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| From: e-NAV Committee | EEP18/10/14  Formerly e-NAV11/output/18 |
| To: EEP Committee  IALA Secretariat | 30th March 2012 |

Liaison Note

Training Requirements

# Introduction

The e-NAV Committee welcomes the opportunity to comment on IALA Recommendation E-141 on AtoN Training and the level 2 courses listed in working paper EEP17/WG3/WP4.

# Action

The EEP Committee is invited to note the following comments.

It is suggested that an additional training module on Radionavigation is included which might include the following topics:

* Introduction to Radionavigation and its importance to Maritime safety: Position, Navigation & Timing (PNT);
* Accuracy, integrity, continuity, availability;
* GNSS;
* Terrestrial systems including propagation of LF signals/ASF etc.;
* Inertial Navigation Systems;
* Vulnerability issues including jamming (intentional and unintentional), space weather etc.;
* Redundancy : Multi-system receivers;
* Applications of GNSS on AtoN (e.g. synchronised lights);
* Augmentation systems (leading into DGNSS module).

The USCG Academy “Radionavigation Engineering Training Course” syllabus is attached which may provide some further information.

The module on DGNSS would appear to be based on the IALA Radio-beacon MF system. Other methods should also be briefly explained, including SBAS. The Virtual Reference Station (VRS) concept should also be considered for inclusion in the module.

It is suggested that a topic on antennas (MF transmitting and GNSS) be included in the DGNSS module.

More general issues such as Health and Safety will also need to be covered for all modules (e.g. boat transfers, working at heights, exposure to High Voltage, RF hazards etc.).

**Radionavigation Engineering Training Course**

* **Monday: Current Issues and Engineering Theory/Application**
* **0800 – 0830: Introductions/Course Overview**.
* **0830 – 0930: Program Office Presentation**.
* **0930 – 1000: Support Office Presentation.**
* **1000 – 1015: BREAK**
* **1015 – 1115: Important sources of information (FRP, FRS, NAVCEN web site, various standards documents, various studies).**
* **1115 – 1215: Accuracy, Availability, Integrity, Continuity, Positioning, Navigation, and Timing.**
* **1215 – 1300: LUNCH**.
* **1300 – 1430: Linear Algebra and Statistical Review**
* **1430 – 1445: BREAK**
* **1445 – 1600: Dilution of Precision (DOP) and position determination.**
* **Tuesday: Engineering Theory/Application** (continued)
* **0800 – 0845: Time division, frequency division, code division.**
* **0845 – 0930: Communications theory review (AM/FM/PM/BPSK/MSK).**
* **0930 – 0945: BREAK**
* **1000 – 1100: Brief GPS/DGPS signal theory overview/Matlab demos.**
* **1100 – 1200: Brief Loran-C signal theory overview/Matlab demos**
* **1200 – 1300: LUNCH**.
* **1300 – 1400: Antenna Electrical Characteristics/Radio propagation.**
* **1400 – 1500: Antenna Modeling and Design for CG Radionavigation.**
* **1500 – 1515: BREAK.**
* **1500 – 1630: Integrated Receivers – Kalman Filter approaches**
* **Wednesday: GPS/DGPS**
* **0800 – 0815: Intro to DGPS team, brief history, sponsors, future vision**.
* **0815 – 1000: GPS and DGPS system description**.
* **1000 – 1015: BREAK.**
* **1000 – 1100: DGPS RF Engineering.**
* **1100 – 1200: Navigation System Operations Issues.**
* **1200 – 1300: LUNCH**.
* **1300 – 1400: DGPS RS/IM Recap**.
* **1400 – 1500: GPS Antenna Recap**.
* **1500 – 1515: BREAK**
* **1515 – 1615: GPS and DGPS Relevant issues**.
* **1615 – 1645: Practical demonstration of positioning accuracies**.

**Thursday: Long Range Terrestrial Navigation Systems**

* ***0800 – 0900: Aviation applications***
* **0900 – 0930:** Description and review of LORAN Recapitalization.
* **0930 – 1015: New LORAN Equipment.** Description of new equipment capabilities.
* **1015 – 1030: BREAK.**
* **1030 – 1100: LICOS Update.** Update of LICOS project.
* **1100 – 1130: LEMS Update.** Update of LEMS project.
* **1130 – 1230: LUNCH**
* **1230 – 1330: Aviation Technical Evaluation Report**
* **1330 – 1430: LORAN Data Channel / Differential LORAN.** Review and future plans/possibilities.
* **1430 – 1445: BREAK**
* **1445 – 1545: LORAN Data Channel / ASF Grid Surveys.** Review and evaluation.
* **1545 – 1630: Conversion from SAM to TOT Control.** Current plan to convert control of Loran system from System Area Monitor (SAM) to Time of Transmission (TOT) control.
* **1630 – 1715: Timing.** Timing capabilities, performance and future possibilities inherent in new LORAN equipment and review of USNO role as Master Clock.

**Friday: Other Issues**

* **0800 – 0830: Coverage prediction software.**
* **0830 – 0930: Other GNSS Systems – WAAS, Galileo, GLONASS, Compass**.
* **0930 – 1030: Interfacing with Aviators: Aviation community’s’ positioning requirements.** Panel discussion.
* **1030 – 1045: BREAK.**
* **1045 – 1145:** **RNAV and Legal Issues.**
* **1145 – 1200:** **Wrap up and Course Critiques**.
* **1200:** **Course adjourns.**