WILD GOOSE ASSOCIATION

15 July 1987

MINUTES OF THE 77th MEETING OF THE BOARD OF DIRECTORS

The 77th meeting of the Board of Directors was held as scheduled 15 July 1987. See Exhibit 1.

Attendees:

Directors	Members	Visitors
W.N. Dean	D.C. Scull	F. Mackenzie
J.F. Culbertson	R.D. Bronson	
M.J. Moroney	R.L. Frank	
W.L. Polhemus		

Approved by Board with changes noted. 19 Oct 87 RKK

Item 1 - Call to Order

The meeting was called to order at 0945 15 July 1987. The number of Directors present DID NOT meet the requirements of a quorum.

Item 2 - Secretary's Report

The Secretary's written report which was distributed to all Directors is shown as Exhibit 2. (Correct Exhibit 2 to be provided)

The minutes of the 76th Meeting were approved.

Item 3 - Treasurer's Report

The Treasurer's Report is shown as Exhibit 3. Following a review and discussion of the report, the report was accepted as presented.

Marchal reported through Dean that final accounting for the 1986 Convention would be forthcoming and that things are coming out "more or less even".

Culbertson indicated he has follow-up information on the WGA logo golf shirts, T-Shirts and hats (discussed under Treasurer's Report - last Board Meeting) to bring up under 1987 Convention Report.

Item 4 - Standing Committee Reports

a. Conventions

1986 - Marchal reported to Dean that Proceedings are due out this week and that he should have final accounting within two weeks. He expects to break even within $500.

1987 - Toms convention report (Exhibit 4) and convention Call for papers with preliminary agenda (Exhibit 5) were discussed. Comments concerning selection of the banquet speaker, the possible addition of a Keynote Speaker, the desire for a General Membership Meeting (possibly AM of second day), Board Meeting (early first day), "user" of the hospitality suite, first-day luncheon, and how this year's Proceedings would be handled will be taken up with convention chairman by Dean. Discussed Toms recommendations in his report regarding use of WGA treasury to compensate retired Board Members/Ambroseno and Fehlner. The Directors agreed that this matter should be taken up separately from convention business and that rewarding the Board from the Treasury might be a dangerous precedence to set.

Culbertson produced samples of WGA logo hats, golf shirts and T-shirts with costs. The Directors unanimously agreed that these items would be very popular at the convention and there should be sufficient quantities for sale including additional hats. Culbertson indicated that the $600 approved at the last Board Meeting would purchase about 30 golf shirts and 40 T-shirts. The Directors believe this quantity should be increased and that a total of $1600 should be advanced from the Treasury to make the purchases. Dean will contact other Directors for their approval. Culbertson will contact Toms with ordering information and costs for hats - order for all items should be consolidated and placed from outside California to avoid sales tax.

Discussed need to insure that the Convention Notebook includes mail lists used this year to advertise convention and distribute Call for papers. - Culbertson will mail copy of Publications List found in files to Toms for inclusion.

1988 - Bronson reported he is focusing on downtown Portland location near public transportation which honors government rate - has at least four candidate locations in mind and is proceeding to negotiate. Theme will address the forthcoming filling of the mid-continent gap. Discussed possibility of extending to Loran-C/GPS mix now being discussed. Should have location nailed down and will advertise during October convention in Washington. Noted that this years' convention conflicts directly with the NASAO General Meeting and in 1988 we will be competing for papers with the Old Crows (September). PLANS-88 will be held in Orlando, FL during December 1988 and should not conflict. Assuming now that the WGA convention dates will be 18 - 20 October 1988 unless other conflicts dictate a recommended change. Chairman expressed need now for small advance ($500) to purchase convention stationary and other expenses. Dean to direct Treasurer to make this advance.

b. Journal

Dean stated that it looks like no Journal for this year - we are probably falling into a biennial schedule - which may be good. Discussed needs for assistance to those doing Journal for technical papers and to review manuscripts for accuracy and completeness (old version of By Laws printed last time). Need was expressed for Journal to be timely so advertisements are not dated. Culbertson suggested that renewed consideration be given to handling the Journal publication commercially (under positive WGA control) including advertising, circulation, etc., using some opportunistic publisher who understands the current level of activity in Loran-C and who could publish the Journal for profit in a very timely manner without over burdening WGA volunteers. Dean stated he would pursue this idea.

Discussed other sources of Loran-C data - need for centralized bibliographies and how to assemble this information. ION's system was discussed as well as what TSC has been doing for the FAA. Moroney volunteered to get sponsor approval for release of TSC information on disks to a Loran-C data base. Bob Frank was asked to look into the matter of assembling such a data base and report to the Board. Moroney will attempt to make the TSC data base available to Frank to examine.

c. Membership

No membership report was received.

d. Newsletter

The Directors agreed that Newsletter is improving with each edition. Next edition due on street after 1 September (cut off date for articles) and before the Convention. Discussed costs for publication and mailing the Newsletter noting that most recent mailings cost 39 cents each for First Class and were sent in envelopes. This to be discussed with Editor to explore possibilities of returning to bulk mailing and perhaps reducing handling costs without creating serious problems for our volunteer editor who is doing an outstanding job.

e. Elections

The Directors were provided copies of the Chairman's Report dated 30 June 1987 (Exhibit 6). The Directors present recognized the problem raised in the Secretary's Report (Exhibit 2) regarding the tie for the 4th and 5th Director positions. This matter was tabled for resolution by a properly constituted Board at the 1987 Convention Board Meeting.

f. Congressional

The Chairman made no report.

Polhemus discussed HR 2310 the Mineta Bill which revitalizes the Airport Development Act and gets wheels rolling for Authorization Bill to include funds for airport development from the Trust Fund. Section 17 Amendment to this Bill includes 4 specific tasks to be undertaken by DOT-RSPA/CG/FAA with Congressman Smith to pursue funding (Exhibit 7). Bill currently is still in full committee (out of sub committee) and should be on the floor later in July 1987.

Polhemus discussed ongoing efforts in Canada regarding Loran-C. Notes summarizing this discussion are included as Exhibit 8.

g. Awards

Frank reported that he needed nominations for ALL awards in spite of TODAY being the deadline for the October awards! Copy of list of prior awards circulated for information (not included with minutes). Frank is in process of contacting all prior Medal of Merit awardees for their input. Culbertson will provide contact point for RADM Manning (Ret). There are two awards for WGA executive Board approval (from President) - also Honorary Membership and need nominations for this.

Item 5 - Old Business

a. GPS Timing of loran chains. Latest efforts discussed earlier in Bill moving through Congress (Exhibit 7)

b. Culbertson's ideas for using surplus. Culbertson suggested copies of report be provided to Directors and that matter be taken up at October Convention. Dean expressed interest in pursuing development of a brochure to be used at other conferences and meetings. Dean will renew discussions with John Beukers who expressed interest in being Publicity Chairman for WGA at last Convention.

Item 6 - New Business

a. RTCA Progress. Dean introduced Draft RTCA letter on GPS from SC 159 along with copies of the minutes of the 17 June 1987 SC 159 Meeting and RTCA paper No. 285-87/SC159-109 Titled Global Positioning System (GPS) Integrity For Civil Aviation (Exhibits 9, 10, and 11). (Full text available on request)

b. Dean introduced copy of FAA Memorandum dated 2 July 1987 signed by Donald Engen (Exhibit 12).

c. Disposition of WGA Hat, Golf Shirt and T-Shirt. The Directors agreed that in the interest of promoting WGA and the forthcoming 1987 Convention at the NASAO Loran-C Working Group meetings (taking place in Portland, OR on 16 and 17 July 1987), these items would be officially presented by Walt Dean or Jim Culbertson as follows:

Golf Hat to John Kern, new Assoc. Admin. for Flight Safety, FAA

T-Shirt to Paul Burket, Admin. Oregon Aeronautics Div. and Chairman of the NASAO Working Group.

Golf Shirt to Cong. Denny Smith.

Item 7 - Next Meeting

The next meeting will be held during the 1987 Convention at the Crowne Plaza - Holiday Inn, Rockville, MD after dinner on Monday, 19 October 1987.

The Board Meeting was adjourned at 1330 on 15 July 1987.

J.F. Culbertson
Acting Secretary

cc: President
Directors
D.C. Scull
R.L. Frank
R.H. Miller
R.D. Bronson
J.L. Toms

EXHIBIT 1

WILD GOOSE ASSOCIATION

June 1, 1987

TO: WGA Directors and Committee Chairmen

FROM: WGA President

SUBJECT: 77th Meeting of the Board of Directors

The next meeting of the Board of Directors will be held Wednesday, 15 July, 1987, at 9:30 AM at the office of ARNAV Systems, Inc., 16100 S.W. 72nd Ave, Portland, Oregon. Please note that this is a change from the previous announcement, caused by a change in the scheduled NASAO meeting to Thursday-Friday.

AGENDA

1. Call to Order

2. Secretary's Report

3. Treasurer's Report

4. Standing Committee Reports
   - a. Conventions
     - 1. 1987 Convention Report — Toms
     - 2. 1988 Convention Report — Bronson
   - b. Journal — Ambroseno
   - c. Membership — Toms
   - d. Newsletter — Miller
   - e. Elections — Van Etten
   - f. Congressional — McGann
   - g. Awards — Frank

5. Old Business
   - a. GPS timing of loran chains
   - b. Culbertson's ideas for using our surplus

6. New Business

7. Establish next Meeting date

Exhibit 2
(correct)

WILD GOOSE ASSOCIATION
118 Quaint Acres Drive
Silver Spring MD 20904

6 July 1987

To: President, Wild Goose Association

From: Secretary, Wild Goose Association

Subject: 1987 Election

Reference: Nominating and Elections Committee memorandum, Results of Election, 1987, dtd 30 June 1987, to Secretary

By copies of the reference, all Directors were informed of the results of the 1987 election. Fourth place in the reverse rank order of elected Directors is tied. Therefore there are two possible rosters for the 1988 Board, not including the three possible appointments by the Board. These are shown at Exhibits 1 and 2.

Neither the Constitution nor By-Laws prescribes a method for resolving the tie for fourth place, and therefore which of the Exhibits should prevail. Since the Board is the highest ruling authority, it is recommended that the Board resolve this issue at the 77th Meeting scheduled for 15 July 1987. A quorum will be required.

Leo F. Fehlner
Secretary

cc: President and Directors

Exhibit 1

3 July 1987
LIST OF CURRENT WGA BOARD MEMBERS
PAGE 1

==========

Bernard Ambroseno
212 Madison Street
Dedham MA 02026

PHONE: 617/329-1500
TYPE: Elected
TERM EXPIRES END OF: 1990

++++++++++

David A. Carter
15922 Paisley Lane
Bowie MD 20716

PHONE: 301/249-5496
TYPE: Elected
TERM EXPIRES END OF: 1990

++++++++++

Leo F. Fehlner
118 Quaint Acres Drive
Silver Spring MD 20904

PHONE: 301/622-0529
TYPE: Elected
TERM EXPIRES END OF: 1990

++++++++++

Vernon L. Johnson
17 Maple Drive
No. Caldwell NJ 07006

PHONE: 201/228-2642
TYPE: Elected
TERM EXPIRES END OF: 1990

++++++++++

Carl S. Andren
3160 Readsborough Court
Fairfax VA 22031

PHONE: 202/628-2436 & 703/560-2198
TYPE: Elected
TERM EXPIRES END OF: 1989

++++++++++

James F. Culbertson
15781 Exeter Street
Westminster CA 92683

PHONE: 714/531-7974
TYPE: Elected
TERM EXPIRES END OF: 1989

++++++++++

John D. Illgen
7819 Langlo Ranch Road
Goleta CA 93017

PHONE: 805/965-0551 & 805/968-3995
TYPE: President 1988
TERM EXPIRES END OF: 1989

++++++++++

Jimmie L. Toms
712 Ridge Drive
McLean VA 22101

PHONE: 301/695-4040 & 703/448-6034
TYPE: Elected
TERM EXPIRES END OF: 1989

++++++++++

3 July 1987
LIST OF CURRENT WGA BOARD MEMBERS
PAGE 2

==========

Walter N. Dean
8060 Sacajawea Way
Wilsonville OR 97070

PHONE: 503/694-1443 & 503/684-1600
TYPE: Ex-President 1988
TERM EXPIRES END OF: 1988

++++++++++

Edward L. McGann
18 Wolcott Avenue
Andover MA 01810

PHONE: 617/275-2010
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

Maurice J. Moroney
21 Greenbrook Road
South Hamilton MA 01982

PHONE: 617/494-2026 & 468-2665
TYPE: Replacement for Illgen
TERM EXPIRES END OF: 1988

++++++++++

William L. Polhemus
P. O. Box 220
Jeffersonville VT 05464

PHONE: 802/644-5569
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

William Schorr
4528 Arendale Square
Alexandria VA 22309

PHONE: 202/267-1326 & 703/360-2046
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

James P. Van Etten
230 Rutgers Place
Nutley NJ 07110

PHONE: 201/661-0876
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

Exhibit 2

3 July 1987
LIST OF CURRENT WGA BOARD MEMBERS
PAGE 1

==========

Bernard Ambroseno
212 Madison Street
Dedham MA 02026

PHONE: 617/329-1500
TYPE: Elected
TERM EXPIRES END OF: 1990

++++++++++

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No. Caldwell NJ 07006

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TERM EXPIRES END OF: 1990

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TYPE: Elected
TERM EXPIRES END OF: 1990

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Carl S. Andren
3160 Readsborough Court
Fairfax VA 22031

PHONE: 202/628-2436 & 703/560-2198
TYPE: Elected
TERM EXPIRES END OF: 1989

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James F. Culbertson
15781 Exeter Street
Westminster CA 92683

PHONE: 714/531-7974
TYPE: Elected
TERM EXPIRES END OF: 1989

++++++++++

John D. Illgen
7819 Langlo Ranch Road
Goleta CA 93017

PHONE: 805/965-0551 & 805/968-3995
TYPE: President 1988
TERM EXPIRES END OF: 1989

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712 Ridge Drive
McLean VA 22101

PHONE: 301/695-4040 & 703/448-6034
TYPE: Elected
TERM EXPIRES END OF: 1989

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3 July 1987
LIST OF CURRENT WGA BOARD MEMBERS
PAGE 2

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15922 Paisley Lane
Bowie MD 20716

PHONE: 301/249-5496
TYPE: Replacement for Illgen
TERM EXPIRES END OF: 1988

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Walter N. Dean
8060 Sacajawea Way
Wilsonville OR 97070

PHONE: 503/694-1443 & 503/684-1600
TYPE: Ex-President 1988
TERM EXPIRES END OF: 1988

++++++++++

Edward L. McGann
18 Wolcott Avenue
Andover MA 01810

PHONE: 617/275-2010
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

William L. Polhemus
P. O. Box 220
Jeffersonville VT 05464

PHONE: 802/644-5569
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

William Schorr
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Alexandria VA 22309

PHONE: 202/267-1326 & 703/360-2046
TYPE: Elected
TERM EXPIRES END OF: 1988

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James P. Van Etten
230 Rutgers Place
Nutley NJ 07110

PHONE: 201/661-0876
TYPE: Elected
TERM EXPIRES END OF: 1988

++++++++++

EXHIBIT

WILD GOOSE ASSOCIATION

TREASURER'S REPORT
JULY 14, 1987

Balance from April 30, 1987		$9,223.09
TRANSACTIONS		
RECEIPTS		
Dues	775.00	
Proceedings/Journals	10.00	
	$785.00	$10,008.09
EXPENDITURES		
Elections Expense	682.17	
Awards '86 Expense	279.88	
Newsletter Expense	337.53	
Bank Charge Expense	9.05	
	$1,308.63	$8,699.46
WGA Account Balance as of July 14, 1987		$8,699.46

Submitted: July 14, 1987

Approved: Date 7/15/87
Board of Directors

Carl S. Andren Treasurer

Walter N. Dean President

EXHIBIT 4 P1/4

M E M O R A N D U M

DATE: July 15, 1987

TO: Walt Dean
FROM: Jimmie Toms JT
SUBJECT: 1987 Convention

Although we are running tight on time, everything seems to be falling in place. Here's a rundown.

Technical Session - Tony Pealer is working with the session chairman to round up the papers.

Luncheon Speakers - I've been trying to contact John Ilgen to request that he set up a DOD rep for one of the slots. Of the ones he suggested earlier, Dr. Tom Quinn seems to be a good choice. If John is at the board meeting, please mention it to him.

Banquet Speaker - Congressman Denny Smith will be the speaker.

Hotel Registration - The enclosed announcement should be in the mail by this weekend to all members. The mailing will include a road map, metro map, and hotel brochures.

In past meetings, the board has briefly discussed use of our funds and some compensation to retired board members. I would like to emphasize my feelings that some consideration be voted for the efforts. One example is the work on the Radio Navigation Journal by Ambroseno and Felhner.

At the very least, I would like to propose to the board that these members such as Ambroseno, Felhner, Johnson and Van Etten plus any others in this category be granted complimentary registration to the 1987 convention.

Lastly, there is a complimentary room attached to the hospitality suite that should be given to one of the members traveling at his own expense.

Walt, I sincerely apologize for not attenting this meeting. Let's talk after the board meeting, and if you desire, I will fly out to meet with you.

EXHIBIT 4 P2/4

1987 WILD GOOSE ANNUAL CONVENTION

HOTEL REGISTRATION AND CONVENTION REGISTRATION

The 16th Annual Convention of the Wild Goose Association will be held October 20, 21, and 22, 1987 in Rockville, Maryland at the Holiday Inn Crowne Plaza.

REGISTATION A registration form is enclosed. Please complete and forward as soon as possible. Advanced registrations assist us in planning our space requirements. We'll have your badge ready when you arrive and you'll avoid any lines or delay. The registration desk will be open from:

3:00 p.m. - 7:00 p.m. on October 19
7:00 a.m. - 3:00 p.m. on October 20 and 21
8:00 a.m. - 12 Noon on October 22

HOTEL Pick up your telephone and make a free call to **1-800-638-5963** (1-800-492-1331 in Maryland). Identify yourself as a WGA conference attendee. DO IT NOW! The rate is $72 per night for a single or double room. There are only a limited number of rooms at this rate so reserve early. See the enclosed material.

P.S. There are executive rooms available on the top floor with extra amenities at $115 per night ($125 double).

METRO The Metro stop is directly behind the hotel. It is a convenient and economical method of attending the convention. A Metro map is enclosed.

HOSPITALITY There will be a hospitality suite available as in past years. The location will be posted at the convention. It is sponsored by the companies and individuals as listed.

SPOUSES Spouses are most cordially invited. There will be special activities such as a van trip to the Harpers Ferry, West Virginia area and a tour of the Kennedy Center for the Performing Arts.

HARDWARE EXHIBITS Exhibit space is available in a room immediately adjacent to the sessions room. It is locked at night. See the enclosed sheet.

GOLF TOURNAMENT The traditional annual tournament will be held at The Redgate Golf Course in Rockville on October 19, 1987. Transportation will be provided from the hotel.

EXHIBIT 4 P3/4

WILD GOOSE ASSOCIATION

REGISTRATION FORM
16th ANNUAL WILD GOOSE CONVENTION
October 20-21, 1987

Holiday Inn Crowne Plaza
Rockville, Maryland

_____
NAME

_____
COMPANY OR GOVERNMENT OFFICIAL

_____
STREET ADDRESS

_____
CITY STATE ZIP CODE

_____
COUNTRY

Members:		
Advanced Pre-registration	$140.00	_____
Registration at Conference	$165.00	_____
Non-Members:		
Advanced Pre-registration	$165.00	_____
Registration at Conference	$190.00	_____
Other Activities:		
Tennis Tournament	$ 15.00/person	_____
Golf Tournament	$ 30.00/person	_____
Extra Proceedings	$ 15.00/each	_____
Guests:		
Luncheon, October 21	$ 17.00/person	_____
Banquet, October 21	$ 35.00/person	_____
Luncheon, October 22	$ 17.00/person	_____

TOTAL ENCLOSED ..... $_____

Make check payable to **WGA 16th Annual Convention** and mail to:

Jimmie L. Toms (ANI)
61 Thomas Johnson Drive
Frederick, MD 21701

EXHIBIT 4 P 4/4

16th ANNUAL WILD GOOSE CONVENTION

October 20-21, 1987

Holiday Inn Crowne Plaza
Rockville, Maryland

REGISTRATION FEE INCLUDES:

1. October 20, 1987: Welcoming Reception
2. October 21, 1987: Luncheon
3. October 21, 1987: Banquet
4. October 22, 1987: Luncheon
5. Attendance at all technical and panel sessions
6. Preprints at convention
7. Convention Proceedings
8. WGA Cap

EXHIBIT 5 1/3

WILD GOOSE ASSOCIATION

OCTOBER 20-22, 1987 MEETING

LORAN-C -- A MID-LIFE SYSTEM

LORAN-C has been with us since the early 1960's. It has developed a large following and many uses not originally envisioned. LORAN-C user costs have come down and the user's capability has increased. Today LORAN-C counts aviation, marine, and land navigation as well as many special purpose users among its clientele. This conference will examine LORAN-C's position in the world radionavigation community and what dimensions it will take in the future. Papers are desired in the following areas:

- Government Policy
- User Equipment Developments
- Marine Systems Applications
- Air Systems Applications
- Surface Systems Applications
- Special Uses and Applications

Abstracts of papers should be sent to the following address by **June 30, 1987:**

Wild Goose Association
c/o Tony Pealer
Systems Control Technology, Inc.
Suite 905
1611 North Kent Street
Arlington, VA 22209

Notification of acceptance will be sent by July 31, 1987. Papers will be needed by September 15, 1987 for preprint in the proceedings.

The 1987 Wild Goose Association Meeting will be held in Washington, D.C. at the Holiday Inn Crowne Plaza from October 20-22, 1987.

EXHIBIT 5 P 2/3

WILD GOOSE ASSOCIATION

OCTOBER 20-23, 1987 MEETING

A G E N D A

DAY 1 MORNING

D. Scull

GOVERNMENT POLICY

- Federal Radionavigation Plan
- DOD Loran-C Use Plans
- FAA Mid-Continent Status
- Loran System in U.S.
- Loran Timing Issues, Use of GPS Time?

AFTERNOON

E McGann

FOREIGN GOVERNMENT LORAN-C ACTIVITIES

- Update of Canadian Loran System and Plans
- Loran Part in IALA Worldwide Radionavigation Plan
- European Loran-C Working Group Policy and Recommendations
- Far East Loran-C Update
- Middle East Loran-C Update

EXHIBIT 5 P3/3

WILD GOOSE ASSOCIATION

DAY 2 MORNING

M. Shuey

LORAN-C IN THE AIR

- New Approaches for Landing
- User Experiences

AFTERNOON

Bill Adams RTCM

LORAN-C ON THE WATER

- User Experiences
- New Developments

DAY 3 MORNING

R Bronson

LORAN-C ON LAND AND OTHER USES

- Land Navigation
- Geostar Retransmission
- Surveying
- Timing

AFTERNOON

V. Lally

USER EQUIPMENT

- New Trends in Equipment
- New Products

EXHIBIT 6

WILD GOOSE ASSOCIATION

June 30, 1987

MEMORANDUM TO: Secretary, Wild Goose Association

FROM: Nominating and Elections Committee

SUBJECT: Results of Election, 1987

WGA ballots for President and Directors were counted at ITT Avionics Division, 500 Washington Avenue, Nutley, New Jersey on June 30, 1987 in accordance with Article IV, Section 5 of the bylaws. Results are as follows:

President:

John D. Illgen	112
Jimmie L. Toms	66
Walter Dean (writein)	1

Director:

Leo F. Fehlner	102	William F. O'Halloran	75
Vernon L. Johnson	95	James O. Alexander	69
Bernard Ambroseno	87	Robert D. Bronson	56
David A. Carter	79	Walter Dean (writein)	1
M.J. Moroney Jr.	79	Jimmie Toms (writein)	2
A. William Marchal	76	William Schorr (")	1

Ballots were counted and are certified by the following members of the Nominating and Election Committee:

James P. Van Etten
James P. Van Etten, Chairman

Robert V. McKeown
Robert V. McKeown, Member

William J. Garmany Jr.
William J. Garmany Jr., Proxy for
Edward L. McGann, Member

Enclosure: WGA Ballots

cc: Directors, Candidates, Nominating & Election Committee

EXHIBIT 7 P1

A. Legislative

Congressman Minetta (R-CA), as Chairman, and the House Aviation Authorization Subcommittee, have completed their work and presented to the full House HR 2310 Re-authorization of the Airport & Airways Improvement Act....funded in part from the Aviation Trust Fund, a $6 B-plus pool of dollars. Congressman Denny Smith (R-OR) has (with Minetta's OK) appended an Amendment known as Section 17 to this Bill.

It may come up for full House approval prior to summer recess but it is not expected to do so until after the recess.

The Amendment contains four tasks of interest to the Loran-C community.

1 - The Secretary of Transportation, acting through the USCG shall undertake to complete and maintain synchronization of all Master Transmitters....etc., to UTC within a range of error less than or equal to 100 nanoseconds.

2 - The Secretary of Transportation acting through the USCG shall study the effect (on the maritime and cartographic communities) of controlling Time of Emission of Secondary transmitters to UTC.

EXHIBIT 7 P2

3 - The Secretary of Transportation acting through the RSPA/TSC, the Action Agency -- shall undertake a study to determine feasibility and means to achieve interoperability of Loran-C and GPS. One goal shall be the use of GPS "common-view" UTC time to achieve and maintain synchronization to within 20-30 nanoseconds.

4 - The Secretary of Transportation acting through the FAA, the Action Agency -- shall establish criteria to be met to achieve certification as a "sole-means" system....Loran-C, GPS, L_C-GPS, Omega-GPS, DME/DME-GPS.

(I will request a verbatim copy of the suggested Amendment.)

EXHIBIT 7 P 3

Monday, 6 April 1987

We* completed the fourth meeting since 2 February at the office of Sec DOT concerning improvements to be made to the Loran system and development of a DOT-sanctioned interface between Loran and GPS.

The U.S. Coast Guard, FAA and the Research & Special Programs Administration (TSC) each agreed to undertake actions which will substantially upgrade the usefulness and performance of the Loran-C system and will create an operational interface between Loran-C and GPS.

Four tasks were assigned by the Office of Sec DOT:

(1) Study and implement Master/Master timing synchronization (to ±100 nanoseconds).
Responsibility, USCG G-TES; budget $800,000 - $1,000,000; period of performance, 2 calendar years; start-up this year. (US Naval Observatory UTC will continue to be the time reference but on a more frequent schedule).

(2) Study the consequences to the maritime community, chart markers, etc. of adopting Time of Emission Control of Secondaries vice SAM Control.
Responsibility, USCG G-TES; budget $200,000 - $250,000; period of performance, less than 2 years....project to be concurrent with Task 1.

(3) Study (the feasibility and means) to achieve interoperability of Loran-C and GPS. This step would include utilization of UTC from the GPS system as an alternative to USNO thereby making all satellites and all Loran-C transmitters share a common knowledge of time. Expected benefit: sync to 20-30 nanoseconds.
Responsibility, RSPA/TSC; budget $500,000; period of performance, probably 2 years.

* A team representing Congressman Denny Smith, Oregon; Sec DOT's office; USCG, FAA and RSPA/TSC.

EXH. 3F 7 P 4

(4) Establishment of (quantitative) criteria to be met in order to receive FAA Certification as a "sole means" navigation aid for operation within controlled/uncontrolled airspace. Systems to be considered: Loran-C RNAV; GPS-RNAV; Loran-C/GPS hybrid RNAV; Omega-GPS hybrid RNAV; DME-GPS RNAV.
Responsibility, FAA; budget $400,000; period of performance, probably 2 years.

Note: All 4 tasks are to be undertaken concurrently....Congressman Smith's office accepted responsibility for raising necessary funds.

I have attached copies of briefing prepared by RSPA and Congressman Smith's office (Polhemus and Enge) which were presented to the Office of the Secretary.

EXHIBIT 7 P5

U.S. Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

MAY 14 1987

Mr. William L. Polhemus
P. O. Box 5
Cambridge, VT 05444

Dear Mr. Polhemus:

Thank you for your participation in the March 26, 1987 "LORAN-C/GPS Common Time Base Conference". We appreciate your interest and the effort you extended to attend the conference. The following paragraphs will provide you a brief summary of the meeting and actions taken or planned as a result of the conference.

The basic issues prompting the conference were:

- Are there significant advantages to improved LORAN-C Synchronization?
- Will Hybrid LORAN-C/GPS qualify as sole means air navigation?

Based on input received at the conference, we perceive the following industry position on the LORAN-C timing/synchronization issue:

- Immediate advantages are gained in going to improved MASTER/MASTER timing
- A market for cross-chain operation receivers will result.
- Industry is ready to produce receivers to accommodate timing improvements.
- Improved timing for all stations based on Time of Emission (TOE) control may offer advantages, but further study is required and users must be given the opportunity to comment on this approach.

Action recommended by the Navigation Working Group was that:

- The USCG proceed to institute improved MASTER/MASTER timing.
- An impact study of TOE control be undertaken.

EXHIBIT 7 P6

On the issue of a Hybrid LORAN-C/GPS system, we saw the following industry concerns:

- o There is need for the FAA to layout requirements for sole means navigation and certification procedures before industry commitment can be made to pursue hybrid avionics development.

- o Hybridization of LORAN-C and GPS will offer benefits to both systems and may allow sole means air navigation, but the concept requires further study.

Actions recommended on the Hybrid LORAN-C/GPS are that:

- o A detailed study be conducted of LORAN-C/GPS interoperability.

- o Sole means navigation requirements be developed and documented.

- o Certification requirements and procedures for hybrid LORAN-C/GPS avionics be developed and documented.

To date the DOT Navigation Working Group has taken the following actions as a result of the conference:

- o RTCA has been approached to look at sole means criteria

- o Congressman Smith's aid and a special assistant to the Secretary of Transportation was briefed on the results of the meeting.

A copy of the Conference Attendees Sign-in List is enclosed for your information. We will advise you of future developments.

Sincerely,

Jack A. Lang,
Executive Secretary DOT
Navigation Working Group

#

EXHIBIT 8 P1

B. Canadian Activities

The negative climate in "official" Canada with respect to Loran-C (the resistance to further implementation of Loran-C and the development of NPA and RNAV procedures) is quietly changing to one of neutrality, maybe even support.

1 - A joint Transport Canada/Air Transport Association Loran-C Technical Working Committee has been formed, has had several meetings, and has completed a set of important field measurements in Quebec. Committee members include 3 engineers from Transport Canada, 2 individuals from ATAC, 2 individuals from Megapulse and Polhemus. Three meetings have been held to date in Ottawa. An action item emanating therefrom specified the need for field strength measurements to be made in central Quebec/Labrador where the geology was regarded as very deleterious to 100kHz signal propagation. Measurements were completed in May, results exceeded Megapulse predictions. Transport Canada engineer concurs; he is to "correct" model used in TC simulation which should lead to an estimate of coverage and transmitter need which is more in line with USCG and Megapulse estimates. The goal of this committee is to obtain agreement within Transport Canada with respect to Loran-C performance so that an official unbiased report concerning its

Exh. 17 & P2

suitability maybe issued by the Ministry. Some means to save face will be a part of the reconciliation.

2 - A second significant step is an intra-departmental agreement between "Transport Canada"(FAA) and "Policy & Research" (RSPA) and a directive from Minister of Transportation assigning responsibility for execution of a multi-modal transportation C/B Loran-C radiolocation services study to Policy & Research. This is an important alteration of policy and should further the cause of Loran. PM for the project will probably be Barry Myers at TDC in Montreal.

3 - Development of a Canadian Radionavigation Plan is underway....under the cognizance of Transport Canada. Policy & Research are pressing to make sure that it addresses multi-modal concerns. Inputs have been requested, informally, from Dave Scull, so non-aviation requirements should be treated fairly. A three-person "review committee" has been identified with Brig. Gen. Keith Greenaway as Chairman. This is good, too!

4 - An evaluation of John Currie's designed MLS is underway at Pemberton, B.C. at this time. Loran-C is

EXHIBIT 8 P3

being used for ground truth verification. USCG supplied one L_C monitor, Megapulse a second, and ANI has provided a 7000 for use in the Air B.C. deHaviland Dash-7 test aircraft. Suggestions have emerged that Loran-C be used in lieu of a second azimuth transmitter for the back course missed approach procedure. Also, that Loran does such a nice job of leading the aircraft to the IAWP....and may, in time, that the dedicated DME might not be required in the future since Loran RNAV could supply the desired Distance To Touchdown or Threshold information. Saves a bundle!

5 - Transport Canada issued an Aeronautical Information Circular in 1984 which is only now being widely circulated; it advises operators on means to obtain approval for VFR and IFR operation with Loran-C. (Copy attached) It has been updated within the past 6 months. It's an important acknowledgment by TC.

6 - <u>RNAV Committee</u>. Transport Canada has agreed to join with ATAC in the formation of a RNAV Working Group with a view to implementation of RNAV-Direct procedures within Controlled and (I believe)

EXHIBIT 8 P 4

Uncontrolled Airspace. Because of the gaps in VOR/DME coverage this initiative will, in the long run, help promote Loran-C RNAV. Also, awareness is growing in Canada of the forecast limitations in the GPS system (only 18 sats [+3 spares], diurnal 20-25 minutes-long P-DOP degradation, need for an external integrity check system) which further stimulates support for Loran.

7 - Three Canadian magazine items and a very interesting letter:

i) "In Our Opinion" by Hugh Whittington, Editor of Canadian Aviation, April '87.

ii) "Time to Stop Dallying Over Loran-C" also by Whittington, May '87.

iii) Letter Rebuttal by Barry Blair, Director, General Air Navigation, Transport Canada.

iv) "The Inevitability of Loran" by Dave Underwood, Flight Magazine, May-June '87...very good arguments.

All in all....things are looking better in Canada!

EXHIBIT 8 P5

Transport Canada / Transports Canada

Air / Air

COM

0/3/84
10th May

AERONAUTICAL INFORMATION CIRCULAR

LORAN-C FOR AIR NAVIGATION

Transport Canada is aware of a growing interest in the use of Loran-C as a means of navigation in certain areas of Canada.

Loran-C is funded and operated by marine agencies and is designed to serve as the primary navigation aid to vessels sailing in coastal areas. Accordingly, transmitters are sited to serve both coasts, the Great Lakes and the St. Lawrence River. They serve their intended purpose well, providing position information to within a few hundred feet. Similar accuracy may be expected by airborne users when flying in these areas, however, once away from the coastal areas, degraded accuracy may be expected.

The main factors affecting accuracy are distance from the transmitters, the geometry existing between the receiver and the transmitters and the type of terrain over which the signals have to cross to reach the receiver. Optimum results will be obtained from ground wave signals having an uninterrupted salt water path to the receiver. Signals with an over-land path are subject to changes in earth conductivity resulting in the receiver measuring incorrect time differences. The presence of sky waves will also introduce errors in the time difference measurements.

Certain drawbacks to the system also serve to restrict its use in air navigation, for example:

(a) there is no NOTAM service for aircraft operators,

(b) aircraft speeds are such that brief signal outages can be unacceptable,

(c) the receiver system may be susceptible to precipitation static,

(d) the most used flying areas are not calibrated or monitored and no back-up transmitter stations exist in many areas.

Despite these drawbacks, Loran-C may be used by aircraft operators within certain areas and constraints. The following guidance is provided to users contemplating the installation of equipment for either VFR or IFR use. Full details may be obtained from Transport Canada's Regional offices.

Installation

The installation of a receiver and associated antenna into an aircraft will be considered a minor modification when the following conditions are met:

(a) the equipment is not connected to aircraft navigation instruments or flight control system,

(b) the installation does not require major structural changes,

(c) the aircraft is placarded to prohibit use of Loran-C for navigation under IFR.

EXHIBIT 8 P 6

All other installations will be considered major modifications.

Whether for VFR or IFR use, Transport Canada requires that the following requirements be met:

1. The installation must comply with the requirements of the E & I Manual, Part II, Chapter I, Section 1.9.

2. The equipment must be listed in the Department of Communications Radio Equipment List.

3. Where the equipment is not intended for use as navigational equipment under IFR, the installation must be placarded to prohibit its use under IFR.

1. VFR Use

There are several inexpensive receivers available that can be a useful aid to VFR navigation provided the user restricts the usage to areas of good signal coverage. Users are cautioned that gross, along or cross-track errors can occur without warning if the receiver locks onto sky waves or other erroneous signals. Furthermore, reports exist of equipment malfunction when flying in the vicinity of high-voltage power transmission lines that employ signalling frequencies.

Approval of an installation by Transport Canada in no way represents a guarantee that the equipment will navigate satisfactorily.

2. IFR Use

As well as satisfying the VFR requirements, approval for IFR use may be obtained after the user demonstrates his ability to use the equipment to navigate within conventional IFR en route tolerances. This would normally:

(a) require a receiver that meets acceptable standards such as FAA TSO C60a, RTCA Doc. DO 159 and FAA AC 90-45a standards,

(b) restrict flight to areas where calibration has guaranteed accuracy and repeatability,

(c) require a return to conventional navigation aids for operations in a radar terminal area and for instrument approach purposes.

3. Extended Use of Loran-C

Commercial operators may obtain authority for the use of Loran-C subject to the foregoing requirements. Approval for use of Loran-C beyond the known areas of signal reliability may be granted after demonstrating the accuracy, reliability and repeatability of the signals along the routes to be flown and during the various seasons of the year. Full details may be obtained from Transport Canada Regional office through the Regional Superintendent of Air Carrier operations.

Barry D. Blair,
Assistant Administrator, Air Navigation

EXHIBIT 8 P7

C. Institute of Navigation

At the Annual Meeting in Dayton, Ohio June 23, 1987 the Council agreed to:

1 - Promote Loran-C Papers which provide evidence of the roles which Loran-C is and will be fulfilling in radionavigation, location, surveillance and timing.

The present situation is partly the fault of the membership of the Loran-C community....it talks only to Cabots, Lodges, God and the WGA.....we (??WGA) have to push the important Loran-C stories onto the ION stage. (We should also run a few ads advertising FRP and USCG plan to keep Loran-C around through the year 2015....in those same spots where Magnavox advertised Loran's demise).

Through direct WGA contact (or for that matter through anyone caring to respond to the call for Papers) with the Technical Chairman of each ION meeting we are encouraged to make sure that at least one or two high caliber papers on Loran-C are offered. The WGA Board might undertake to identify one or two key issues, topics or achievements and appropriate authors to be "invited!" (you will) to present at each of the key meetings...e.g. ION - 2 per year, two

EXHIBIT 8 P8

at each IEEE PLANS Bi-annual meeting and one or two at each NAECON, EASCON and WESCON meetings annually.

As a last resort the Board might submit 3 or 4 of the best papers from the WGA's preceding annual meeting, for presentation at ION (most societies frown on this procedure).

2 - Loran-C - GPS Workshop. It was agreed that ION would extend by one day its planned 26-28 February 88 Technical Meeting in Santa Barbara, California in order to accommodate a Workshop on Interoperability of Loran and GPS (is this Loran-G or GPS-L?)....and also Omega-Loran, etc. The goal would be to establish a basis for a specification which stipulates an X% Confidence of achieving, 100% Availability (e.g. defines level of dissimilar redundancy required) of navigation - location - timing, signals affording a 95% Probability of Fix Accuracy (in domestic airspace, $\leq$ 1/4 nm accuracy, and in oceanic airspace, $\leq$ 3 nm) through year 2015.

Bob Lilley, Ohio University has agreed to be Chairman. This meeting will serve to spread the word about

EXHIBIT 8 P9

HR 2310, the Smith Amendment, which should have been funded by this time, and should also have appeared in the Congressional Record.

It will also serve to confirm the need for RTCA and RTCM work with respect to an interoperability MOPs; to stimulate some hard-nosed work on performance specs; and should begin to establish Loran as an effective and equal partner to GPS. (Look for a re-awakening of military interest in hybrid systems).

3 - The Royal Institute of Navigation. Conference on "Radionav 2000 - the European Dimension" scheduled for 22-24 March 88. The Director states that there is a multi-national growing acknowledgment of the need for a terrestial-based radiolocation service approximately equal in performance to that of GPS but not vulnerable to the same external phenomena. Loran-C is regarded as the appropriate candidate.

It would seem that Loran is on a roll!

(From: Real Admiral R.M. B[illegible]yne, CB

THE ROYAL INSTITUTE OF NAVIGATION
at The Royal Geographical Society
1 Kensington Gore, London SW7 2AT
Tel. 01-589 5021

EXHIBIT 8 P/0

7

1-011-44-1-589-5021

30 June 1987

Dear Major Pothemus,

RADIONAV 2000 - the European Dimension

NAV 88

Following the success of its previous annual international conferences, the Royal Institute of Navigation is delighted to announce NAV 88. This is a 3 day conference to be held at the CITY UNIVERSITY, London EC1, from 22-24 March 1988. The topic is:

RADIONAVIGATION 2000 - the European Dimension

The aims and scope of this conference are explained in the enclosed copy of the Advance Notice and Call for Papers.

The president and council have much pleasure in inviting you to present a paper as outlined in the attached Form 1. In order to facilitate the work of the papers selection committee I would be most grateful for your early confirmation that you will be willing to accept this invitation. It would also be most helpful if you could return Form 2 at the same time.

In the event that you unfortunately cannot accept this invitation, we would much appreciate your proposal for an alternative speaker. It would very much assist our Committee if you could obtain the agreement of your proposed alternative. Authors will not be required to pay a registration fee for the day on which they present their paper.

I look forward to hearing from you at your earliest convenience and, if possible, no later than 15 July.

Yours Sincerely

T.G. Rungoye

Director

RTCA Paper No. 337-87/SC159-111

D R A F T

The Honorable William H. Taft, IV
Deputy Secretary of Defense
The Pentagon
Washington, D. C. 20310

Dear Mr. Taft:

The comprehensive Global Positioning System (GPS) User Policy of May 22, 1985 announced that DoD will make GPS available to civil, commercial and other users on an international basis. Shortly thereafter, the Radio Technical Commission for Aeronautics (RTCA) initiated development of Minimum Aviation System Performance Standards for civil aircraft operation and use of GPS. This activity is being undertaken by Special Committee 159 composed of participants from government, industry and other parts of the aviation community.

In its deliberations to date, the committee has identified critical coverage and integrity deficiencies in the current GPS satellite configuration that will prevent optimum application of GPS to civil aviation. The aviation community is concerned about the impact of these deficiencies on current DoD/DoT policy to use GPS in the national airspace. These deficiencies would preclude national and international use of GPS as a sole means navigation system. The RTCA believes the deficiencies could be eliminated and substantial benefits would accrue to both the DoD and civil community if 24 satellites were deployed. The reasons are as follows:

1. The coverage of the currently planned GPS constellation (18 satellites + 3 active spares) has areas of substantially degraded performance lasting more than 20 minutes, which will regularly occur on a worldwide basis. This precludes the use of GPS as a sole-means aeronautical navigation system and restricts its use to a supplemental navigation aid. This would severely limit replacement of existing navigation systems as envisioned in the Federal Radionavigation Plan.

2. The currently planned GPS constellation will not have adequate integrity for civil use, i.e. the ability of the system to provide timely warning to users when GPS should not be used for navigation. Such protection is necessary and would have to be provided by an independent integrity system including ground monitoring and satellite relay to airborne users with the planned configuration. However, the much improved characteristics of a 24 satellite constellation would allow self-contained monitoring by GPS user equipment to meet the integrity needs under nearly all operating conditions.

EXHIBIT 9 P1

It is believed that the cost of providing an expanded constellation would be minimal and should not greatly influence current launch assets for the 28 Block II satellites. The RTCA is, however, aware that the orbital configuration for a 24 satellite constellation would differ from that currently planned.

For the reasons stated above, the RTCA strongly recommends a 24 satellite constellation be favorably considered at this time. We would be pleased to discuss this matter further with you or a member of your staff.

Sincerely,

William C. Fuchs
Executive Director

EXHIBIT 9 P2

RADIO TECHNICAL COMMISSION FOR AERONAUTICS

One McPherson Square, 1425 K Street, N.W., Suite 500

Washington, D.C. 20005

Telephone: (202) 682-0266

RTCA Paper No. 307-87/SC159-110
June 17, 1987

MINUTES OF THE SIXTH MEETING

Special Committee 159

MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD FOR GPS

The sixth meeting of SC-159 was held June 3, 1987 in the RTCA Conference Room, One McPherson Square, 1425 K Street, N. W., Suite 500, Washington, D. C. 20005. The following attended:

L. Chesto, Chairman	Aeronautical Radio
F. White, Secretary	Honeywell, Sperry Flight Systems Consultant
K. Bierach	Radio Technical Commission for Aeronautics
R. Bowers	Air Transport Association
R. Braff	MITRE Corporation
A. Brown	Applied Technology Associates
R. Brown	Iowa State University
D. Bruce	SRSA
W. Chapman	Federal Aviation Administration
J. Colclough	Rockwell International
T. Elwell	U.S. Coast Guard
O. Hall	OSTI/OSD
J. Headlund	Boeing
W. Helmbrecht	Honeywell Sperry
R. Hendrickson	GPS Joint Program Office
P. Jorgensen	The Aerospace Corporation
R. Kalafus	DOT/Transportation Systems Center
J. Landis	ARINC Research
Y. Lee	MITRE Corporation
C. Longman	Consultant
R. MacEwen	Transport Canada
C. Mason	U. S. Coast Guard
K. McDonald	Federal Aviation Administration
G. Quinby	AOPA & NBAA Consultant
E. Rish	Synetics
R. Rissmiller	Federal Aviation Administration
B. Russell	Air Transport Association
D. Scull	DOT/Research & Special Programs Administration
B. Stein	SAIC
J. Stolpman	Bendix/King Radio
R. Stratton	Transport Canada
S. Turnquist	Arinc Research
E. Wallar	Systems Control Technology

FAINT & 10 PI

R. Wilks — SRSA
A. Winick — MITRE Corporation Consultant

* *

The agenda for the meeting was as follows:

1. Chairman's Remarks

2. Approval of Minutes of the Fifth Meeting, RTCA Paper No. 148-87/SC159-92.

3. Review of EUROCAE WG-28 Activities, RTCA Paper No. 245-87/SC159-99.

4. Discussion of GPS Joint Program Office Letter Concerning Satellite Failures, RTCA Paper No. 244-87/SC159-100.

5. Briefing and Discussion on Development of Standards for GPS/Loran-C Hybrid System, RTCA Paper No. 244-87/SC159-98.

6. Report of the Integrity Working Group Activities, RTCA Paper No. 221-87/SC159-96.

7. Review of Task Assignments.

   a. Operational Environment
   b. Functional Requirements

8. Assignment of Tasks.

9. Other Business.

* *

In accordance with the Federal Aviation Advisory Committee Act, Ms. Wendie F. Chapman, Federal Aviation Administration, was the Designated Federal Employee for this meeting.

* *

Agenda Item 1. Chairman's Remarks.

The Chairman called for introductions which were accomplished. Wendie Chapman was introduced as the "Designated Federal Representative," and those who had not attended SC-159 previously were invited complete registration forms, which are necessary for RTCA records as a Federal Advisory Committee.

Agenda Item 2. Approval of Minutes of the Fifth Meeting (RTCA Paper No. 148-87/SC159-92.

Page three of the minutes, last paragraph, line two: Change to read 1.2.1.1.3. Page four, first paragraph, line 1: change Augment to Argument; line 4: change Associates to Associated; second to last line, first paragraph,

EXHIBIT 18 P2

delete first PDOP in the line. Page 5, last full paragraph, third line from bottom, change wind to wing. With these minor changes, the minutes were approved.

Agenda Item 3. Review of EUROCAE WG-28 Activities (RTCA Paper No. 245-87/SC159-99.

With regard to the suggestion of Paragraph 8.2 concerning GPS receiver "validation," the committee took the view that it was not ready to endorse the EUROCAE suggestion, that dynamic simulation techniques are necessary to permit qualifying a GPS receiver. The comments of Paragraph 5.1 of the EUROCAE paper are believed to be inappropriate since they concern a "draft" version of the Integrity Working Group which in many instances has been substantially changed.

Agenda Item 4. Discussion of GPS Joint Program Office Letter Concerning Satellite Failures (RTCA Paper No. 247-87/SC159-100).

The USAF response, RTCA Paper No. 247-87/SC159-100, was discussed by the committee. The letter was not as useful as the committee had hoped it would be. For example, the verbiage "very rare" is not as useful as would be order-of-magnitude numbers. The word "unlikely" can be read to apply to the spacecraft or to the system. Which is intended? It was noted, in this connection, that the Department of Transportation (DOT) had been asked by the Department of Defense (DOD) to coordinate (as may be appropriate) and submit its requirements which will assist in setting forth some of the needs expressed by the committee in its letter to the GPS JPO. The committee agreed that Cdr. R. G. Hendrickson of the GPS Joint Program Office (who regularly attends SC-159 meetings as its representative) would coordinate obtaining the desired information from the GPS Program Office.

Agenda Item 5. Briefing and Discussion of Development of Standards for GPS/Loran-C Hybrid System (RTCA Paper No. 244-87/SC159-98).

RTCA Paper No. 244-87/SC159-98 and an associated document titled, "DOT Navigation Working Group Presentation on Loran-C Timing & Hybrid GPS/LORAN-C" (dated 4/6/87) were introduced by Dave Scull and discussed by the committee. With regard to the "Compilation of Recommendations" (the last page of the attachment) the committee took the view that it can take no position on these recommendations since they fall outside of the present terms of reference of the committee. The committee also wanted the record to show that it understands the interest of LORAN-C manufacturers and many users in GPS/LORAN-C interoperability and encourages those interested in this concept to define what their requirements are as a useful first step.

Agenda Item 6. Report of the Integrity Working Group Activities (RTCA Paper No. 221-87/SC159-95).

Chairperson Dr. Alison Brown had prepared a summary of the report in a set of slides which was provided as RTCA Paper No. 275-87/SC159-105. Table 2-3 was amended by the committee by changing the entry under Paragraph 2.2.4.5 (En Route Domestic-(Requirements) to Y (yes) with an associated footnote reading "Assuming 90-45 accuracy is not required." It was also suggested that the

table have the following qualifier: "This table should only be used after careful reading of the source paragraphs."

The committee accepted the conclusions in the form submitted. A minor editorial change was made to conclusion No. 3 by adding - "planned 18 plus 3 spares" between the words "the" and "GPS" in line two of that conclusion.

Recommendation number two was not accepted in the form submitted. As an alternative thereto it was agreed that the Chairman, Larry Chesto and Jerry Bradley of FAA will work together to draft a request to the GPS Joint Program Office (at El Segundo) to establish a Working Group to answer question concerning selective availability.

Recommendation 3 was changed to read as follows:

> "Committee on GPS Integrity Channel (GIC) Data Format
>
> In consideration that many years will elapse before all programmed GPS satellites are launched and in recognition that the GPS satellite constellation may be limited to only 18 plus three satellites, it is recommended that action be initiated within RTCA to create a standard data format suitable for broadcasting GPS integrity data using a GPS Integrity Channel (GIC). In addition, this effort should consider the requirements for integrity monitor stations and suitable communication media for the GPS Integrity Channel." (See Agenda Item No. 9D.)

With these changes the recommendations were accepted.

Secretary's Note: A copy of the Integrity Working Group Report, RTCA Paper No. 285-87/SC159-109, is enclosed for Active committee members.

Agenda Item 7. Review of Task Assignments.

Several working papers were submitted in response to the task assignments. One by Rudy Kalafus, intended to provide information for Section 2.3 of the draft MASP document, was titled "Shortcomings of the System," RTCA Paper No. 216-87/SC159-94, and Dr. Alison Brown submitted a paper titled "Integrity Requirements," RTCA Paper No. 274-87/SC159-104. Neither paper was reviewed in detail but they were considered to be generally acceptable for use in the committee's MASP document.

Agenda Item 8. Assignment of Tasks.

Work assignments related to development of MASP (see Agenda Item 7 sub paragraph 3 of RTCA Paper No. 148-87/SC159-92 -- Minutes of the Fifth Meeting.

a. Jim Stolpman of Bendix/King Radio agreed to draft the section titled "Airborne Receiver Requirements."

b. Chic Longman agreed to draft a paper on Geodetic-Earth Reference Model Requirements, to be included in item 4.

Agenda Item 9. Other Business.

a. Grover Brown - Report on the Status of His Studies in Support of a 24 Satellite Constellation.

A brief status report was presented by Grover Brown showing the results of his Monte Carlo simulation using 24 satellites in six equally spaced rings, 4 satellites per ring with no selective availability and assuming a five-degree mask angle. Four plots were provided, see RTCA Paper No. 280-87/SC159-107.

b. Dr. Alison Brown - Report on the Status of Her Studies of a 24 Satellite Constellation Looking at Geometry From an Integrity Point of View.

Her paper concludes that simulation results indicate receiver autonomous integrity monitoring would prove effective where the GPS constellation provided by both the 3-Plane and 6-Plane constellation is suitable to provide integrity for all phases of flight except for non-precision approach. Results show that the 6-Plane constellation has marginally poorer geometry for satellite failure detection than the 3-plane constellation. For other results, refer to RTCA Paper No. 279-87/SC159-102.

c. Wichita Aircraft Certification Office Policy Letter, RTCA Paper No. 276-87/SC159-106.

The letter was issued by the Wichita Aircraft Certification Office to provide guidance to two applicants who desired to use GPS as an add-on sensor to a multi-sensor flight management system. Ralph Rissmiller, FAA, assisted the discussion of the letter and was most helpful. The committee noted that on page 3 of the letter, subparagraph e, where the letter discussed "mask angle," in reality what is being discussed is the minimum usable elevation angle. A question was asked of Ralph regarding the words in subparagraph 2 of the letter (page one) which indicate "a low false alarm rate" is required. The indication was that a rate of 1 in 10 to the minus five looks acceptable.

d. GPS Integrity Channel (GIC) Working Group is Formed.

The committee formed a GIC Working Group and provided Terms of Reference, RTCA Paper No. 281-87/SC159-108. A show of hands indicated that four persons then attending the meeting would participate. It was also agreed that the formation of this working group should be widely publicized in an endeavor to obtain participation from other that aviation interests.

e. Honeywell, Ltd.

Honeywell, Ltd. (Ontario, Canada) comments on the draft version of the committee's MASP (RTCA Paper No. 174-87/SC159-93) were reviewed and incorporated into the current draft MASP where appropriate.

RTCA Paper No. 285-87/SC159-109
June 3, 1987

GLOBAL POSITIONING SYSTEM (GPS)

INTEGRITY FOR CIVIL AVIATION

Prepared by:
SC-159 Integrity Working Group

EXHIBIT 10

TABLE OF CONTENTS

FIGURES AND TABLES

4.0 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary of Conclusions

1. Stand-alone GPS user equipment can normally provide the integrity acceptable for its use as a supplementary navigation system.

2. By combining GPS user equipment with other navigation equipment to provide GPS integrity (see Table 2-3), the availability of GPS as a supplementary navigation system is increased.

3. The use of stand-alone GPS user equipment for sole-menas navigation requires augmentation of the planned 18 plus 3 spare GPS satellite constellation for improved coverage and the provision of acceptable integrity monitoring to the user.

4. A 24 satellite GPS constellation would provide coverage adequate for civil sole-means navigation and integrity for all phases of flight except possibly non-precision approach.

5. A GPS Integrity Channel (GIC) with two additional geosynchronous GPS satellites will provide both coverage and integrity for sole-means navigation over CONUS.

6. The presently planned selective availability errors need to be reduced to meet the 100 m alarm limit goal for non-precision approach.

4.2 Recommendations

1. Expanded GPS Constellation

This working group recommends that the Department of Defense be urged to expand the GPS system to 24 satellites. This constellation will assure continuous coverage and integrity of civil navigation world-wide.

2. Reduction in the Effect of Selective Availability

Analyses by the working group and by others has shown that the presently specified level of Selective Availability (SA) errors will not allow the non-precision alarm limit goal of 100 m to be met. It is recommended that a joint working group involving both SC-159 and DoD personnel be formed to (a) determine the appropriate alarm limit required for non-precision approach, (b) determine the SA level and bounds needed to meet these requirements, and (c) study the planned SA errors to ascertain their effect on GPS integrity. The acceptability of a reduced level of SA to the DoD should also be assessed.

3. Committee on GPS Integrity Channel (GIC) Data Format

In consideration that many years will elpase before all programmed GPS satellites are launched and in recognition that the GPS satellite constellation may be limited to only 18 plus 3 spares, the working group recommends that action be initiated within RTCA to create a standard data format suitable for broadcasting GPS integrity data using a GPS Integrity Channel (GIC). In addition, this committee should consider requirements for integrity monitor stations and suitable communications media for GPS Integrity Channel.

4. Topics for Further Study

The following topics are recommended for futher study:

a. Self-contained Integrity Methods

Quantitative measures need to be made of the radial error that can be protected against for various levels of Selective Availability and various satellite constellations.

b. GPS-LORAN

Techniques for using LORAN measurements to check the integrity of GPS need to be studied in detail, and the benefits of integrating GPS and LORAN be investigated.

c. Baro-Altitude Aiding

The use of baro-altitude for integrity purposes needs further quantitative study.

EXHIBIT 12

Memorandum

U.S. Department of Transportation
Federal Aviation Administration

Subject: INFORMATION: Loran C Program

Date: JUL 2 1987

From: Administrator

Reply to Attn. of:

To: Regional Directors

On the eve of my departure as Administrator I want to make a few comments on the Loran program which stands out as an example of the progress that can be made when the aviation community works together to achieve a common goal. In less than 3 years, Loran has progressed from an intriguing concept to the reality of instrument approaches at eight airports across the Nation. It appears, furthermore, that our long-term objective of unrestricted Loran nonprecision approaches in the NAS will be met before the end of 1990.

I was especially happy to participate in the first Loran instrument approach at Hanscom Field in Bedford, Massachusetts. It was an excellent opportunity to demonstrate our full commitment to this vital program. Before the end of the year, at least four more Loran procedures will be approved at other airports and another at a heliport where the procedure is specifically intended to enhance the safety and efficiency of helicopter operations in the Gulf of Mexico.

The agency can justifiably be proud of many aspects of the Loran program. Loran signal monitors were conceived and the procurement is in progress, flight inspection methods were created, and a Notice-to-Airmen system for Loran was established. Of particular importance in the program has been the close cooperation between the FAA and other organizations; that cooperation has been the basis for the successes that we claim. In this regard, the FAA encouraged and supported industry efforts to produce Loran aviation receivers and to incorporate the latest technologies that sell at very attractive prices. The Loran early implementation project, which resulted in approaches at those first eight airports, was conducted for the FAA by the DOT Transportation Systems Center. We have worked closely with the U.S. Coast Guard so that transmitters will be acquired by the FAA Southwest and Northwest Mountain regions. Finally, the unflagging dedication to the Loran program of State Aviation Directors under the aegis of the National Association of State Aviation Officials has been vital. The state group has done a superb job of focusing the needs and requirements of their aviation constituents so that we could make the most productive use of our energies and resources.

Your participation in the Loran program will become increasingly important in 1988 when nationwide deployment of operational Loran aviation monitors will begin. The implementation plan for the monitors soon will be available with the planned sites for each monitor designated. Completion of installation of all monitors by early 1989 and the mid-continent transmitters by the end of 1990 will be major steps in providing a Loran capability in the National Airspace System. The final steps will be approval of additional avionics units that meet FAA standards and development of new approach procedures, especially at the smaller, general aviation airports not served by current approach aids.

I know that I can count on your support to continue the rapid progress of the Loran program and to reach the goals of improved area navigation and instrument approach procedures at more airports nationwide. If you feel that a status update of the Loran program would aid implementation in your region, please contact John Kern, AVS-2, the project leader for the FAA Loran team. John will arrange for members of our Loran group to provide briefings for the program.

Let's make it happen!

Don Engen

Donald D. Engen