

ILA28/NAV99
NELS COVERAGE IN UK & IRISH WATERS

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Introduction

The Marine Navigation Plan (MNP) published in 1997 by the General Lighthouse Authorities (GLA) of the UK & Ireland included provision for adopting LORAN-C as the terrestrial radionavigation system backup to GPS. This would replace the Decca Navigator System which will no longer be supported by the GLA after 31 March 2000. Any decision to adopt Loran-C would be dependent on proof of satisfactory coverage of UK & Irish waters. This paper reports the results of measurements carried out to establish the coverage and performance.

User Requirements

The MNP was the result of the most widespread consultation among the Maritime Community that the GLA had ever undertaken. Most respondents advocated supporting GPS with LORAN-C and providing DGPS as effective ways of minimising loss of navigation data due to interference as well as when satellites become unavailable. The ROYAL MAJESTY (1995) is a classic example of a shipping casualty resulting from blind over reliance on GPS. Among the accident investigator's findings was the lack of deliberate cross-checking between GPS and LORAN-C to verify the vessel's position within the integrated bridge system.

The MNP provides for a mix of visual, audible and electronic AtoN to ensure the safe and expeditious navigation of vessels. Users agreed that both LORAN-C and GPS are required because:

- the mixture of systems is complementary enabling the user with a hybrid receiver to cross-check between systems;
- LORAN-C would provide the necessary ground-based radionavigation system back-up to the GPS satellite system;
- IMO recommends that electronic charts (ECDIS) have two inputs wherever possible and it would be sensible if these were from two independent radio navigation systems.

The Royal National Lifeboat Institution reported in 1997 that the delay in operational capability of LORAN-C was a source of concern to their lifeboat fleet since a second independent position-fixing system was required to complement their DGPS fitting programme, to ensure adequate safety of navigation in service. Other rescue services have expressed similar views.

Performance Assessment

This assessment of Loran-C performance is based on measurements carried out on board GLA buoy tenders by the GLA Development Department.

The performance is for the existing system, without the Irish station, which has not yet been built.

Coverage has been assessed in terms of signal to noise ratio and related to receivers of different qualities. The term good quality receiver has been used to mean one which will operate down to a signal to noise ratio of -10 dB. All receivers fitted to commercial, fishing and pleasure craft would be expected to perform this well, given adequate care in the installation. A low quality receiver means one which just complies with the minimum performance specification of 0 dB SNR (IEC 1175). The monitoring receiver used in these trials operates down to -25 dB and this is the performance to be expected from modern receiver designs. A calibration check was carried out by a proven method using a field strength meter (Ref. 1), so that the Signal to Noise Ratios (SNR) on the monitoring receiver could be related to navigation receiver performance.

The measurements were carried out in 1996 and 1997 round Scotland onboard the Northern Lighthouse Board tender MV Pharos and in 1998 and 1999 on Trinity House Vessel (THV) Mermaid and the Commissioners of Irish Lights Tender Granuaille round the Irish, Welsh and English coasts.

Scotland

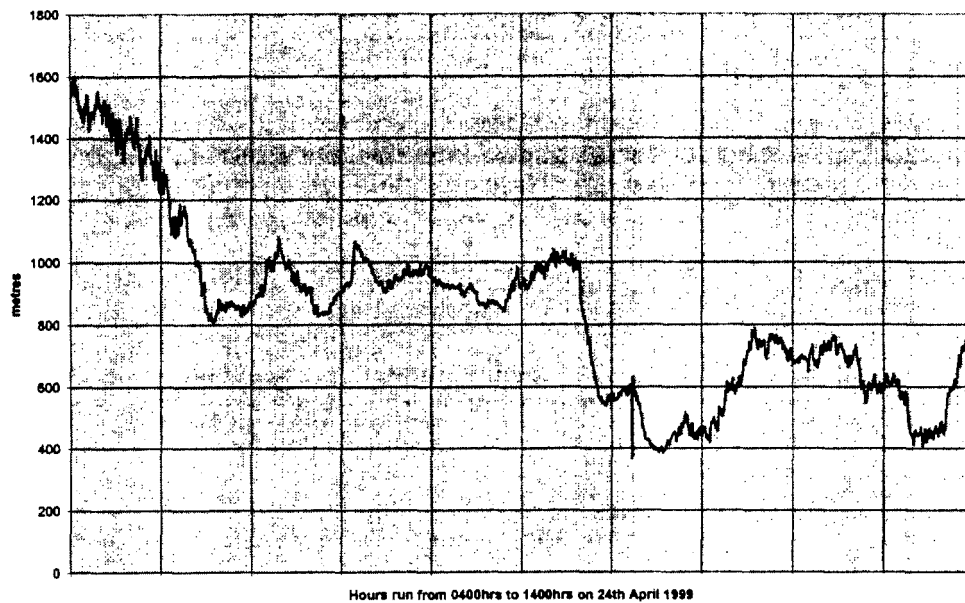
The 1996 and 1997 measurements were performed onboard MV Pharos during positioning voyages from Oban on the West coast to Leith on the East. Each lasted approximately a week and took place during August. The results have been reported in detail in previous papers presented to the International Loran Association (Refs. 2 & 3) and will only be summarised here.

The 1996 measurements were made using a good quality navigation receiver, with DGPS as a reference. Reception of the Loran signals was generally adequate to obtain a position and accuracy was within the 0.25 n.m. specification for the system on the East coast. On the West and North coasts errors of up to 0.5 n.m. were common, because of the landpaths from the stations used (Sylt, Vaerlandet and Lessay). However, these errors were consistent and could be corrected. Other chains could be received, but the geometry was not suitable to provide a useful position.

In 1997 a high-performance monitoring receiver was used, again with DGPS as the reference. This receiver was able to receive at least seven and usually all eight of the NELS transmitters, but results have been related to the performance which might be expected with a navigation receiver. Results on the West and North coasts again showed large, but consistent errors. Reception all the way up the West coast was adequate for an good quality receiver. On the East coast, signal levels are considerably higher as the landpaths are shorter or non-existent.

Ireland

Data round the Irish coast from Dun Laoghaire on the East to Galway on the west was obtained with the monitoring receiver installed on THV Mermaid. In the Irish Sea signals were adequate for even a low quality receiver and errors were generally in the region of 0.25 to 0.5 n.m. Round the South coast signals declined and by the Fastnet a good quality receiver would be needed. A plot of the error distance against time is shown for the leg from Fastnet round Mizen Head and up to Loop Head. The large variations reflect the changing landpaths over mountainous terrain.



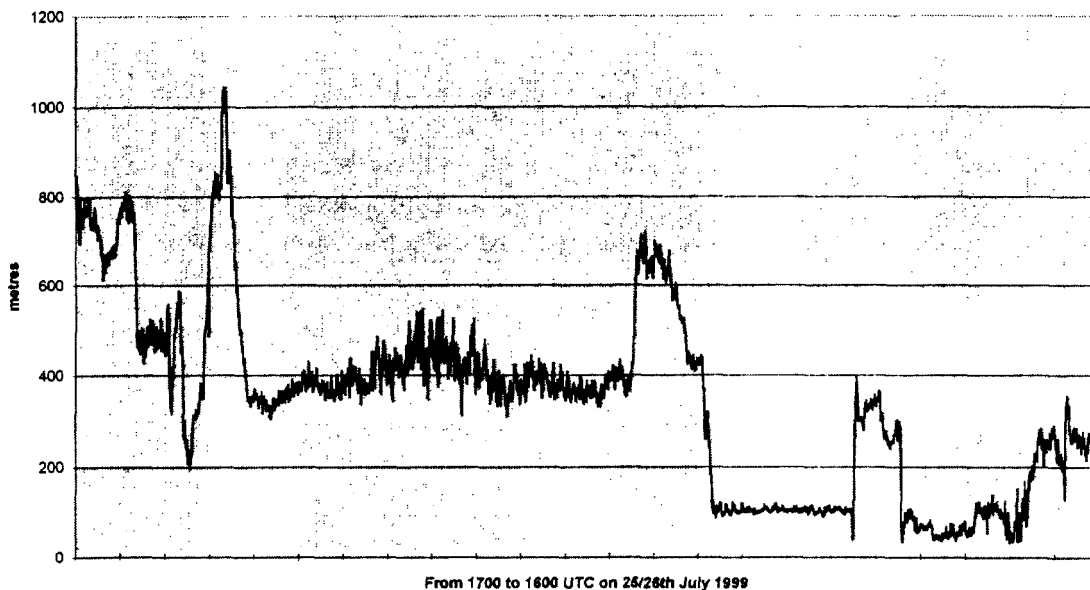
The signals recovered up the West coast to Galway Bay, to the extent that low quality receivers would be adequate. Errors here were between 0.5 and 1 n.m., though still consistent. Measurements have now been taken round the whole coast of Ireland using ILT Granuaille, but the results are still being analysed.

West of England and Wales

Signal levels round the West of England and into the Bristol Channel would require a good quality receiver. Errors were 0.25 to 0.5 n.m.

The plot shows the leg from Lizard round Lands End and up the Bristol Channel to Swansea.

Error distance - Lizard Point to Swansea

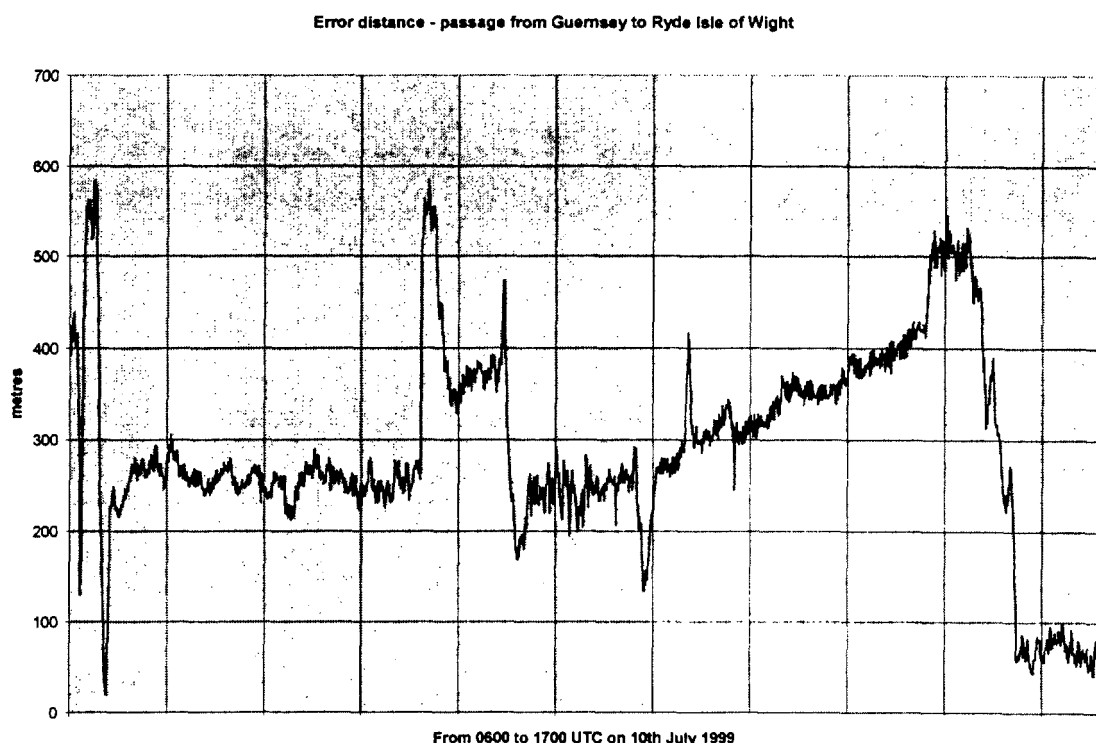


The large variations when rounding Lands End can be seen.

English Channel

A low quality receiver should operate in this area, though errors were again in the region of 0.25 to 0.5 n.m.

The plot shows the errors between the Channel Islands and the south coast of England. The effects of the Normandy peninsula on the path from Lessay can be seen.



Conclusions

The measurement programme is continuing and there are several areas which have not yet been covered. On the basis of the measurements made so far. It can be concluded that adequate signals can be obtained from the existing Loran system round the coasts of the UK to obtain a position fix with a good quality receiver. Except to the south-west of Ireland and in the Bristol Channel, even low quality receivers should operate. However, in areas other than the East coast of England and Scotland, corrections for landpath effects would be essential and they would be desirable even on the East coast. NELS has a project underway to collect such correction data.

References

1. Last J.D. & Ward N. 1989. Proceedings of the 18th Annual Technical Symposium of the Wild Goose Association, p. 99.
2. Ward N. 1996. Proceedings of the 25th Annual Technical Symposium of the International Loran Association, p. 125.
3. Ward N. & Goodman C.W.S. 1998. Proceedings of the 27th Annual Technical Symposium of the International Loran Association, p. 271.