This document includes excerpts from:

FAA Advisory Circular 150/5340-26

Maintenance of Airport Visual Aid Facilities

Dated 4/4/2005

We have included the information that we have found pertinent to the maintenance of our Lumacurve airfield signs. The Advisory Circular in its entirety can be found on the FAA's website: www.faa.gov

CHAPTER 3. MAINTENANCE MANAGEMENT.

3.0 MAINTENANCE PHILOSOPHY.

The purpose of the maintenance management system is to ensure the maximum availability of any given system at a minimum cost in man-hours or funds. "Availability" and "costs" are relative terms; they must be interpreted for each airport. For example, a CAT I runway may still be considered operational with 15% of the edge lights out, while a PAPI system may be unserviceable with more than one lamp out per box. By the same reasoning, the cost of maintaining a spare regulator may be considered cost prohibitive, while stocking replacements for 10% of the runway edge lights may be considered a normal practice. In addition, operational factors are a major consideration in determining what maintenance is required. Airports with heavy traffic may require more frequent maintenance servicing than those used only by light traffic. The maintenance operations include maintenance planning, preventive maintenance inspection, visual inspection, repair, installation, calibration, and unscheduled maintenance procedures. Maintenance procedures, including the work order and documentation required, may vary between airports. The purpose of this document is to provide the minimum maintenance procedures required for safe and efficient movement of aircraft during takeoff, landing, and taxiing operations.

Regardless of the actual maintenance routines decided upon, the following elements are essential to any controlled maintenance program. The maintenance procedures in this AC are considered minimum guidelines:

a. Document the service checks that comprise the maintenance program.

b. Record the performance of each maintenance action, scheduled or unscheduled.

c. Document repairs and troubleshooting performed on each piece of equipment and the results of those actions as well as the symptoms related to the malfunction. This allows for more rapid troubleshooting of similar problems at a later date.

3.1 MAINTENANCE SCHEDULE.

Documenting the maintenance schedule by spelling out each item of routine maintenance is beneficial in several ways:

a. It allows planned allocation of man-hours to the maintenance function.

b. It helps to establish spare part stock levels.

c. It identifies the necessary maintenance routines to new employees, decreasing training time needed for system familiarization.

d. It identifies the scope of the maintenance task in terms of man-hours and material requirements.

3.2 MAINTENANCE RECORDS.

Maintenance records are an important part of an effective maintenance management system; they provide a service history of each piece of equipment, ensure regular maintenance without duplication of effort, and provide a data base for statistical analysis of lighting system performance. Without records, knowledge gained from regular inspections will not be retained, and preventive maintenance will be difficult. An effective records system should

allow for the recording and retrieval of information with a minimum of effort. The records system should compile data that will document the effectiveness of the maintenance program. By checking the records, a manager should be able to determine whether a particular maintenance task is being done too frequently or not often enough. By such a trial-and-error process, a maintenance program uniquely tailored to the facility can be developed.

3.3 PREVENTIVE MAINTENANCE PROGRAM.

Reliable functioning of airport lighted visual aids is essential to airport safety, capacity, and operation especially for low visibility operations. Therefore, it is essential that a preventive maintenance program be established to ensure reliable service and proper equipment operation. Properly scheduled inspections, testing, and calibrations are essential to the proper functioning of these systems. Airport lighting systems are designed to be dependable and may continue to operate for long periods of time even if maintenance is neglected. Eventually a failure will occur and, if the failure occurs at a critical time, safety may be jeopardized. Lighted visual aid maintenance should receive high priority to prevent equipment failure, false signals, and deterioration of the system.

3.3.1 Installation and Material.

The first element in a preventive maintenance program is high quality, properly installed equipment. Preventive maintenance is difficult on equipment that has been installed haphazardly without consideration of maintenance requirements. When such conditions exist, they should be brought to the attention of the proper authority and corrected rather than trying to establish a preventive maintenance program to compensate for the condition.

Consult the electrical maintenance supervisor at an airport prior to and during the design of any installation of new or additional visual aid systems. By so doing, the airport can avoid costly problems during and after construction. Consideration should also be given to the method of selection and training of any contractor personnel involved in the installation of airfield lighting products. The need for specialized training for airport maintenance electricians applies to the contractor personnel also.

3.3.2 Personnel.

The second element in a preventive maintenance program is trained experienced personnel. Maintenance personnel should have a thorough knowledge of the equipment, should have experience with high voltage, and should be able to make careful inspections and necessary repairs. Special training is available and may be desirable, as most well-qualified electricians can be trained on-the-job if suitable supervision and instruction are provided. Considerable experience with the equipment and its operation is desirable. These individuals should be present, or on-call, during the operating hours of the airport to correct any deficiencies that may develop. In short, airport visual aid maintenance personnel should be specialists in the field.

3.3.3 Tools and Test Equipment.

The third element in a preventive maintenance program is the tools and test equipment required to perform the maintenance. This includes specialized tools and test equipment, adequate working space, adequate storage space, spare parts, and applicable technical manuals.

3.3.4 Preventive Maintenance Inspection Program.

The fourth element in a preventive maintenance program is an effective preventive maintenance inspection schedule for each visual aid. This schedule should also include all cable systems. The preventive maintenance inspection (PMI) schedule is the foundation for the successful maintenance of the equipment. If the PMI is performed properly and at the scheduled time, it will ensure top system performance and will minimize unscheduled interruptions and breakdowns. Review of the inspection records, checks, tests, and repairs provides a constant awareness of the equipment condition and gives maintenance personnel advanced warning of impending trouble.

3.3.5 Preventive Maintenance Inspection Schedule.

Scheduled inspections and tests are those accomplished on specific types of equipment on a periodic basis. The schedule may be based either on calendar or on hourly-use increments. The PMI schedules, based upon recommendations from the manufacturers and users of the equipment, are considered to be the typical requirements to keep the equipment in good condition. Adjust the frequency of a particular PMI after experience is gained under local operating conditions.

3.4 RECORD RETENTION.

There is no set period of time that maintenance records should be kept, but in keeping within the goals mentioned above, a period of twice the longest period recorded would appear to be the minimum (i.e., 2 years in the case of annual maintenance action). Records of daily inspection will, of course, lose their significance much sooner,

probably within a month. It should be noted however, that maintenance records should be retained permanently, if possible, as situations may develop years later in which those records can prove invaluable.

3.5 REFERENCE LIBRARY.

Establish a reference library to maintain a master copy of all Equipment Technical Manuals (ETMs), ACs, as-built drawings, and other useful technical data. The electrical supervisor should establish and maintain responsibility for maintaining the technical reference library and ensure that technical manuals and drawings are kept up to date and not lost or damaged.

3.5.1 Equipment Technical Manuals (ETMs).

ETMs and other manufacturer's literature form an important part of the reference library. Obtain two copies of all technical manuals and related manufacturer's literature. Retain a master copy in the reference library, and provide a separate copy for the shop. In addition, keep a copy of each equipment manual at the equipment location. This facilitates troubleshooting and repairs without the necessity of traveling back to the shop location to retrieve the manual. Do not remove the master copy of the technical manual from the reference library as it can easily become misplaced or lost. In the event the shop copy is lost, make another photocopy of the technical manual from the reference library instead of releasing the master copy.

3.5.2 Advisory Circulars.

Important reference information on installation, design tolerances, and operation of visual aid equipment may be found in FAA ACs. Include a copy of the ACs covering the equipment at the facility, along with a copy of this AC, in the reference library.

3.5.3 Other Technical Data.

Other reference information that is occasionally useful should also be added to the library. This might include local electrical codes, engineer's handbooks, test equipment manuals, and other general information publications.

3.5.4 As-Built Drawings.

Maintain the master copy of all as-built (record) drawings as part of the reference library. Incorporate modifications to any equipment into the drawings as soon as the modification is completed. Give a copy of the "as-built" lighting plan, showing the location of all cable runs, runway lights, etc., and including the wiring diagrams for the lighting, engine generator, and the visual aid system, to the field technicians as a working copy. Install or identify test points at appropriate locations in the field circuitry and record locations of these test points on the "as-built" drawings. Immediately update any notations regarding test points or discrepancies in the drawings made in the field on the master set in the reference library.

3.6 SPARE PART PROVISIONING.

This paragraph contains guidelines on how to establish a stock of spare parts to be used for quick repair of lighting equipment that fails unexpectedly. The purpose of a spare parts system is to have the necessary part on hand when
 a piece of equipment fails; this will minimize the time the system is out of operation. However, the greater the number of spare parts stored, the greater the inventory costs. The optimum spare part system balances the cost of system downtime (lost operation, tenant inconvenience, safety, etc.) with the cost of purchasing and storing spare parts. A small airport with few operations may suffer little inconvenience with the loss of their lighting system and may, therefore, choose to stock few spare parts. A large airport may rely heavily on its lighting system for low visibility operations and would, therefore, require a substantial quantity of spare parts. In the case of a large airport, the funds lost by the tenants due to interrupted operations and the impact on the safety and security of the traveling public must also be taken into consideration. A malfunction at a major airport can have a far reaching effect on the national airspace system. When establishing a spare parts inventory, two questions must be answered:

(1) What parts should be stocked?

(2) How many of each part?

When new construction occurs or a project is funded for replacement of existing systems, fund and include a quantity of spare parts (fixtures, lamps, fuses, relays and spare CCR control boards, etc.) in the equipment furnished by the contractor. This gives the maintenance department a built-in stock of spare parts and lessens the time required to procure parts for the new equipment. This is especially true if the equipment being installed is different from what is currently in use.

3.6.1 Choosing Spare Parts.

To answer the two questions posed above, several factors must be considered, including failure rate, part availability, and effect of the part failure.

3.6.2 Failure Rate.
The failure rate (or replacement rate) is the product of the expected life of an item and the number of items in the system. For instance, if a lamp is expected to last six months, and we have 100 lamps in the system, then an average of 100 lamps will be replaced every six months or approximately four per week. Accurate records of parts used over time will help immensely in determining a failure rate.
3.6.3 Part Availability.
Part availability refers to the time it takes to secure a replacement part. This usually means procurement lead time. If a part can be readily procured from shelf stock of a local supplier, it might not be necessary to add the part to the spare parts inventory; as it could be purchased when needed or the number of spare parts in the inventory could be reduced. However, if there is a six-week lead time required by the supplier, then stock six times the weekly failure rate (24 lamps in the example above). Spare parts for constant current regulators and other special equipment fall into this category. For instance, a replacement printed circuit board or other assembly typically has a six to twelve week lead time and unless a spare regulator is maintained for emergency use, the loss of a circuit could have a serious effect on airport operations. There are methods of obtaining parts which may reduce the effect of a long lead time. These include substitution (the use of a functionally equivalent part from another manufacturer), cannibalization (replacing one of a pair of adjacent failed lamps by "borrowing" a lamp from elsewhere in the system), and temporary fixes (such as the use of portable lights in place of the fixed light installation) while awaiting corrective maintenance. It should be noted, however, that these solutions should be considered only as an emergency measure and that proper spare parts provisioning will eliminate the need for such techniques.
(As a result of our "Wait-Less" service, it is not necessary to maintain a large inventory of Lumacurve spare parts. Common parts as well as custom legend panels will be produced & shipped same day if the order is received before 10AM eastern standard time.)
3.6.4 Effect of the Failure.
The effect of the failure of a particular spare part depends on how important the part is to the equipment it is installed in, and how vital the equipment is to airport operations. The failure of a lamp in an edge light would not lead to any system downtime, but the failure of a circuit board in a constant current regulator would cause the loss of the entire lighting circuit that it powers. The equipment manufacturer will give guidance on recommended spare
18 4/4/2005 AC 150/5340-26A parts. As experience is gained with the system, other parts may be added or deleted from the inventory. The impact of a part's failure should be considered when building a spare parts inventory.
3.6.5 Part Identification.
An important part of maintaining a spare parts inventory is accurately cataloging the parts on hand by manufacturer's part number. This is important to ensure that the correct part is used in a broken piece of equipment; many optical parts are visually similar but vary significantly in performance. The use of the manufacturer's part number is also vital when reordering; if a part is ordered by its generic name, the manufacturer may send a later version of the part which is incompatible with the existing system. It is extremely important to maintain manufacturer's data which reflects your equipment, describing the type, model number, and serial number details.
3.6.6 Use of Original Equipment Manufacturer (OEM) Part.
The use of non-OEM parts or lamps in FAA approved equipment is strongly discouraged. The FAA has strict specifications for approval of all airport lighting equipment and use of non-OEM parts or lamps in such equipment or systems can render the equipment to be functionally non-FAA approved. This could possibly lead to serious liability consequences in case of an aircraft incident at an airport following these practices. In the case of runway and taxiway lighting fixtures, the use of a generic, non-approved lamp can render the photometric output of the fixture out of specification with disastrous results in light output and, consequently, safety of low visibility operations.

Warning: The use of non-OEM replacement parts in Lumacurve signs will void the FAA certification (as noted in the ETL Certificate of Conformance), void manufacturer warranties as well as compromise future product support and upgrades.

5.4 ILLUMINATED RUNWAY AND TAXIWAY GUIDANCE SIGNS.

5.4.1 Cleaning.

Most signs require minimal maintenance aside from lamp replacement. However, with the intrusion of dust, dirt and water it is necessary to inspect and clean the interior of signs periodically to ensure proper light output. Mice and other rodents are known to set up house-keeping in signs. Frequently, this results in damage to wires and other components and the presence of grass, trash and other bedding material. For these reasons, inspect and clean airfield guidance signs at least twice a year.

5.4.2 Lamp Replacement.

As with all airport lighting systems, re-lamping should be accomplished with the sign de-energized to prevent the possibility of electric shock. This has been made an easier task by the addition of switches on signs to disconnect the power. The act of re-lamping has also been made easier and quicker by designs of both incandescent and fluorescent types that allow re-lamping without the use of tools.

5.4.3 Current Check.

At least twice a year, the current through the lamp circuit should be checked to verify that it is correct for the sign in question. If not correct for all steps, make current adjustments on the sign internal regulator board or if a Style 5 sign, check the circuit CCR to make sure it is operating at 5.5A.