REPORT
on
The Thirteenth Session of the Council of the
Far East Radionavigation Service (FERNS)

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1. Opening of the Session

1.1 The thirteenth session of the Council (FERNS 13) was held in St Petersburg, Russia during the period 6 – 10 September 2004. A welcoming statement by Mr. Boris Alyoshin, Director General of the Federal Agency for Industry at the Russian Ministry of Industry and Power Engineering, was read by Mr Sergei Pisarev. The welcoming address is given at Annex 1. Mr Pisarev then declared the meeting open and proposed that the Chairman should be Mr Vadim Zholnerov, Deputy Director General of the Russian Institute of Radionavigation and Time. This proposal was agreed unanimously.

1.2 Mr, Zholnerov thanked all Members for the trust they had placed in him and expressed his hopes that the session would help to further improve and promote the co-operation on radionavigation services in the Far East and that participants would have an opportunity to enjoy some of the local history of the area and the culture of the country

1.3 At the invitation of the Chairman each participant was introduced to the meeting. Representatives of the following Members and Observers participated in the session:

Members:

The People's Republic of China;
Japan;
The Republic of Korea; and,
The Russian Federation.

Observers:

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA);

1.4 At the invitation of the Chairman each participant was introduced to the Council. A full list of participants is given in Annex 2.

2 Approval of the Agenda

2.1 In introducing the draft agenda the Chairman explained that as a result of several other international meetings being held on Loran-C and Chayka representatives from other organisations that had been invited to participate in the special meeting of experts on the future status of Loran-C/Chayka systems had been unable to attend this session. It was therefore proposed that the documents relevant to this matter should be considered under Agenda item 5.1. This was agreed and as there were no other comments the agenda was accepted for the conduct of the meeting. The agenda and the list of documents submitted for discussion is given at Annex 3.

3. Presentation of a Report by Each Country on the Loran-C/Chayka Programme.

3.1 An analysis of the operation of the Russian stations in the Russian/American Loran-C/Chayka Chain (RAC Chain) and the Russian and Korean Chains of FERNS was given by Russia (**CS 13/3/1**).

The analysis was calculated using the net time of each station operation and the net time that each station was off-air. In accordance with the methodology used for the RAC Chain, the time for technical maintenance of each station was not taken into consideration.

Information was given on the upgrading programme of the Russian stations to increase their reliability and on the reconstruction of general engineering facilities that is currently underway. New control and synchronisation units are being installed at the Petropavlovsk and Aleksandrovsk stations and the Ussuriysk station will be provided with the equipment in 2005.

The future planned operations of the Chayka Radionavigation system were also described in the document, together with the envisaged integration of Chayka with satellite navigation systems.

3.2 Details of the operational status of the North West Pacific Chain were given by Japan Coast Guard in **CS 13/3/2**. The document explained that the chain is operating normally and that the average availability of each station was: Niijima 99.57%; Geshashi 99.65%; Minaitorishima 99.58; Tokatibuto 97.89% and Pohang 99.20%.

Information was also given on the reasons for all major off-air periods. In addition, details of the availability of each baseline and the signal availability of each transmitting station were given on a month by month basis for the year of August 2003 to July 2004.

3.3 China reported (**CS 13/3/3**) on their efforts to co-ordinate and control the Chinese Loran-C system and, in particular on the staff training and equipment maintenance that ensured the system operated in a normal condition. It was noted in the report that after 10 years continuous operation, the performance of some equipment was beginning to degrade, this had made necessary the strengthening of management and the introduction of daily checks, weekly maintenance, monthly examinations and off-air overhauling every 3 months.

Consideration is being given to improving system reliability by replacing control systems, frequency systems and synchronization monitoring systems. In addition, the controlling measures of TOE are being considered to raise synchronous accuracy.

In reply to a question by Russia, it was said that the replacement equipment was intended mainly to improve the reliability and integrity of the system. However, a database of ASF had been established and it was expected that this would enhance the accuracy of the whole system.

3.4 The status of Loran-C stations of the Korean Chain was given in **CS 13/3/4**. The availability of each station over the last twelve months of operation was at least 99.37% and the availability of the chain was 98.52%. The non availability of the Ussurisk station was noted in the report and the hope expressed that the station would soon be on air in accordance with the conclusions of the FERNS Governmental Agreement.

3.5 The Council expressed its concern about the operation of the Petropavlovsk, Aleksandrovsk and Ussuriisk stations and urged Russia to take the necessary actions to enable the stations to operate in accordance with the FERNS Intergovernmental Agreement of 22 December 2000.

4 Operational matters for FERNS co-operating chains.

4.1 Scheduled Off-air for 2005

4.1.1 The off-air schedules for Russia, Japan, China and Korea (**CS 13/4/1, CS 13/4/2, CS 13/4/3 (Rev.2)** and **CS 13/4/4** respectively) were introduced.

Korea was invited to collate the off-air schedules of all the FERNS chains and provide the complete list to all Members by no later than 1 December 2004.

4.1.2 In response to a question from Russia about the average time required to maintain a Loran-C or Chayka antenna, it was generally considered that eight hours was considered to be a reasonable time to inspect the antenna installation and carry out regular maintenance services and activities.

4.2 Other Operational Matters

4.2.1 Japan proposed (**CS 13/4/2-1**) the establishment of a joint MOMAF/JCG Working Team to study the establishment of an alternative effective and economical communication system using Internet for communications between the Control Centres at Chiba and Pohang. The purpose of the alternative system is that it would replace the current communication system provided by KDDI in Japan and KT in Korea.

It was agreed that JCG and MOMAF would carry out a joint study into the possible use of Internet for operational communications between Chiba Control Centre and Pohang Control Centre and report the outcome of the study to the 14th Council Session. It was noted that particular attention should be paid to the need for the communication link to be secure and available for 24 hours every day.

4.2.2 Japan expressed concern (**CS 13/4/2-2**) that the Russian Chain has not yet entered into formal operation as one of the co-operating chains of FERNS. Japan considered the problem has arisen because Russia has not yet taken measures to meet the coordinated signal by using the inverted phase code of Chayka signals.

To enable this problem to be resolved Japan has continued to transmit a testing signal since July 1995. However, the Russia Chain still does not provide a normal service to Loran-C users and consequently there is an unnecessary financial burden on Japan by continuing to transmit the testing signal for a service that does not provide an effective service for Japanese Loran-C users sailing within coverage of the Russia Chain.

Japan urged Russia to invert the phase code of the Chayka signal, otherwise it might become necessary to temporarily “off-air” the transmissions of Tokatibuto station on GRI 7950 until receiving notification that the Chayka signals have been modified.

In response Russia introduced **CS 13/3/1 Add.1** which described the differences between the parameters of the Russian and Japanese stations, explained the tests and trials that had been carried out to resolve the problem and proposed some possible solutions to overcome the present difficulties. The document also mentioned why the suspension of operation of the Takatibuto station in the Russian Chain would not be advisable and would not be in accordance with the Intergovernmental Agreement of December 22, 2000,

5. Technical matters for FERNS co-operating chains.

5.1 FERNS Co-operating Chains Improvement Plan.

(Note. This agenda item also included papers provided for discussion during the proposed Meeting of experts on the future status of Loran-C/Chayka systems.)

5.1.1 Japan introduced their proposals (**CS 13/5-1/2**) on Improvement Plan of FERNS Chains. Information was given on the current situation of Loran-C in Japan and described how improvements are being made to the positional accuracy by use of actual ASF corrections and by the introduction of a new control system.

Japan considered that the following would contribute to the development of Loran-C/Chayka:

- An international understanding of the vulnerability of GNSS and the need for a back-up system;
- The development of improved international standards for Loran-C/Chayka receiving equipment
- The unification of time control systems; and,
- The development of low cost hybrid GNSS/Loran-C/Chayka receiving equipment.

In response to a question about whether Japan had a mandatory requirement for the carriage of Loran-C/Chayka equipment, it was reported that it had such a requirement for the carriage of either a GNSS or a Loran-C receiver, but the majority of users chose GPS equipment.

5.1.2 Russia introduced a paper on “Prospects for CHAYKA development in the Russian Federation in XXI Century”. A copy of the paper is given in Annex 4. The conclusions of document are:

- The Russian Federation considers CHAYKA as a significant component of an integrated radionavigation service.
- The Russian Federation plans to support CHAYKA operation and improvement up to 2015.
- The CHAYKA further operation as a part of integrated radionavigation service as well as component of international radionavigation systems needs the dual-purpose status.

- The development of international standard of GNSS correcting data transfer via LORAN-C/CHAYKA shall be started urgently.
- The IMO and ICAO regulations for LORAN-C/CHAYKA onboard equipment can provide significant support for this systems future.

In response to questions, Russia confirmed that;

- The paper reflected the recommendations that are being prepared the responsible agencies for consideration by the Government in 2005/6;
- The proposals contain some features that will be similar to e-Loran but there will also be some differences because the research in Russia began earlier that the work in the US;
- An ICAO Conference held this year in St Petersburg had recommended that consideration should be given to the possibility of including the use of the Loran-C/Chayka system in ICAO documentation.

5.1.3 **CS 13/5-1/3** was introduced by China. The document considered various facts about the provision of Loran-C/Chayka services and the matters on which action should be taken by FERNS members to enhance radionavigation in the Far East. In particular the view was expressed that FERNS should make every effort to:

1. maintain continuous operation of Loran-C and Chayka;
2. further assess the capability and method for Loran-C and Chayka as complementary, back or enhanced system to GNSS; and,
3. improve Loran-C and Chayka with regard to accuracy, coverage, reliability, signal accuracy and reliability, including the possible introduction of ASF and TOE technology.

5.1.4 China also introduced a paper on the future status of Loran-C which is given in Annex 5. The presentation concluded that Loran-C/Chayka is a suitable back-up for GNSS for the following reasons:

1. The operating frequency, signal characteristics and error mode of Loran-C/Chayka are different from that of GNSS. Therefore, Loran-C does not share the same vulnerabilities;
2. With proper modulation, Loran-C/Chayka is able to transmit DGNSS corrections, integrity information and other data with no harm to its own performance; and

3. Loran-C/Chayka is already there, and it is most economic and cost-effective to make it as complementary backup to GNSS.

5.1.5 The report of the Technical Working Group (**CS 13/5-1/4**) on the FERNS Co-operating Improvement Plan was introduced by Prof. Chung Se-Mo. The report addressed several related matters including

- An assessment of the vulnerability of GNSS signals to interference in the marine environment;
- Understanding of the term "back-up to GNSS";
- Does the risk of interference to GNSS signals in the marine environment justify the need for a "back-up" radionavigation system?
- Is Loran-C and/or Chayka suitable to provide a back-up service to GNSS; and,
- What other services can be provided by Loran-C and/or Chayka in a GNSS environment?

The major conclusions contained in the report are:

1. In regions where Loran-C or Chayka transmissions are currently available the probable loss of GNSS signals is full justification for these services to be retained;
2. Loran-C and Chayka are the most appropriate radionavigation systems to provide back-up to GNSS;
3. State of the Art performance specifications for Loran-C and Chayka receiving equipment should be developed. Preferably these should be integrated with performance specifications for GNSS receiving equipment to provide a hybrid system;
4. A universal performance standard for modulating the pulses of Loran-C and Chayka transmissions for the purpose of providing differential GNSS corrections should be developed.

5.1.6 The Chairman read a letter to the Council that had been sent on 2 September by Dr. Linn Roth, President of the International Loran Association. A further message received from Dr. Roth on 9th September, which included a copy of a letter from the US Secretary of Transportation concerning the future of Loran as part of the US long term radionavigation system mix was also read to the Council. Copies of the letters are given at Annex 6.

5.1.7 Korea introduced **CS 13/5-2/4** which addressed the future of Loran-C/Chayka systems. The document explained the situation in Korea concerning the future of their stations and informed the Council that the future Loran-C operation of MOMAF is dependant on the outcome of the Loran evaluation currently being undertaken in the USA.

In response to a question, it was explained that un-manned transmitting stations was made possible by the use of highly reliable equipment and controlling the transmitters remotely from a Control Centre

5.2 Other Technical Matters

5.2.1 **CS 13/5/1-1** that provided experimental investigation results on the efficiency estimation of the SNS Differential Corrections using the Petrozavodsk Chayka RNS Station was presented by Russia. It was explained that the purpose of the investigation was to determine the optimum message coding scheme for modulating Chayka signals to transmit differential corrections for Satellite Navigation Systems without significantly degrading the use of the Chayka signals for position determination.

CS 13/5/1-2 on the experimental results of determination of the Chayka Systems transmission parameters using the measurement equipment set of the Internavigation RTC was also presented by Russia. The aim of the experimental trials was to determine the degree of influence of the differential mode of operation of the Petrozavodsk Chayka station on the radionavigation signal parameters with various levels and indices of modulation

Descriptions were given of the equipment used in each experiment, the methods used in conducting the investigations and the results obtained. The composite conclusions of both experiments were that:

- Three level modulation with ± 1.5 μs shift and a shortened Reed-Solomon code is preferable. It allows up to three errors in a message and supports the required data rate of 50 bits/s.
- Chayka stations can be used as reference stations to transmit differential corrections for Satellite Navigation Systems without deterioration to their operational quality.

6 Co-ordination of other radionavigation services in the Far East.

6.1 DGNSS Services

6.1.1 The problems and prospects as regards development of the marine differential GLONASS/GPS subsystem in Russia was reported in **CS 13/6/1**. The report explained the difficulties that were being faced in this work through the lack of standards for the organisation of a DGNSS service, DGNSS equipment and a training system for DGNSS personnel

The DGNSS stations being installed in Russia have an operating range of 250 km and currently five stations have been deployed, one is fully operational and the other four are operating in "test" mode.

In response to questions it was stated that:

- The need for standards for DGNSS equipment related specifically to reliability andavailability issues and not to the transmission characteristics which have been set out by the ITU;

- The baud rate of the signals was originally set to 200 but has now been adjusted to 100.

Russia agreed to their report being made available to the IALA Radionavigation Committee for their information.

6.1.2 The effect of a GPS anomaly on the DGPS service provided by Japan was reported (**CS 13/6-1/2-1**). The unhealthy state of satellite PRN#23 caused abnormal differential correction signals to be transmitted for approximately 1 hour and 45 minutes, followed by a period of approximately 1 hour during which no differential corrections were transmitted because the satellite had by then been declared unhealthy but was still being used by all Japanese DGPS stations as the reference satellite.

Japan broadcast a Navigation Warning to ships navigating in Japanese waters, notifying them of the anomaly.

6.1.3 The Council was informed (**CS16/6-1/2-2**) that Japan Coast Guard has announced that local weather reports will be broadcast by its 27 DGPS stations. Each DGPS station will be capable of transmitting reports, using message type 16, from up to six local weather observation centres. Each report will be updated every 30 minutes.

6.1.4 Information was given by China (**CS 13/6-1/3**) that 20 DGPS stations are provided in their country. The first six stations were put into normal operation in July 1997. However, after being in continuous operation for eight years the number of failures of some equipment, and transmitters in particular, are increasing. Work on upgrading the stations will commence at the end of 2004 and will involve replacing the transmitters and computer system as well as enhancing the operating system and interface.

Additional measures are under consideration to improve availability and integrity including the establishment of a central control centre and two or three more stations. Feasibility and assessment studies will take place at the end of 2004 and, if appropriate, this will be followed by the development of a construction plan.

6.2 Co-ordinated revised frequency plan for DGNSS stations

6.2.1 No papers had been submitted on this agenda item. However, during the discussions on the documents given under agenda item 6.1 Russia and China had expressed concern about the possibility of mutual co-channel interference being caused unless adequate co-ordination took place during the planning phase of the DGNSS stations.

6.2.2 The Chairman drew attention to the fact that discussions on the co-ordination of these services took place during both the 11th and 12th sessions of the FERNS Council. He stressed the importance of ensuring that co-channel interference is reduced to a minimum because of the need to provide users with a reliable service.

6.2.3 All members agreed to provide to the 14th Council Session information on the DGNSS stations that they have put into operation and the planning for future stations. The information provided would include the name of the station, its location, frequency of operation and operational range

6.3 Required availability rate for DGPS stations

6.3.1 Korea reported (**CS13/6-1/4**) that a reference station with a synchronised timing system has been completed at Muju in 2004, two further stations, at Chunchon and Yongju respectively, are under construction and should be completed this year, with three more stations, at Chonwon, Pyongchang and Sunsan respectively, to follow. It is planned to extend the synchronised timing system for GNSS back-up infrastructure and the timing of all NDGNSS will be synchronised to the Muju reference station.

Information was given on the development of a DGPS receiver with an Electronic Chart in local-mode for coastal users as part of their applications plan of DGNSS infrastructure.

Korea also reported the availability rate achieved for DGPS by their NDGNSS stations during the period September/03 to June/04 and expressed their support for the availability to be 99.8% in accordance with IMO and IALA recommendations.

6.4 Other Radionavigation Services

6.4.1 Japan reported (**CS 13/6-2/2**) that their AIS service in the Tokyo area began operations on 1 July 2004. Vessels of length 200m and over as well as other "controlled vessels" fitted with AIS equipment need no longer report via VHF radiotelephone to Tokyo-Wan VTS Centre when entering the passage route into Tokyo Bay. Vessels with a tonnage of 10,000 or more are "controlled vessels" in Tokyo Bay.

6.4.2 The AIS service covers a greater area than the existing radar system and therefore expands the area over which the Tokyo-Wan VTS Centre can provide an effective advisory service.

7. Any other business.

7.1 A system for the electromagnetic monitoring of short-term earthquake precursors based on ground and space-based radionavigation systems was described by Russia (**CS 13/7/1**). Experimental and theoretical studies have shown that parameters of signals from the Alpha, Loran-C/Chayka and GLONASS/GPS radionavigation system undergo anomalous variations when propagating through seismo-active regions during the time preceding an earthquake.

7.2 The simultaneous reception and processing of signals from these radionavigation systems at monitoring centres and the high-precision synchronisation of time scales of all the systems and their components against a common-time scale will enable the detection of an earthquake precursor and provide an estimate of its intensity and the co-ordinates of its epicentre.

7.3 The document proposed that an infrastructure of a monitoring network be set up by FERNS States and suggested the matters that should be contained in the first phase of its development to provide short-term warnings of earthquakes.

7.4 In reply to a question about the impact on the monitoring system by variations to the propagation path of signals caused by other phenomena, it was said that there was a probability that between 10% and 20% of variations were precursors to earthquakes. It was considered this probability was sufficient to initiate a warning because of the devastating effect of earthquakes on life, buildings and transportation infrastructure.

7.5 The problems related to the development of a new edition of the Russian Radionavigation Plan were introduced to the meeting (**CS13/7/1-1**). Information was given on the manner in which the various national and international radionavigation systems were taken into consideration and on the need for the Plan to be consistent with similar planning taking place in adjacent parts of the world. The problem of the need to protect the vulnerability of radionavigation systems from damage and interference was also reported to be a matter for consideration in the Plan.

7.6 The presenter also gave an explanation of the use of a Navigation Journal prepared by the Internavigation R&TC and requested the meeting to authorise information about this Council Session being published in the Journal. This was agreed unanimously.

8 Date and venue of the 14th session.

8.1 At the invitation of the Republic of Korea (**CS 13/8/4**) it was agreed that the 14th session of the Council will be convened in Seoul, Korea in 2005. The Ministry of Maritime Affairs and Fisheries will determine the venue and specific dates for the meeting, which will probably be held in late October, and inform members of FERNS at least four months prior to the session.

9. Closing of the session.

9.1 The Council reviewed the draft report of the 13th session and adopted it with amendments. The final report is given in Document **CS13/9/1**.

9.2 The Council expressed its great appreciation to the Russian Institute of Radionavigation and Time and the Internavigation R&TC for the excellent arrangements made for the meeting, the hospitality that had been shown to all participants and for the very interesting

cultural tour to Petersghoff and the visit to RIRT that were undertaken.

9.3 The Chairman extended his appreciation to all the delegates for the hard work, mutual understanding and co-operation that contributed to the success of the session.

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