIREMENTS.	120/240V 1Ø 3 WIRE 25 KVA (NOTE 3)	120/240V 1Ø 3 WIRE 15 KVA (NOTE 3)	120/240V 1Ø 3 WIRE 15 KVA (NOTE 3)	120/240V 1Ø 3 WIRE 15 KVA (NOTE 3)	120/240V 1Ø 3 WIRE 15 KVA (NOTE 3)		120/240V 1Ø 3 WIRE 15 KVA
d. ANTENNA OPTIONS	V-RING OR APC TOA	V-RING	V-RING	V-RING	LPDA		YI TOA
e. ORIENTATION OF SHELTER	DOOR FACING STRIP END OF RUNWAY AT A MINIMUM OF 350 FT. FROM RUNWAY CENTERLINE AND WITHIN ± 30° OF LONG AXIS OF ANTENNA.	LONG AXIS OF SHELTER PERPENDICULAR TO AND AT A MINIMUM DISTANCE OF 250 FT. FROM RUNWAY CENTERLINE AND WITHIN ± 30° OF LONG AXIS OF ANTENNA	SAME AS MARK Ia	SAME AS MARK Ia	LONG AXIS OF SHELTER PARALLEL TO RUNWAY CENTERLINE		250 FT. MINIMUM FROM RUNWAY CENTERLINE; MIDWAY BETWEEN ARRAY(S).
f. LOCATION OF PRIMARY POWER ENTRY	THRU FLOOR TO LEFT OF DOOR.	THRU FLOOR TO LEFT OF DOOR.	THRU FLOOR TO LEFT OF DOOR	THRU FLOOR TO LEFT OF DOOR	THRU FLOOR TO LEFT OF DOOR.		THRU FLOOR TO LEFT OF DOOR
g. LOCATION OF RF OUTPUT CABLES	THRU FLOOR ADJACENT TO REAR WALL	THRU FLOOR TO LEFT OF DOOR.	THRU FLOOR TO LEFT OF DOOR.	THRU FLOOR TO LEFT OF DOOR	THRU FLOOR TO LEFT OF DOOR.		THRU FLOOR ADJACENT TO LEFT WALL
h. NO. OF INTERLOCK PAIRS (WHEN REQUIRED).	2	2	1	3	3		2
i. CABLE REQUIRED BETWEEN SHELTER AND ANTENNA							
(1) OBSTRUCTION LIGHTS.	1 - 3/C # 8 ARMORED 600V (250 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT. - 400 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT. - 400 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT. - 400 FT.)	#12 - 2 DF		2 - 3/C # 8 ARMORED 600V (300 FT.)
(2) CONVENIENCE OUTLETS	1 - 3/C # 8 ARMORED 600V (250 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT. - 400 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT - 400 FT.)	1 - 3/C # 8 ARMORED 600V (250 FT. - 400 FT.)			1 - 3/C # 8 ARMORED 600V (700 FT.)
(3) ANTENNA HEATERS	1 - 3/C # 4 ARMORED 600V (250 FT.)	1 - 3/C # 4 ARMORED 600V (250 FT. - 400 FT.)	1 - 3/C # 4 ARMORED 600V (250 FT. - 400 FT.)	1 - 3/C # 4 ARMORED 600V (250 FT. - 400 FT.)			N/A
(4) MONITOR DETECTOR SIGNAL AND COMMUNICATIONS PHASING SIGNAL.	3 - RG - 214/U (250 FT. EACH RUN) 1 SHIELDED PR. #19 (250 FT.)	1 - 8 PR. # 19 ARMORED (250 FT. - 400 FT.). 1 - RG - 214/U (250 FT. - 400 FT.)	2 - 1/2" FOAM DIELECTRIC 50 OHM RG - 331/U (250 FT. - 400 FT.) 1 - RG - 214/U (250 FT. - 400 FT.)	1 - 8 PR. # 19 ARMORED (250 FT. - 400 FT.) 1 - RG - 214/U (250 FT. - 400 FT.)	SHIELDED AUDIO MONITOR CABLE.		1-17 PR. SHIELDED #19 600V (700 FT.) 1 - 1 PR #19
(5) ANTENNA FEEDLINE RF CABLE	2 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT.)	2 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT. - 400 FT.)	2 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT. - 400 FT.)	2 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT. - 400 FT.) 1 - RG - 214 (50 FT.)	2 - 7/8" ALUMIFOAM JACKETED CORX		COURSE ANTENNA 1 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT - 400 FT.); 1 RG - 214/U (50 FT.) CLEARANCE ANTENNA 1 - 7/8" FOAM DIELECTRIC 50 OHM RG - 333/U (250 FT - 400 FT.), 1 - RG - 214/U (50 FT.)
(6) FAR-FIELD MONITOR CABLES	N/A	N/A	N/A	N/A	N/A		1 - RG - 214/U (30 FT - 40 FT.); 1 - 3/C #8, 600V, 3/C #14 AWG
2. GLIDE SLOPE.							
a. TYPICAL SHELTER PLOT SIZE.	50 FT. X 50 FT.	50 FT. X 50 FT	50 FT. X 50 FT.	50 FT. X 50 FT.	50 FT. X 50 FT.		50 FT X 50 FT
b. SHELTER SIZE	8 FT. X 12 FT.	8 FT. X 12 FT.	8 FT. X 12 FT.	8 FT. X 12 FT.	8 FT. X 12 FT		8 FT. X 12 FT
c. POWER REQUIREMENTS	120/240V 1Ø 3 WIRE 15 KVA	120/240V 1Ø 3 WIRE 15 KVA	120/240V 1Ø 3 WIRE 15 KVA	120/240V 1Ø 3 WIRE 15 KVA	120/240V 1Ø 3 WIRE 15 KVA		120/240V 1Ø 3 WIRE 15 KVA
d. ANTENNA OPTIONS	HULL - REFERENCE, SIDEBAND - REFERENCE, CAPTURE EFFECT.	HULL - REFERENCE, SIDEBAND - REFERENCE, CAPTURE EFFECT.	HULL - REFERENCE, CAPTURE EFFECT.	HULL - REFERENCE, CAPTURE EFFECT	HULL-REFERENCE, SIDEBAND - REFERENCE, CAPTURE EFFECT		HULL-REFERENCE, SIDEBAND- REFERENCE CAPTURE EFFECT
e. ORIENTATION OF SHELTER.	LONG AXIS OF SHELTER PERPENDICULAR TO RUNWAY CENTERLINE. DISTANCE FROM LEADING EDGE OF SHELTER TO CENTER OF ANTENNA IS 10 FT.	LONG AXIS OF SHELTER PARALLEL TO RUNWAY CENTERLINE. DISTANCE FROM LEADING EDGE OF SHELTER TO CENTER OF ANTENNA IS 10 FT	SAME AS MARK Ia	SAME AS MARK Ia	LONG AXIS OF SHELTER PARALLEL TO RUNWAY CENTERLINE. DISTANCE FROM LEADING EDGE OF SHELTER TO CENTER OF ANTENNA IS 3 FT.		LONG AXIS OF SHELTER PERPENDICULAR TO RUNWAY CENTERLINE. DISTANCE FROM LEADING EDGE OF SHELTER TO EDGE OF ANTENNA FOUNDATION IS 4 FT
f. LOCATION OF PRIMARY POWER ENTRY	THRU FLOOR TO RIGHT OF DOOR.	THRU FLOOR TO LEFT OF DOOR.	SAME AS MARK Ia	SAME AS MARK Ia	THRU FLOOR TO LEFT OF DOOR AND ADJACENT TO LEFT WALL		THRU FLOOR TO LEFT OF DOOR
g. LOCATION OF RF OUTPUT CABLES	THRU FLOOR ADJACENT TO REAR WALL.	THRU FLOOR TO LEFT OF DOOR.	SAME AS MARK Ia	SAME AS MARK Ia	THRU LEFT WALL APPROX 5 25 FT ABOVE FLOOR		THRU FLOOR ADJACENT TO LEFT WALL
h. NO. OF INTERLOCK PAIRS (WHERE REQUIRED)	2	2	1	3	3		2
i. CABLE REQUIRED BETWEEN SHELTER AND ANTENNA.							
(1) OBSTRUCTION LIGHTS AND CONVENIENCE OUTLET.	1 - 3/C # 12 ARMORED 600V (75 FT.)	1 - 3/C # 12 ARMORED 600V (75 FT.)	1 - 3/C # 12 ARMORED 600V (75 FT.)	1 - 3/C # 12 ARMORED 600V (75 FT.)	-		1 - 3/C SH #14 AWG (100 FT.)
(2) MONITOR DETECTOR POWER	N/A	1 - 3/C # 12 ARMORED 600V (75 FT.)	N/A	N/A	-		N A
(3) INTEGRAL MONITOR SIGNAL COMMUNICATION LINE	2 - RG - 214/U (75 FT.)	1 - 8 PR. # 19 (150 FT.)	1 - 1/2" FOAM DIELECTRIC 50 OHM RG - 331/U (75 FT.)	1 - RG - 214/U (150 FT.)	-		1 - 3 C SH #19 AWG (50 FT.)
(4) COUPLING CIRCUITS	N/A	N/A	N/A	N/A	N/A		1 - RG - 188/U (100 FT.)

NOTES: 1. FRONT WALL OF SHELTER REFERS TO WALL WITH DOOR.

2. REAR WALL OF SHELTER REFERS TO WALL OPPOSITE FRONT WALL

3. 25 KVA FOR PRE-MARK I AND MARK I WITH V-RING ANTENNA HEATERS.

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APPENDIX B

ILS EQUIPMENT REQUIREMENTS

FIGURE 2. ILS EQUIPMENT CONSTRUCTION REQUIREMENTS

PAGE 1 OF 2

FACILITY / EQUIPMENT TYPE	RECONFIGURED TOCC TYPE	MARK Ia	MARK Ib	MARK Ic	MARK Id	MARK Ie	AN/GRN-27-28
2. GLIDE SLOPE. (CONTINUED)							
(6) DISPLACEMENT DETECTOR	N/A	N/A	N/A	N/A	N/A		1 - 4/C 26 #20 AWG (100 FT.)
(8) GLIDE SLOPE ANTENNA FEED LINES	2 - RG - 214/U (75 FT.)	2 - 1/2" FOAM DIELECTRIC 50 OHM RG - 331/U (75 FT.)	2 - 1/2" FOAM DIELECTRIC	2 - RG - 214/U (50 FT.)	-		1 - RG - 214/U (200 FT.)
(7) HEATER POWER.	1 - 3/C # 12 ARMORED 600V (75 FT.)	N/A	N/A	1 - 3/C # 12 600V (40 FT.)	N/A		N/A
j. CABLE REQUIRED BETWEEN SHELTER AND MONITOR MAST							
(1) OBSTRUCTION LIGHTS AND CONVENIENCE OUTLETS.	1 - 3/C # 12 ARMORED 600V (300 FT.)	1 - 3/C # 12 ARMORED 600V (400 FT. - 500 FT.)	1 - 3/C # 12 ARMORED 600V (400 FT. - 500 FT.)	1 - 3/C # 12 ARMORED 600V (400 FT. - 500 FT.)	1 - 3/C # 12 ARMORED 600V (400 FT - 500 FT.)		1 - 3/C 26 #14 AWG (350 FT.)
(2) MONITOR DETECTOR POWER	1 - 3/C # 12 ARMORED 600V (300 FT.)	1 - 3/C # 12 ARMORED 600V (400 FT. - 500 FT.)	N/A	1 - 3/C # 12 ARMORED 600V (400 FT. - 500 FT.)	#12 - 2 WF		N/A
(3) MONITOR DETECTOR SIGNAL AND COMMUNICATION	1 - RG - 214/U (300 FT.); 1 - SR. PR. # 19A (300 FT.)	1 - 8 PR. # 19 (400 FT. - 500 FT.)	1 - 1/2" FOAM DIELECTRIC 50 OHM RG - 331/U (400 FT. - 500 FT.)	1 - 6 PR. # 19 ARMORED (400 FT. - 500 FT.)	1 - 6 PR. #19 ARMORED (400 FT - 500 FT.)		1 - 3/C 26 #18 AWG (350 FT.)
(4) COMBINING CIRCUITS	N/A	N/A	N/A	N/A	N/A		1 - RG - 188/U (350 FT.)
3. BARRIER BEACONS							
a. TYPICAL PLOT SIZE							
(1) INNER	N/A	N/A	N/A	N/A	N/A		30 FT. X 30 FT.
(2) MIDDLE.	20 FT. X 30 FT.	8 FT. X 8 FT.	8 FT. X 8 FT.	8 FT. X 8 FT.	10 FT. X 32 FT.		30 FT. X 30 FT.
(3) OUTER	25 FT. X 30 FT.	8 FT. X 8 FT.	8 FT. X 8 FT.	8 FT. X 8 FT.	10 FT. X 32 FT.		30 FT. X 30 FT.
(4) OUTER WITH COOLG.	85 FT. X 80 FT.	-	-	-	30 FT. X 30 FT.		-
b. SHELTER/TRAILER/EQUIPMENT CABINET SIZE.	SHELTER - 7 FT. X 8 FT.	EQUIPMENT CABINET - 2.5 FT. X 2 FT.	EQUIPMENT CABINET - 2.5 FT. X 2 FT.	EQUIPMENT CABINET - 2.5 FT. X 2 FT.	SHELTER - 8 FT. X 8 FT.		25 FT. X 10.5 FT COUNTERPOISE WITH A POLE MOUNTED TRANSMITTER 20" X 20"
c. POWER REQUIREMENTS	120 V 10 3 WIRE 5 KVA	120V 10 3 WIRE 5 KVA	120V 10 3 WIRE 5 KVA	120V 10 3 - WIRE 5 KVA	120V 10 3 WIRE 5 KVA		120V 10 3 WIRE 5 KVA
d. ANTENNA TYPES	V-YAGI	SINGLE YAGI	SINGLE YAGI	V-YAGI	DM-SINGLE YAGI; SM V-YAGI		COLLINEAR
e. LOCATION OF PRIMARY POWER ENTRY.	THRU FLOOR TO LEFT OF DOOR	THRU BOTTOM OF EQUIPMENT CABINET	THRU BOTTOM OF EQUIPMENT CABINET.	THRU BOTTOM OF EQUIPMENT CABINET.	THRU FLOOR ADJACENT TO RIGHT WALL.		THRU BOTTOM OF EQUIPMENT CABINET
f. LOCATION OF RF OUTPUT CABLE	THRU REAR WALL OVERHEAD TO ANTENNA	THRU BOTTOM OF EQUIPMENT CABINET	THRU BOTTOM OF EQUIPMENT CABINET.	THRU BOTTOM OF EQUIPMENT CABINET	THRU REAR WALL OVERHEAD TO ANTENNA.		THRU BOTTOM OF EQUIPMENT CABINET.
g. NO. OF INTERLOCK PAIRS (WHERE REQUIRED)	1	2	2	2	2		2
h. CABLE REQUIREMENTS BETWEEN TRANSMITTER AND ANTENNA.							
(1) ANTENNA FEEDLINE	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U		1 - RG - 214/U (50 FT.)
(2) MONITOR SIGNAL	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U (30 FT.)	1 - RG - 214/U		1 - RG - 214/U (50 FT.)
(3) CHARGER CABLE	N/A	N/A	N/A	N/A	N/A		3/C #8 600V (15 FT.)
(4) BATTERY CABLE.	N/A	N/A	N/A	N/A	N/A		3/C #14 SR (15 FT.)

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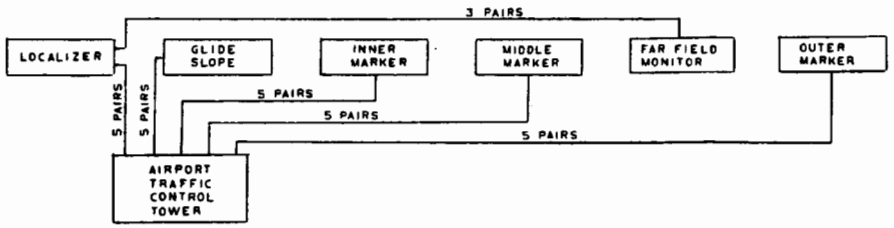
REMOTE CONTROL LINE REQUIREMENTS



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APPENDIX 8

ILS EQUIPMENT REQUIREMENTS
FIGURE 2. ILS EQUIPMENT CONSTRUCTION REQUIREMENTS

APPENDIX 9. PREPARATION OF PLOT DESCRIPTIONS

1. BACKGROUND INFORMATION.

   a. Requirement of Description. A description of a plot of land describes the lengths and directions of the boundary lines of the plot and provides a description of its location with respect to an identifiable point or monument that can be used for accurately reconstructing the actual boundaries. Plot descriptions may vary widely, depending upon the area in which the land is located, and the antiquity of the descriptions by which the property was previously recorded. There are no absolute rules for the wording of a legal description. The language used will vary according to the writer. However, the description must clearly define the location of the plot and describe its boundaries.

   b. Data for Description. The description and location of land in municipal areas, where land is valuable, are generally more precise than those for plots of land located in rural areas. Lands recorded in earlier times are often based on a hierarchy of previous surveys and local land-marks, now difficult to identify. Descriptions of plots of land located within municipal boundaries will generally use data established by city surveys and plot subdivisions established by real estate developers, and which have been placed in public records. Descriptions of plots of land in rural areas will generally use data established by state plane coordinate systems, previous land surveys described in the records of former land conveyances, or the township and sectional subdivisions previously established by the U.S. General Land Office (now the Bureau of Land Management), The areas of the U.S. divided into townships and sections include Alaska, Florida, Alabama, Mississippi and all states west of the Ohio and Mississippi Rivers except Texas and Hawaii. Texas and some of the above areas use a similar land subdivision system modified to accommodate the boundaries or the original Spanish land grants. Other areas will use data established by previous land surveys of governmental control surveys. Ideally, a plot of land should be located by reference to geographical coordinates or a permanent bench mark established by a governmental agency. Once the reference monument has been chosen, the description of a plot of land may begin at any convenient corner, called the point of beginning (pob) and proceed around the boundary of the plot, describing the direction and lengths of the boundary lines in the order in which they occur so as to return to the pob.

2. SAMPLE DESCRIPTION IN RURAL AREA. The following is an example of a plot description used in a rural area based upon data contained in previous land records:

"Beginning at the northwest corner of that parcel of land owned by Joseph James as described in Deed Book 150, page 300, records of Columbia County, State of Missouri, said northwest corner being an iron pin in the south corner of the intersection of State Route No. 20 and County Road No. 450, thence proceed S 30° 30' W (true) along the easterly boundary of said County Road No. 450, a distance of 1150 ft. to the point of beginning of the following described parcel; thence S 59° 30' E (true), a distance of 150.0 ft; thence, S 30° 30' W (true) a distance of 60.0 ft.; thence N 59° 30' W (true) a distance of 150.0 ft. to the easterly side of the said State Route No. 20; thence N 30° 30' E (true) along the easterly side of the route a distance of 60.0 ft. to the point of beginning, containing 0.21 acres, more or less."

3. SAMPLE DESCRIPTION IN MUNICIPAL AREA. The following description is an example of a plot description utilizing a municipal subdivision:

"Beginning at the northwest corner of Lot 61, Evergreen Subdivision, as recorded in Platbook No. 150. Land Records of City of Columbia, State of Kansas, said point being the point of beginning of the following described parcel, thence East (true) a distance of 40.0 ft.; thence, South (true) a distance of 50.0 ft.; thence, West (true) a distance of 40.0 ft.; thence,North (true) a distance of 50.0 ft. to the point of beginning, containing 0.05 acre, more or less."

4. SAMPLE DESCRIPTION OF PLOT ON AIRPORT. The following description is an example of a description for leasing a glide slope plot, referred to the runway threshold:

"Beginning at a metal tag set on the runway centerline at the east end of the eastwest runway, said point, being also known as the threshold of Runway No. 28, Columbia Municipal Airport, Columbia, Missouri, run N 78° 30' W (true) along the centerline of said runway a distance of 1015.0 ft.; thence,N 11° 30' E a distance of 320.0 ft. to the point of beginning of the following described parcel; N 11° 30' E a distance of 50.0 ft; thence,S 78° 30' E (true) a distance of 300.0 ft; thence,S 11° 30' W (true) a distance of 50.0 ft.; thence,N 78° 30' W (true) a distance of 300.0 ft. to the point of beginning, containing 0.34 acre, more or less."

5. USE OF TRUE BEARINGS. The directions called out in modern plot descriptions should be given in bearings referred to true north. Since most early land survey used magnetic compasses for determining directions, many of the early descriptions are given in magnetic bearings. The magnetic declination at the time of the original survey is often not known. Thus, if location accuracy is required in land surveys, the use of magnetic bearings should be avoided.

APPENDIX 10. INSTALLATION OF UTILITIES IN A HIGHWAY RIGHT-OF-WAY

1. GENERAL. In order to extend electrical or telephone service to an ILS facility (especially marker beacons), it is often necessary to obtain a work permit for construction in the right-of-way of a highway. If the utility company does not obtain the permit, it will be necessary for the FAA (Logistics division) to do so. In order to obtain a construction permit, it may be necessary to submit to the department having jurisdiction over the highway, a map and/or information which clearly indicates the character, extent, and location of the work to be performed as well as the method of performing work, such as open trench, boring, aerial, etc.

   a. Underground work refers to excavating, tunneling, boring, installing, extending existing facilities, adding to existing conduits, and making commercial service connections for subsurface facilities.

   b. Overhead work refers to aerial or above ground installations of poles, towers, and lines and other necessary equipment for such utilities as telephone and electrical power.

2. APPLICATION FOR PERMIT. An application for a construction permit in a state highway right-of-way may require the following information, which is obtainable by the site survey engineer.

   a. Type of work:

      (1) Electric power.

         (a) Overhead.

         (b) Underground.

      (2) Telephone.

         (a) Overhead.

         (b) Underground.

   b. Location:

      (1) County.

      (2) Town.

      (3) Highway number.

      (4) Usage names of road (if any).

(5) Direction to nearest town or city.

(6) Topographic features (roads, curbs, sidewalks, culverts, bridges, retaining walls).

c. Description of work:

(1) Depth of excavation with profiles (if required).

(2) Offsets from edge of pavement.

(3) Vertical clearance (if required).

(4) Length of underground cable, conduit, etc.

(5) Stations at work site.

(6) If a pavement cut is required, show length, width, and depth of cut, and indicate method of cutting and backfilling.

(7) Mile post number and distance.

3. GENERAL CONSTRUCTION REQUIREMENTS.

a. Overhead Construction.

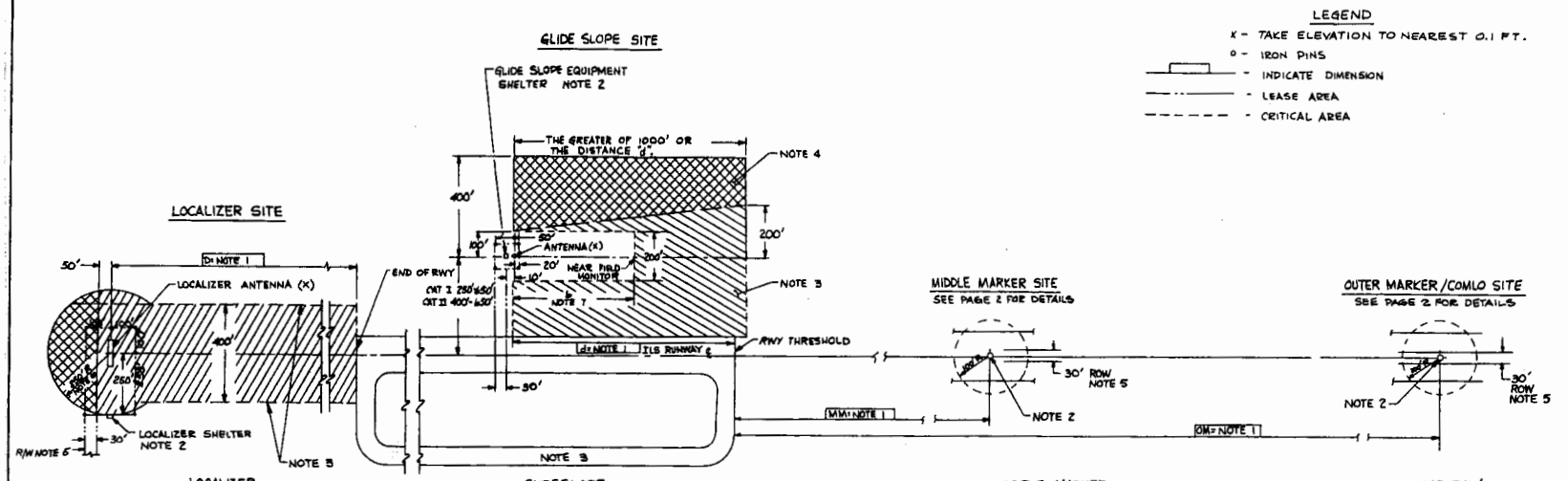
(1) The minimum vertical clearance for overhead power and communication lines above the highway shall conform to the National Electrical Code.

(2) In order not to conflict with the safety, maintenance efficiency, and appearance of the highway, ground mounted facilities should be mounted at or as near as practical to the right-of-way line.

b. Underground Construction.

(1) Underground utility construction should conform to all applicable codes, standards, and specifications.

(2) Highway crossing should be located as nearly perpendicular to the highway alignment as practical.



LOCALIZER

NOTES:

1. DISTANCE 'D' DETERMINED BY TERRAIN AND SITING CONDITIONS
2. LOCALIZER SHELTER MAY BE LOCATED ON EITHER SIDE OF ANTENNA ARRAY AT A MINIMUM DISTANCE OF 250' FROM THE RUNWAY CENTERLINE EXTENDED. THE TRANSMITTER SHALL BE LOCATED WITHIN ± 30° OF THE ANTENNA'S LONGITUDINAL AXIS.
3. THE CROSS HATCHED AREA IS TO BE CHECKED FOR OBSTRUCTIONS AND CONTOUR INFORMATION OBTAINED.
4. THE DOUBLE CROSS HATCHED AREA NEED NOT BE CHECKED FOR OBSTRUCTIONS WHEN A UNI-DIRECTIONAL LOCALIZER ANTENNA ARRAY IS INSTALLED. THE TRAVELING WAVE ANTENNA AND THE LOG-PERIODIC DIPOLE ANTENNA ARE IN THIS CATEGORY.
5. ACCESS ROAD RIGHT-OF-WAY TO BE DETERMINED IN THE FIELD.
6. KEYHOLE AREA TO BE FREE OF INTERFERENCE SOURCES (TREES, BUILDINGS, FENCES, ETC.).

GLIDESLOPE

NOTES:

1. DISTANCE 'd' DETERMINED BY OPERATIONAL REQUIREMENTS AND TERRAIN CONDITIONS.
2. THE GLIDE SLOPE SHELTER IS TYPICALLY LOCATED 10' BEHIND (IN THE DIRECTION OPPOSITE THE APPROACH THRESHOLD) THE ANTENNA MAST.
3. THE CROSS HATCHED AREA IS TO BE UNIFORMALLY GRADED (SEE NOTE 8) AND HAVE THE SAME LONGITUDINAL SLOPE AS THE RUNWAY. OBTAIN CONTOUR AND OBSTRUCTION DATA.
4. IN THE DOUBLE-CROSS HATCHED AREA, GRADING MAY BE LIMITED TO REMOVAL OF HILLS WHICH WOULD REFLECT THE GLIDE SLOPE SIGNAL INTO THE USABLE AREA.
5. ACCESS ROAD RIGHT-OF-WAY TO BE DETERMINED IN FIELD.
6. TAXIWAY AND/OR GLIDE SLOPE SITE MAY BE ON OPPOSITE SIDES OF THE RUNWAY.
7. DISTANCE 'D' IS DISTANCE FROM GLIDE SLOPE ANTENNA TO MONITOR ANTENNA.
8. FINISHED GRADES SHALL NOT EXCEED DESIGN GRADES BY MORE THAN ± 0.1 FOOT.

MIDDLE MARKER

NOTES:

1. DISTANCE 'MM' BASED ON DECISION HEIGHT, GLIDE ANGLE, TCH, AND HIGHEST POINT IN RWY TDZ.
2. SEE PAGE 2 FOR TYPICAL PLOT LAYOUT.
3. OBTAIN CONTOUR INFORMATION NECESSARY FOR SITE AND ACCESS ROAD CONSTRUCTION.
4. DETERMINE CLEARING REQUIREMENTS.
5. ACCESS ROAD RIGHT-OF-WAY TO BE DETERMINED IN FIELD
6. SHOW ALL OBJECTS WITHIN 100' THAT PENETRATE A 20° ANGLE WITH RESPECT TO LOWER MARKER ANTENNA ELEMENT.

OUTER MARKER/COMLO

NOTES:

1. DISTANCE 'OM' IS TYPICALLY LOCATED FROM 4 TO 7 NAUTICAL MILES FROM THE ILS RWY THRESHOLD.
2. SEE PAGE 2 FOR TYPICAL PLOT LAYOUT.
3. OBTAIN CONTOUR INFORMATION NECESSARY FOR SITE AND ACCESS ROAD CONSTRUCTION.
4. DETERMINE CLEARING REQUIREMENTS.
5. ACCESS ROAD RIGHT-OF-WAY TO BE DETERMINED IN FIELD.
6. SHOW ALL OBJECTS WITHIN 100' THAT PENETRATE A 20° ANGLE WITH RESPECT TO LOWER MARKER ANTENNA ELEMENT.

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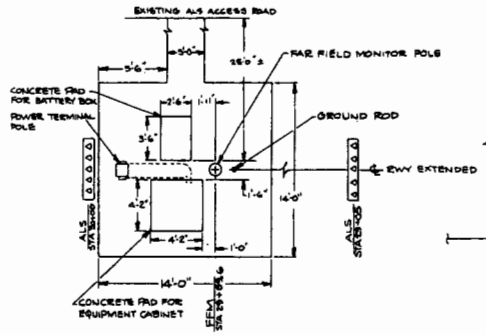
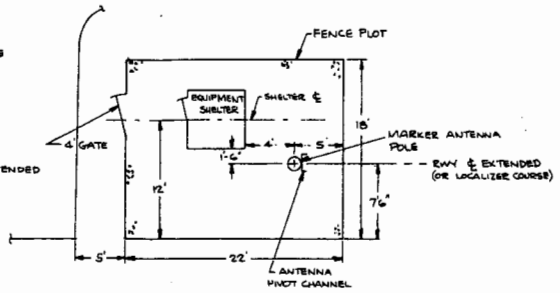
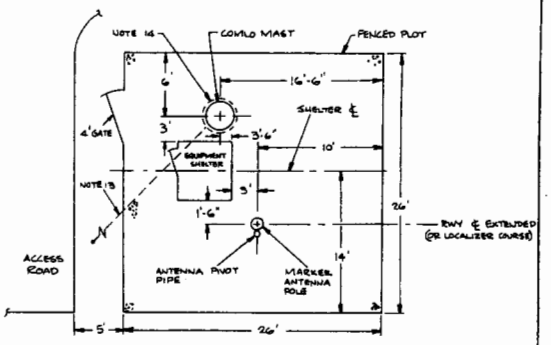
APPENDIX 11
ILS SURVEYING DATA



FAR FIELD MONITOR LAYOUT



MARKER ONLY SITE LAYOUT



MARKER/COMLO SITE LAYOUT

NOTES:

1. SHOW NEAREST POWER POLE AND TELEPHONE POLE.
2. DETERMINE ACCESS ROAD RIGHT-OF-WAY.
3. SHOW ALL OBJECTS WITHIN 100 FT THAT PENETRATE AN ANGLE OF 20° WITH RESPECT TO THE LOWER MARKER ANTENNA ELEMENT (TREES, REFLECTING SURFACES, POWER LINES).
4. DETERMINE LIMITS OF CLEARING.
5. DETERMINE TERMINAL POLE LOCATION.
6. OBTAIN TOPOGRAPHY THOROUGH ENOUGH TO SHOW ALL SWALE AND DITCH BOTTOMS, BANK TOPS AND DEPRESSION BOTTOMS, AND ALL RELEVENT BREAKS IN GRADE. GIVE A CLEARLY DEFINED BENCH MARK REFERENCE IF ANY CONSTRUCTION IS TO BE DONE TO AN EXACT GRADE.
7. DETERMINE THE EXISTING GROUND ELEVATION AT ANTENNA.
8. OBTAIN METES AND BOUNDS PLOT DESCRIPTION.
9. DETERMINE THE LOCATION AND DEPTH OR ELEVATION OF ALL UNDERGROUND UTILITIES WHICH MAY AFFECT THE SITE AND DETERMINE THE NAMES AND ADDRESSES OF PERSONS TO CONTACT WHO WILL STAKE OUT THE LINES.
10. DETERMINE DRAINAGE REQUIREMENTS SO THAT NO FEATURE OF THE FACILITY WILL FLOOD, WASH, IMPEDE DRAINAGE, OR POND WATER.
11. AT THE SITE AND ALONG THE ACCESS ROAD SAMPLE THE SOIL TO DETERMINE THE DEPTH OF TOP SOIL AND COMPOSITION OF SUB GRADE. IF POOR SOIL CONDITIONS ARE FOUND, CONTACT THE PROJECT ENGINEER.
12. IF SITES ARE LOCATED WITHIN APPROACH LIGHTING SYSTEMS INDICATE LOCATIONS OF ADJACENT LIGHT STATIONS AND INTERCONNECTING CABLES.
13. COMLO SITES REQUIRE SIXTEEN (16) EACH RADIALS (EQUALLY SPACED AND EQUAL TO OR LONGER THAN THE COMLO ANTENNA HEIGHT). RADIALS SHALL BE BURIED 6 INCHES MINIMUM BELOW GROUND. RADIALS SHALL BE AWG #6 SOLID COPPER WIRE.
14. COMLO SITES REQUIRE A RING BUSS OF AWG #2 SD SOLID COPPER WIRE. DIAMETER OF RING IS 9 FEET.

APPENDIX 12. GLIDE SLOPE SITING CALCULATIONS

1. INTRODUCTION. This appendix provides information to the site survey engineer who is tasked to locate a glide slope antenna that will provide a specified glide angle and threshold crossing height. The best source of information relative to siting a glide slope antenna is contained in Order 6750.16A, chapter 3. Sample calculations are presented employing those methods and formulas presented in Order 6750.16A.

2. GLIDE SLOPE LATERAL DISTANCE FROM RUNWAY CENTERLINE. The lateral distance of the glide slope antenna from the runway centerline is governed by Order 6750.16A, paragraph 28d. In general, the minimum allowable distance for the glide slope antenna mast is 250 feet (400 feet for Category II ILS) from the runway centerline. The maximum allowable distance is 650 feet for both Category I and II ILS. Locations between the minimum and maximum distance are based upon the height of the antenna mast to be employed. Order 6750.16A, figure 3-16, depicts the allowable antenna mast height as a function of lateral distance from the runway centerline. For example, assume a situation as depicted in figure 1 in which a 3^{o} glide slope angle and a lateral distance of 300 feet from the runway centerline is proposed.

   a. Determination of Antenna Height. Refer to figure 3-16 of Order 6750.16A. At the proposed lateral distance (300 feet) a maximum allowable height of 35 feet above the runway centerline is permitted.

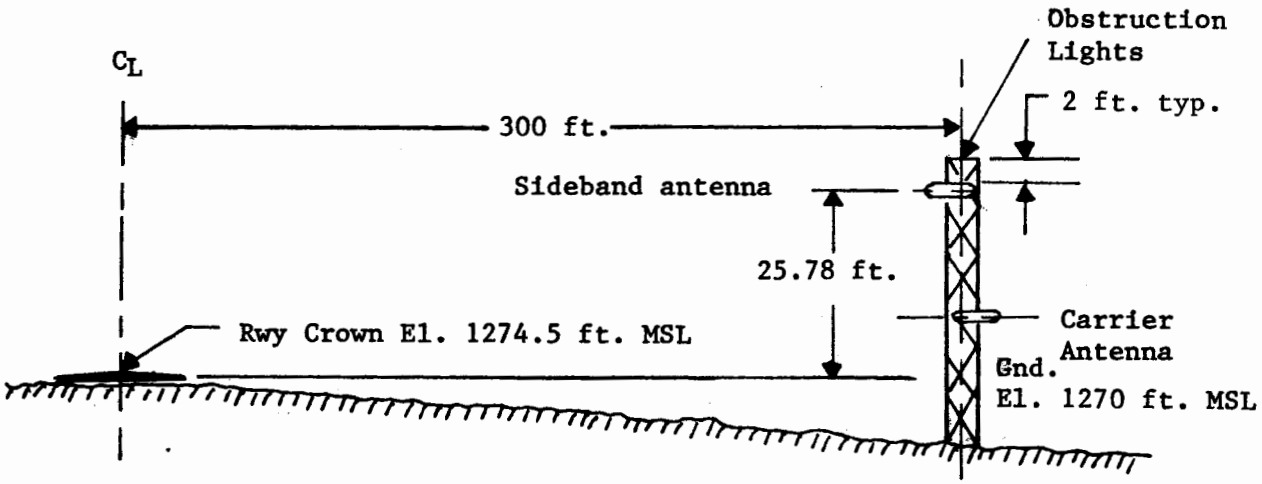
   b. Determination of Terrain Slope. Determine the average slope of the terrain for approximately the first 1000 feet in front of the antenna. Assume, in this case, that the ground slopes up as shown in figure 2. Since the difference in elevation between the glide slope site and a point approximately 1000 feet in front of the antenna (assuming average slope) is 1273.5 feet - 1270.3 feet = 3.5 feet. The slope is calculated to be:

$$S = \frac{3.5}{1000} = .0035$$

   Arctan .0035 = 0.2^{o}

   c. Correction of Glide Angle Setting for Average Terrain Slope. Refer to Table 1, Antenna Height for Null Reference System. Since the ground in front of the antenna in this example slopes upward 0.2^{o}, it is necessary to compensate for this slope before using the table. The desired glide angle is 3.0^{o} and the ground slopes upward 0.2^{o}; therefore enter the table at 2.8^{o}, which results in a sideband antenna height of 30.28 feet. (If the ground had sloped downward, the compensation would have resulted in an increased glide angle setting).

FIGURE 1. EXAMPLE FOR GLIDE SLOPE LATERAL DISTANCE.



Type of Configuration: Null Reference

Desired Glide Angle: 3.0^{o}

FIGURE 2. DETERMINATION OF GLIDE ANGLE CORRECTION FOR SLOPING TERRAIN.

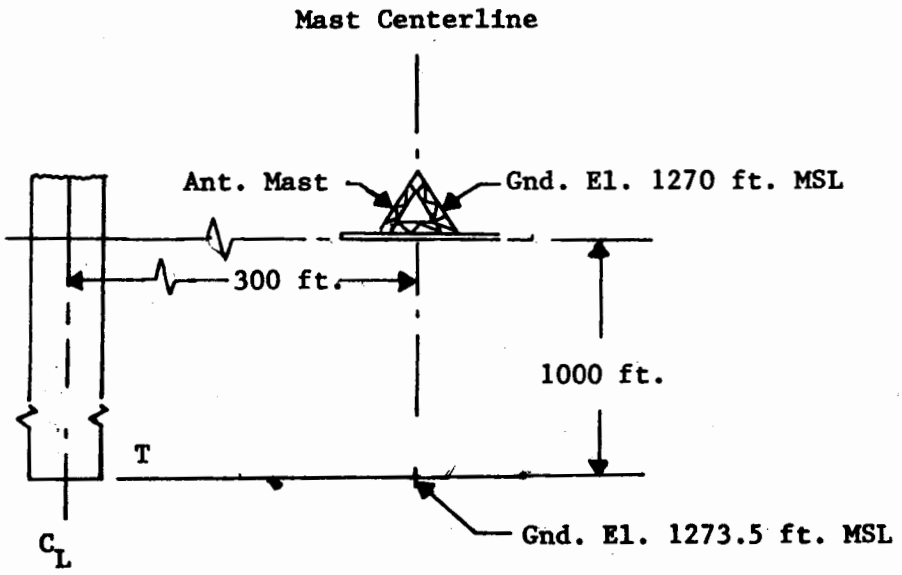


TABLE 1. ANTENNA HEIGHTS FOR NULL REFERENCE SYSTEM
(EXTRACTED FROM TABLE 2, ORDER 6750.6)

Desired Glide Angle Corrected	Sideband Antenna Height (Ft)
1.8°	47.09
2.0°	42.38
2.2°	38.53
2.3°	36.86
2.4°	35.32
2.5°	33.91
2.6°	32.61
2.7°	31.40
2.8°	30.28
3.0°	28.26
3.2°	26.50
3.4°	24.94
3.6°	23.55
3.8°	22.32

d. Determination of Elevation Difference Between Antenna and Runway. Determine the difference in elevation between the ground at the antenna mast and the point on the runway centerline opposite the mast by consulting as-built construction drawings of the airport. Beware of runway overlays which may not show up in the drawings. If accurate elevation information can not be obtained from available drawings, the elevation should be determined by actual field survey level measurements. Assume that in this example the runway centerline elevation at the point opposite the glide slope is 1274.5 feet msl, and the ground elevation at the antenna is 1270 feet msl. The glide slope mast may not penetrate an elevation greater than the 35 feet determined in paragraph 2a plus the elevation of the runway of 1274.5 feet, the result being 1309.5 feet.

e. Obstruction Lights. To the 30.28' determined under step c, add 2 feet (typical) in order to accommodate the obstruction lights. This places the total height of the mast at 32.28 feet or 1302.2 feet msl.

f. Summary. The result of this analysis is that the mast clears the obstruction clearance requirement by 1309.5 feet - 1302.2 feet or 7.3 feet. Where extensive grading is involved, it is important to examine all possible locations and to site the antenna as close to the runway centerline as permissible. This may prevent unnecessary earthwork and allow shorter access road and cable lengths.

3. GLIDE SLOPE LONGITUDINAL DISTANCE FROM RUNWAY THRESHOLD. The optimum longitudinal distance back from the runway threshold (or displaced threshold) is a function of the desired glide angle, TCH, runway gradient, extent of smooth terrain in the site area and beyond threshold, and the required obstruction clearance criteria. Detailed longitudinal distance requirements are contained in Order 6750.16A, paragraph 28e. If the desired longitudinal distance has not been preestablished by prior feasibility or office studies, the site survey engineer should determine the desired location in the field. In order to accurately predict the TCH, the slope of the reflecting plane directly in front of the glide slope tower and toward the threshold must be considered.

   a. Glide Slope Site with Ideal Longitudinal and Lateral Terrain. In the ideal case, in which the terrain from the runway to the antenna site has a smooth drop-off that does not exceed 1.5% gradient, the TCH should be computed from the crown of runway elevation. Figure 3 represents this case. The RPI and GPI are coincident since there is no runway slope. Knowing the desired glide angle θ and the TCH, the longitudinal distance d can be solved for directly as shown.

   b. Glide Slope Site with Irregular Terrain. The threshold crossing height should be computed using the ground elevation at the antenna site when the terrain drops off rapidly from runway to antenna and when drop-off is smooth but exceeds 1.5% gradient. Figure 4 represents the case where the difference in elevation between the runway and the site is taken into account when computing the TCH.

4. LOCATING THE GLIDE SLOPE MONITOR MAST. The exact location of the monitor mast is not determined until after flight check; however, approximations can be made in order to determine a probable location for construction purposes. This will enable the site survey engineer to investigate the site conditions where the monitor is likely to be located and to estimate the length of cable run that will be required. The following equations will provide approximate locations for monitors at null reference, sideband reference, and capture effect glide slope locations.

Null Reference	Sideband Reference	Capture Effect
$D = \frac{32\lambda}{16\,\theta_o^{\,2}}$	$D = \frac{1.082\lambda}{16\,\theta_o^{\,2}}$	$D = \frac{2\lambda}{4\,\theta_o^{\,2}}$

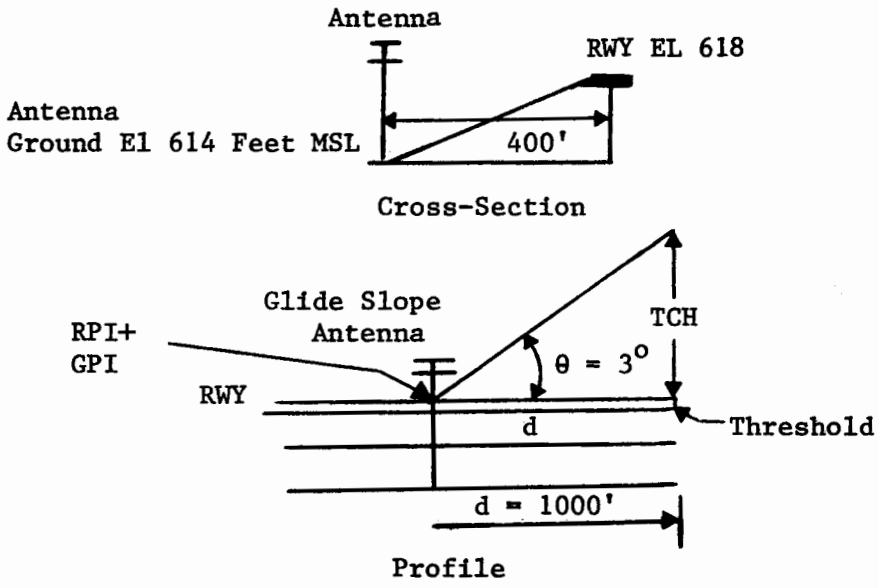
where:

D = distance from glide slope antenna to monitor mast in feet.

θ_o = glide slope angle in radians. ($1^o = 0.01745$ radians)

λ = glide slope wavelength in feet.

FIGURE 3. TCH COMPUTED FROM CROWN OF RUNWAY ELEVATION



RPI Runway Point of Intercept.

GPI Ground Point of Intercept.

θ Glide Angle.

d Longitudinal distance between rwy threshold and glide slope antenna.

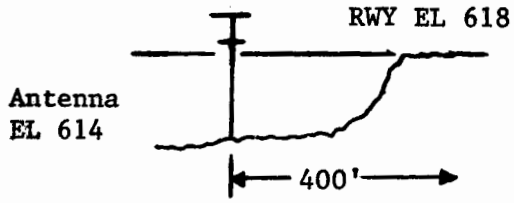
Antenna Site Computations

TCH = tan θ x d

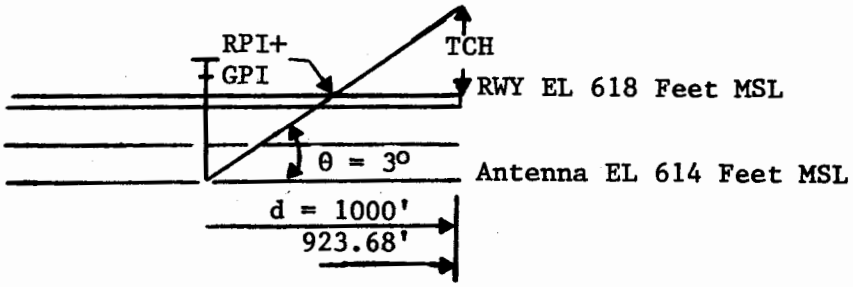
TCH = .05241 x 1000 = 52.41 feet

GPI = 52.41 ÷ .05241 = 1000 feet

FIGURE 4. TCH COMPUTED FROM GROUND ELEVATION AT ANTENNA



Cross-Section



Profile

RPI Runway Point of Intercept.

GPI Ground Point of Intercept.

θ Glide Angle.

d Longitudinal distance between rwy threshold and glide slope antenna.

Antenna Site Computations

TCH = [tan θ x d] - difference in elevation.

TCH = [.05241 x 1000] - 4 = 48.41 feet.

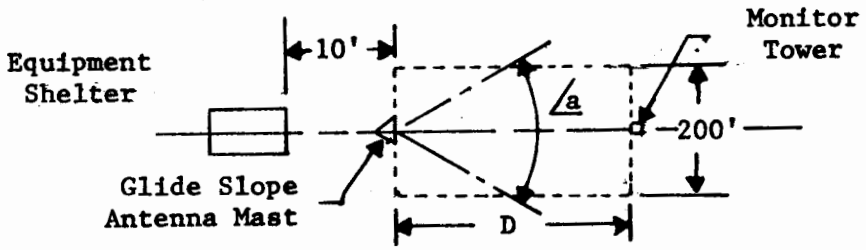
GPI = 48.41 ÷ .05241 = 923.68 feet.

$$(\lambda \text{ ft.}) = \frac{186{,}000 \text{ mile/second} \times 5280 \text{ feet/mile}}{f \text{ (Hz)}}$$

f(Hz) = glide slope assigned station freq. (329.15 - 335 MHz).

The offset distance from the glide slope centerline is determined by the ILS electronic equipment installation team at the time of flight inspection. This angle may be as much as $\pm 30^{\circ}$, as shown in figure 5.

FIGURE 5. TYPICAL NEAR FIELD MONITOR LAYOUT



1. D = Distance from glide slope antenna to monitor antenna.

2. Monitor antenna may be offset by ± a from the glide slope centerline where a = 30 degrees maximum.

CONSTRUCTION INFORMATION \ EQUIPMENT TYPE	RECONFIGURED TUBE TYPE	MARK Ia	MARK Ib	MARK Ic	MARK Id	MARK Ie	AN/GRN-27-28
LOCALIZER PLOT LAYOUT	D-6032-1	D-5942-4	D-5942-4	D-5942-4	D-6054-1		D-46052-3
LOC. EQUIPMENT SHELTER FOUNDATION	D-5990-7 D-5991	D-5778 D-5942-4	D-5778 D-5942-4	D-5778 D-5942-4	D-6054-6		
LOC. ANTENNA FOUNDATION	D-6032-4,5 D-6073-1,2	D-5849-1,2,3	D-5849-1,2,3	D-5849-1,2,3	D-6054-2,3		D-46052-6 D-6073-1,2
LOC. ANTENNA ELEVATED PLATFORMS	D-6032-6,7, 8, 9	D-5859-1,2,3	D-5859-1,2,3	D-5859-1,2,3	D-6054-11 TO 22		
LOC. SHELTER PRIMARY POWER DISTRIBUTION	D-5990-12,13 TI 6750,77	D-5778-7,11 D-5942-4	D-5942-4	D-5942-4	D-6041-2,5,9		D-6041-4
LOC. SHELTER DESIGN	-	-	-	-	D-6041 SERIES		D-46041 D-46042 D-46043 D-46044
FAR FIELD MONITOR LAYOUT	N/A	N/A	N/A	N/A	N/A		D-46046
FFM ANTENNA SUPPORT	N/A	N/A	N/A	N/A	N/A		D-46047-2,3
GLIDE SLOPE PLOT LAYOUT	D-6032-2	D-5907-1	D-5942-1	D-5942-1	D-6054-4		D-46077-1
G.S. EQUIPMENT SHELTER FOUNDATION	D-5990-7 D-5991	D-5778-9	D-5778-9	D-5778-9	D-6054-6		D-46077-3
G.S. ANTENNA TOWER FOUNDATION	D-6032-10	D-5907-1	D-5942-2,3	D-5942-2,3	D-6054-5		D-46077-3
G.S. SHELTER PRIMARY POWER DISTRIBUTION	D-5990-14,15 TI 6750,77	D-5778-7,11	D-5942-1	-	D-6041-5		D-6041-4
G.S. SHELTER DESIGN	-	-	-	-	D-6041 SERIES		D-46041 D-46042 D-46043 D-46044
NEAR FIELD MONITOR LAYOUT	D-6032-2	D-5907-1	D-5942-1	D-5907-1	D-6054-4		D-46077-1
NFM ANTENNA FOUNDATION	D-6032-10	D-5907-1	D-5942-2	D-5907-1	D-6054-10		D-46077-3
MARKER BEACON PLOT LAYOUT	D-6032-3	D-5818-1	D-5818-1	D-5818-1,5	D-6054-7,8		D-46085-1
M.B. EQUIPMENT SHELTER FOUNDATION	D-5990-7 D-5991	D-5818-1	D-5818-1	D5818-1,5	D-6054-9		D-46085-1
M.B. ANTENNA FOUNDATION	D-5818-1,5	D-5818-1	D-5818-1	D-5818-1,5	D-6054-7,8		D-46085-1
M.B. SHELTER PRIMARY POWER DISTRIBUTION	D-5990-16,17 TI 6750,77	D-5818-1	D-5818-1	D-5818-1,5	D-6042-2,5		D-46085-1 D-46087
M.B. SHELTER DESIGN					D-6042 SERIES		D-46085 D-46086
DISTANCE MEASURING EQUIP. LAYOUT					D-6078-1		
DME MAST ASSEMBLY					D-6078-2		

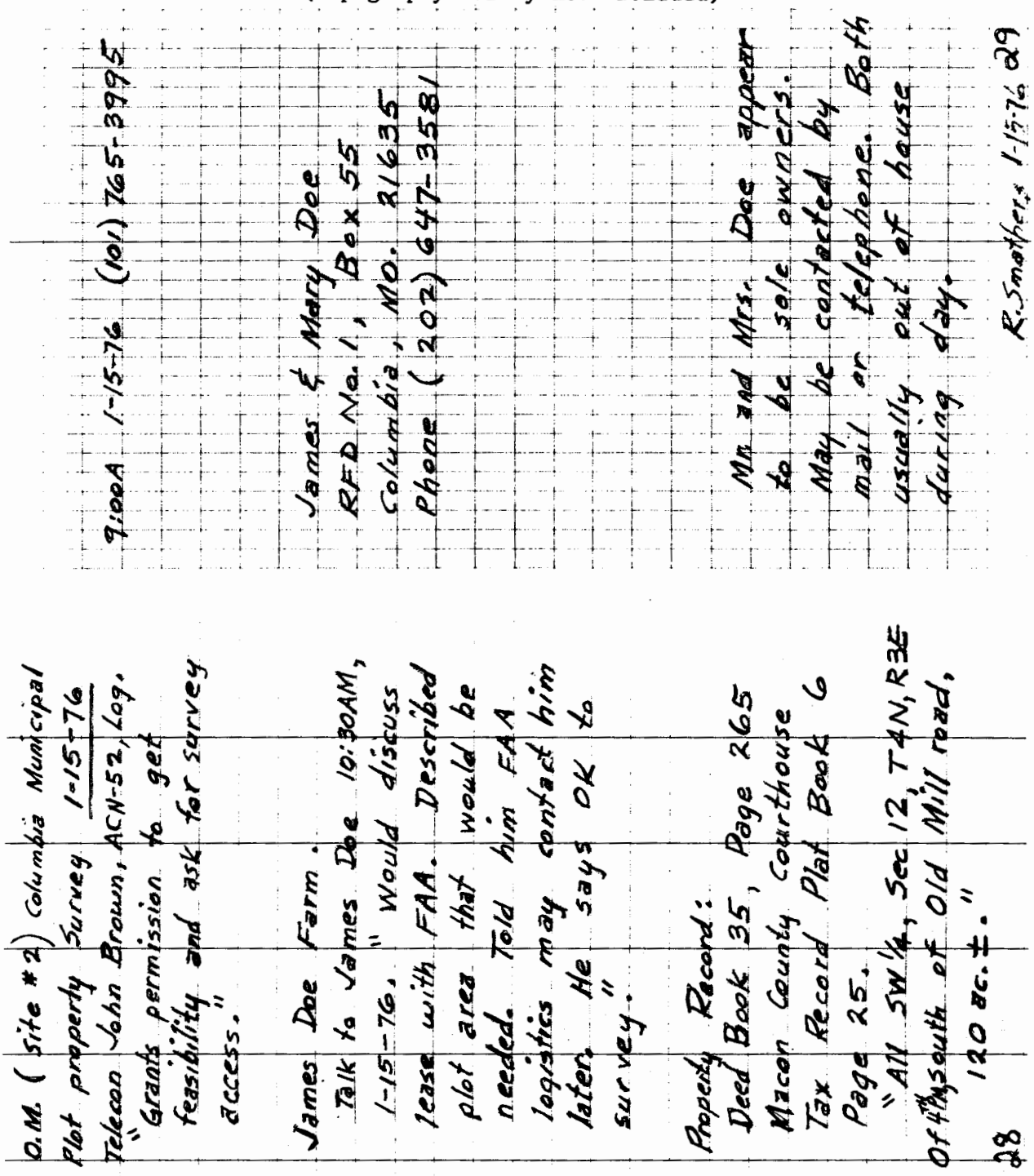
6750.36
APPENDIX 13
INDEX OF
NATIONAL STANDARD CONSTRUCTION DRAWINGS

269-270

APPENDIX 14. SAMPLE FIELD NOTEBOOK

FIGURE 1. OM FIELD SURVEY

(Topography Survey not Included)



OM (site #2) cont'd.
1-16-76 Traverse of plot.

Sta.	True Brg.	Mag * Check	Dist. Ft
A	S80°30'E	S80°15'E	1125.0
B	S80°30'E	S80°20'E	50.0
C	S9°30'W	S9°15'W	60.0
D	N80°30'W	N80°45'W	50.0
E	N9°30'E	N9°30'E	60.0

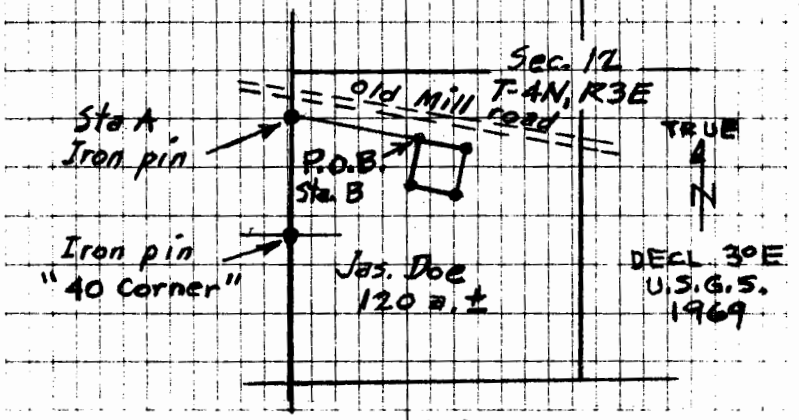
Plot area is pasture land- slopes downward approx. 1:50 to the eastward.
Grove of 40' high trees ≈250' E of site.
2' deep ditch parallels old Mill road 26' S of ℄
4 strand barb wire fence parallels S side Old Mill road, 40' from ℄.

* Az. circle set for DECL. = 3° E.

Iron pin NW cor. Doe property
40' S of ℄ old Mill road.
B.S. to "40 corner" for true az.
P.O.B. of proposed OM parcel.
40' S of ℄ Old Mill road.

No visible rock outcrop.
Jones & Jones, Contracting Engrs, Columbia, say frost depth is 18".

FIGURE 1. (CONTINUED) OM FIELD SURVEY



R.S mathers 1-16-76

FIGURE 1. (CONTINUED) OM FIELD SURVEY

OM (site #2) cont'd.
1-17-76

Power: 13KV. pwr line parallels north side of Old Mill road, 60' from ℄. Talked to Jack Jones, Columbia Pwr & Light Co. 9:30AM.
"They could provide 120/240v. drop to customer meter on south side of road. Drop not to exceed 260'.

Road: Sandy clay soil. Road should be near existing grade. Ditch W. side to Old Mill rd. 24" culvert needed at Old Mill road.

TV: Nearest home with TV ant. ≈ 900' east.

Jack Jones, Serv. Engr.
(501) - 878 - 6865
Columbia Power & Light Co.
150 Main St.,
Columbia, MO 21635

Detailed road survey not necessary.

TV channels 3, 12 and 25 used in area. TV stations ≈ 25 mi. to north.

R. Smathers 1-17-76

32

33

APPENDIX 15. SAMPLE PROCUREMENT REQUEST (POWER SERVICE)

READ INSTRUCTIONS ON REVERSE *NO CARBON REQUIRED* PAGE 1 OF 2 PAGES

DEPARTMENT OF TRANSPORTATION

PROCUREMENT REQUEST PROCESS RAPIDLY

PROCUREMENT REQUEST NO.

DATE RECEIVED

1. NAME, PHONE NUMBER, AND ROUTING SYMBOL OF PERSON TO CONTACT
Project Engineer

2. TYPE OF REQUEST (Check one)
A. [X] NEW REQUEST
B. [ ] CHANGE TO PENDING PR NO. ____
C. [ ] MODIFICATION TO CONTRACT OR ORDER NO. ____

3. ORIGINATING OFFICE DATA
AF Division ACN-400

4. ADDITIONAL INFORMATION (Suggested supply sources, security data, etc.)
Virginia Electric
3584 Parkwood Drive
Salem, Virginia 12345 ATTN: Mr. Steve Halpern

5. APPROVALS

APPROVING OFFICIALS (A)	ROUTING SYMBOL (B)	DATE (C)	INTERNAL ROUTING INITIALS (D)	INTERNAL ROUTING ROUTING SYMBOL (E)
(1) AUTHORIZED REQUISITIONER Frank Radlee, Chief	ACN			447.3
Radar-Navaids Engr. Sect	447			442
(2) ACCOUNTING CERTIFICATION OFFICER				
				425
(3)				423
(4)				50

6. CONSIGNEE AND DESTINATION
FAA
Airway Facilities Sector
Roanoke County Airport
Salem, Virginia 12345
Mark for: RWY 34

7. DATE(S) REQUIRED
June 1, 1976

8. GOVERNMENT FURNISHED PROPERTY
[ ] YES [X] NO (If "YES," see par. 8 of Instructions on reverse.)

9. DESCRIPTION OF ITEMS OR SERVICES

ITEM NO. (A)	ITEM OR SERVICE (Include Specifications and Special Instructions) (B)	QUANTITY (C)	UNIT (D)	ESTIMATED COST UNIT (E)	ESTIMATED COST AMOUNT (F)
	Electric power service is required for the Localizer, Runway 34, Roanoke County Airport, Salem, Virginia Service requested is described on the enclosed Form, Electric Service Specifications				
				TOTAL ESTIMATED COST	$

10. ACCOUNTING DATA

Charges: Nonrecurring 027.0/C8047/13041234/2370
Recurring 601/C8500/211/2370
System Code 3131-0-101

FORM DOT F 4200.1 (3-71)

THIS DOCUMENT IS A CONTEXT AND FORMAT SAMPLE ONLY

Department of Transportation
Federal Aviation Administration

Contract No.: 130/21856

ELECTRIC SERVICE SPECIFICATIONS

1. Premises to be served Roanoke County Airport, Salem, Virginia

2. Facility to be serviced ILS Localizer, Runway 34

3. Estimated Service Requirements:
   Estimated maximum demand: 25 kW
   Estimated monthly consumption: 7,500 kWh/mo.

4. Point of Delivery: The point of delivery shall be FAA terminal pole as shown on drawing CN-D-0002, Localizer Vicinity sketch.

5. Description of Electric Service. The electric power supplier will furnish single-phase, 3 wire, 60 Hertz, alternating current at 120/240 volts.

6. Type of Load: Electronic Air Navigational Aid Equipment, Lighting, Convenience Outlets, Heating, and Air Conditioning (13,000 Btu).

7. Metering and Billing. Service will be measured at _____ volts by _____ watt hour meter(s) and _____ demand meter(s).

8. Service to be terminated as follows: Virginia Electric Co. (V.E.C.) shall terminate service at a meter socket on the terminal will be provided by the FAA contractor. The FAA terminal pole, location is approximately five feet northwest of V.E.C. Pole No. 1 located on the South Side of Thompson Rd., Salem, Va. Trenching, duct (if required), and backfill from utility pole V.E.C. No. 1 to the FAA terminal pole will be provided by the FAA contractor. High voltage conductors, transformer, and secondary cable from the transformer to meter socket shall be provided by utility company. Secondary wiring from the meter to the equipment shelter will be provided by the FAA contractor. V.E.C. shall furnish and install the meter.

APPENDIX 16. REPORTING OF ILS DATA TO THE NATIONAL FLIGHT DATA CENTER (NFDC)

As required by Order 7900.2, each region shall notify NFDC of the establishment of a new ILS facility 90 calendar days prior to commissioning. The data required by NFDC is listed below and should be available from the ILS Project Data Checklist (Appendix 4). The type of drawing shown in figure 1 may be useful when developing the data for NFDC.

1. State - _____
2. City - _____
3. Airport - _____
4. Category of operation - _____
5. Associated runway - _____
6. Approach bearing (true) - _____
7. Magnetic variation and date - _____
8. Engineering drawings; general plan of airport, and contour profile of ILS runway centerline extended (3 copies). _____
9. Localizer.
   (a) Latitude/longitude of antenna - _____
   (b) Ground elevation of antenna array center (msl, nearest foot) - _____
   (c) Elevation-highest point of antenna structure - _____
   (d) Distance from array to runway stop end - _____
   (e) Stop end runway elevation - _____
   (f) Runway length - _____
   (g) Identifier - _____
   (h) Frequency - _____
   (i) Voice availability - _____
   (j) Course width - _____

(k) Back course status - _____

(l) Restrictions - _____

(m) Commissioning date - _____

(n) Engineering drawing (Plot plan - 3 copies) - _____

10. Glide Slope.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation of antenna (msl, nearest foot) - _____

(c) Elevation-highest point on antenna tower (msl, nearest foot) - _____

(d) Ground elevation runway opposite antenna (msl, nearest foot) - _____

(e) Distance from runway centerline - _____

(f) Approach threshold elevation (msl, nearest foot) - _____

(g) Distance from runway threshold - _____

(h) Threshold crossing height - _____

(i) Frequency - _____

(j) Glide angle (degrees and minutes) - _____

(k) Equipment configuration (example: single, null reference) - _____

(l) Restrictions - _____

(m) Commissioning date - _____

(n) Engineering drawing (plot plan - 3 copies) - _____

11. Outer Marker.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation (msl, nearest foot) - _____

(c) Distance from runway threshold - (in feet and nautical miles) - _____

(d) Altitude GS over marker (msl, nearest foot) - _____

(e) Distance from runway centerline extended (feet) - _____

(f) Commissioning date - _____

(g) Engineering drawing (plot plan - 3 copies) - _____

12. Middle Marker.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation (msl,nearest foot) - _____

(c) Distance from runway threshold (feet) - _____

(d) Altitude of GS over marker (msl, nearest foot) - _____

(e) Distance from runway centerline extended (feet) - _____

(f) Commissioning date - _____

(g) Engineering drawing (plot plan - 3 copies) - _____

13. Inner Marker.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation (msl,nearest foot) - _____

(c) Distance from runway threshold (feet) - _____

(d) Altitude of GS over marker (msl, nearest foot) - _____

(e) Distance from runway centerline extended (feet) - _____

(f) Commissioning date - _____

(g) Engineering drawing (plot plan - 3 copies) - _____

14. Distance Measuring Equipment.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation at antenna (msl, nearest foot) - _____

(c) Elevation (highest point of antenna) (msl, nearest foot) -
_____

(d) Distance from stop end of runway and centerline - _____

(e) Frequency - _____

(f) Commissioning date - _____

(g) Engineering drawing (plot plan - 3 copies) - may be part of localizer plot plan - _____

15. Compass Locator.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation at antenna (msl, nearest foot) - _____

(c) Distance from threshold - (in feet and nautical miles) - _____

(d) Output power - _____

(e) Identifier - _____

(f) Frequency - _____

(g) Voice availability - _____

(h) Voice used for approach control - _____

(i) Locator classification (LOM, LMM, etc.) - _____

(j) Commissioning date - _____

(k) Name of RBN if used as compass locator - _____

(l) Engineering drawing (plot plan - 3 copies) - may be part of outer marker plot plan - _____

16. Nondirectional Beacon.

(a) Latitude/longitude of antenna - _____

(b) Ground elevation at antenna (msl, nearest foot) - _____

(c) Identifier - _____

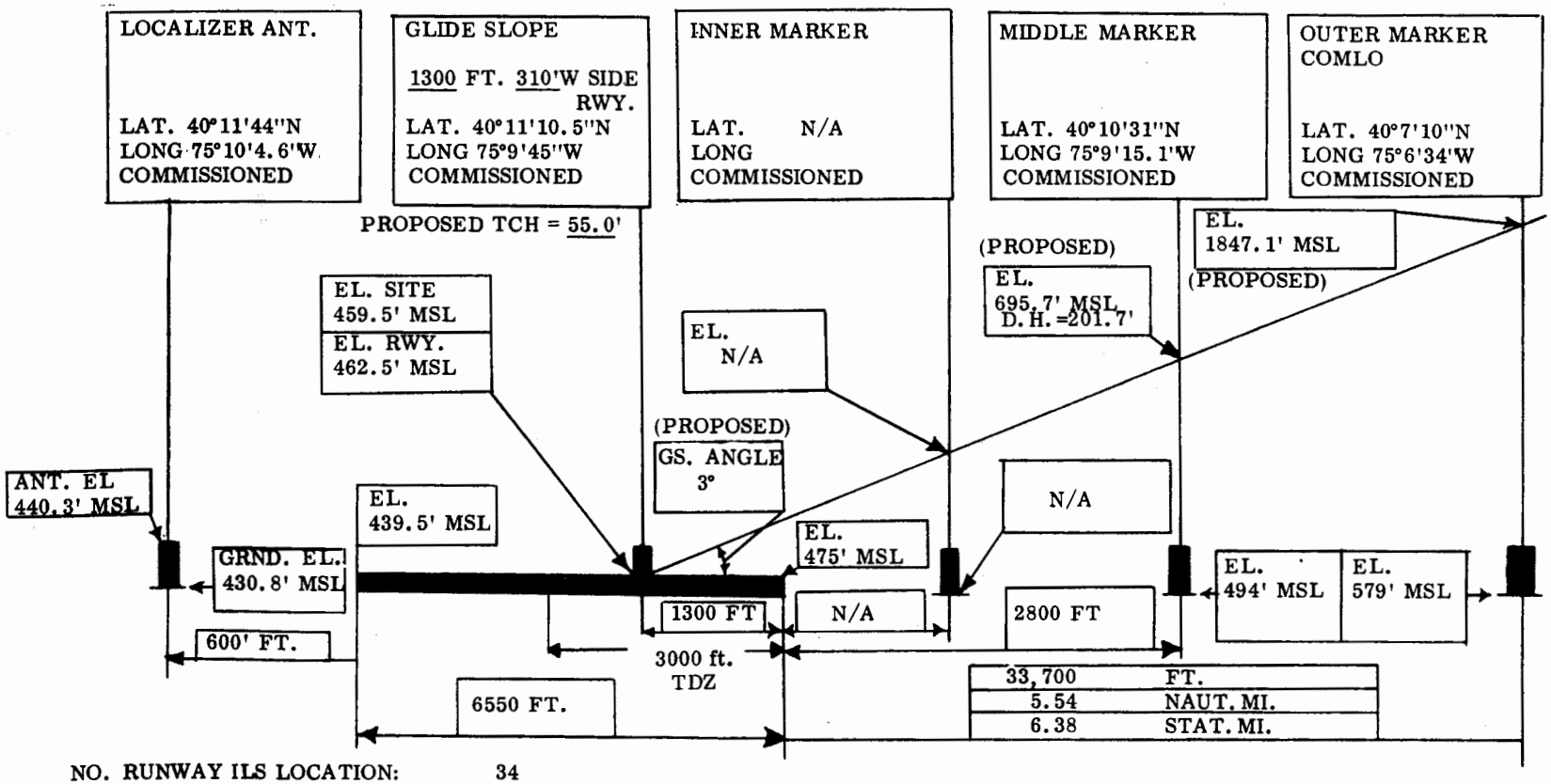
(d) Frequency - _____

(e) Commissioning date - _____

(f) Output power - _____

(g) Engineering drawing (plot plan - 3 copies) - _____

FIGURE 1. INSTRUMENT LANDING SYSTEM DATA



NO. RUNWAY ILS LOCATION: 34
RUNWAY LENGTH: 6550'
RUNWAY WIDTH: 150'
MAGNETIC APPROACH BEARING: N16°43'23"E
MAGNETIC DECLINATION: 10°30'00"
DATE OF MAGNETIC DECLINATION: 1966
LOCALIZER COURSE WIDTH:
LOCALIZER FREQUENCY (HZ):
GLIDE SLOPE FREQUENCY (HZ):
INNER MARKER FREQ. (HZ):
MIDDLE MARKER FREQ. (HZ):
OUTER MARKER FREQ. (HZ):

TYPE OF ILS: Category I
LOCATION Roanoke County Airport
Salem, Virginia

SUBMITTED BY: _____
CIVIL ENGINEER

APPROVED BY: _____
CHIEF, ENVIRON. ENGR. BRANCH

DATE: _____

APPENDIX 17. TYPICAL A-95 NOTIFICATION DATA SHEET

1. Project Title: _____

2. Funding:

   a. Federal (actual/estimated) _____

   b. Other (specify) _____

3. Geographic Location:

   a. State _____

   b. County _____

   c. General Location: (For example: on airport property, in section, range, township, etc.)

4. Program under which project is planned: (F&E), etc.) _____

5. Proposed date of physical implementation: _____

6. Project Description: (Plain language - briefly include purpose and benefits) _____

7. Person to contact if additional information is needed:

   (Name, address and telephone number) _____

8. Construction costs _____

APPENDIX 18. INSTRUMENT LANDING SYSTEM DESCRIPTION

1. GENERAL DESCRIPTION. A standard instrument landing system consists of a localizer, glide slope, marker beacons, and, possibly, such ancillary aids as a compass locator or a nondirectional beacon. The ILS provides electronic signal information/guidance to properly equipped aircraft in order to facilitate their approach and landing during adverse visibility conditions.

   a. Alignment Guidance. The signal used to align the aircraft on the approach path is radiated by the ILS localizer facility. The preferred localizer site is on the extended centerline of the runway beyond the stop end.

   b. Descent Guidance. The signal used to control the descent path is radiated by the ILS glide slope facility. The glide slope facility is located to one side and in the vicinity of the touchdown zone of the ILS runway.

   c. Location Information. The ILS marker beacons are used to inform pilots of significant points in the approach course. An outer marker (OM) beacon is located along the runway centerline extended at the point where the aircraft should intercept the glide slope signal. A middle marker (MM) is located at the point where an aircraft reaches the decision height (DH) of a Category I ILS approach. An inner marker (IM) is located at a point where an aircraft reaches the decision height point of a Category II ILS approach. At the decision height point, the pilot either completes his landing under visual conditions or executes a missed approach if the runway is not visible.

2. DESCRIPTION OF COMPONENTS.

   a. Localizer. The localizer equipment consists of an antenna array with its long axis arranged perpendicular to the localizer course. The antennas receive their signal from transmitting equipment housed in a transportable equipment shelter. The transmitter operates on one of twenty channels within the frequency band of from 108 to 112 MHz. The transmitter output power is variable between 20 to 200 watts with a typical antenna gain from between 4 to 12 dB. The localizer signals are adjusted to produce an angular width of about 700 feet at the ILS runway threshold. The minimum usable distance is 18 nautical miles. The localizer coverage is such that at 18 nautical miles the signal is usable within ± 10 degrees from the course line at -114 dBW/m^2. At 10 nautical miles, the signal is usable within ± 35 degrees of the course line. The localizer course line tends to be a straight line, which corresponds to the runway centerline. The localizer equipment shelter is environmentally self-contained and typically 8 feet x 12 feet or 8 feet x 16 feet in size.

b. Glide Slope. The glide slope antennas are mounted on a self-supporting triangular steel tower, which ranges in height from 40 to 60 feet (depending on site conditions). The antennas receive their signal from transmitting equipment housed in a transportable equipment shelter. The transmitter operates on one of twenty channels within the frequency band of from 329.15 to 335.0 MHz. The transmitter output power varies from 4 to 14 watts. The glide slope coverage is such as to allow satisfactory operation within a sector ± 8 degrees from the centerline of the ILS glide path to a distance of 10 nautical miles. The minimum field strength within the coverage sector is -95 dBW/m^2. The ILS glide path angle is typically 3 degrees above the horizontal so that it intersects the middle marker at about 200 feet and the outer marker at about 1400 feet above the runway elevation. The glide slope equipment shelter is environmentally self-contained and typically 8 feet x 12 feet in size.

c. Marker Beacon. The transmitting antenna is typically installed on a wood pole with the overall height of the antenna and pole typically being 20 feet. The antenna is fed from transmitting equipment housed either in a transportable equipment shelter located adjacent to the antenna or in a small equipment cabinet mounted either on or at the base of the pole. The marker beacon facility operates at 75 MHz in a highly directional vertical plane, which has an elliptical shape in the horizontal plane. The transmitter output power is typically 3 watts or less. The outer, middle, and inner marker equipment shelter is environmentally self-contained and typically 6 feet x 6 feet, 7 feet x 9 feet, or 6 feet x 8 feet in size. Equipment cabinets, where used, are typically 2.5 feet x 2 feet in size.

d. ILS Ancillary Aids. While they are not considered to be a specific component of the standard ILS facility, COMLO's, NDB's, and DME's may be installed as required.

(1) Compass Locator (COMLO). Compass locators broadcast a low-powered, nondirectional signal within the frequency band of 200 to 415 kHz in order to aid pilots in locating the ILS localizer course. The COMLO antenna is normally collocated with the outer marker beacon, with the transmitting equipment being housed in the marker beacon equipment shelter. The COMLO antenna is typically self-supporting and does not exceed a height of 65 feet. In order to enclose the buried ground counterpoise required by a COMLO, a plot size 100 feet x 100 feet is normally required.

(2) Distance Measuring Equipment (DME). The DME is used instead of the outer marker beacon when site conditions prevent the installation of an outer marker beacon, i.e., an approach over-water. The DME transmitting antenna is typically located 6 feet from the ILS localizer equipment shelter. The total

height of the DME antenna and supporting mast is approximately 19 feet. The DME transmitting equipment is located within the localizer equipment shelter.

(3) Nondirectional Beacon (NDB). The NDB transmits a low powered nondirectional signal on which a pilot may "home" using automatic direction finder equipment installed in the aircraft. The NDB operates in the 200 to 415 kHz frequency range at an output power of 25 watts. The NDB facility typically consists of a vertical self supporting antenna system at a typical height of 50 feet and a transmitter unit housed in an aluminum shelter and mounted on a wooden pole.