LORAN-C APPROACH CONSIDERATIONS

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Past Joint University Program efforts have resulted in Loran-C receiver design and testing, followed by enhancements for full RNAV operation with CRT pilot display. The use of Loran-C in the airspace and the number of commercial receivers available have exploded in recent years; pressure is mounting for approval of Loran-C use during approaches to landing.

The Avionics Engineering Center, in work for the State of Ohio Department of Development, has evaluated such approach applications at Galion, Ohio Municipal Airport and at Mansfield, Ohio Lahm airport. Loran-C data were referenced to ground-tracker data to determine that the Loran-C approach path was straight, flyable, and parallel to the runway centerline. The 0.2 nm offset, while within FAA requirements for RNAV approaches without correction, can easily be corrected to an on-centerline approach path.

There is little argument that Loran-C signals offer the basic accuracy required to design approaches in the coverage regions of existing chains. Seasonal variation in the Loran-C grid and the permanent grid warp caused by overland propagation can be corrected by publication of offsets, either in Loran-C or geodetic terms, to the WGS-72 coordinates defining FAF and MAP. The remaining concerns, then, center on system integrity. One important integrity factor is the airborne receiver and the means for determining its correct operation prior to initiating an approach.

It is possible that a Loran-C receiver may track a zero-crossing of the 100 kHz signal other than the desired third cycle. The result of a single cycle slip can be a position error of one nautical mile or more, depending upon the receiver's position relative to transmitter pair baselines. A cycle slip on the station being used as the master might cause considerable resultant error, by introducing TD errors in both hyperbolic LOPs being used. Such errors might be tolerable in enroute flight, but are certainly unacceptable in terminal-area operations.

The pilot needs a reliable method for receiver checking before an approach, while still in the enroute phase of flight, when primary (VOR) navigation aids are available. Overflight of a VOR station, comparison of Loran-C with a VOR/DME or VOR-RNAV fix, or perhaps a simple angular comparison when within some established distance from a VOR, all offer candidate cross-checking methods.

Effects of various combinations of cycle slip events upon the approach path flown need to be demonstrated and understood, also.

These Loran-C operational issues will be investigated using the following program steps:

1. A Loran-C approach will be designed for the Ohio University Airport:

a. WGS-72 coordinates will be determined for runway thresholds, using Navy TRANSIT data, ground surveys and compass readings of actual runway bearing.

b. Final approach fixes will be computed, at five miles from each threshold, for straight-in approach paths.

c. TERPS criteria will be consulted to determine compliance with approach obstruction limits.

d. Each approach will be test-flown, using theodolite/ranger ground-truth systems to provide referenced data giving uncorrected Loran-C path position and structure.

e. TD and geodetic correction values will be developed, and the approaches will be re-flown with corrections applied. Video-tape data will be collected to verify the quality of the resulting approaches.

f. The approaches will be re-flown with various combinations of cycle slip, and the resulting path location documented.

g. The offsets observed in item f., above, will give guidance as to available options for receiver integrity checks prior to approach.

Specific test plans are in preparation for each step, and results will be reported as data become available.