

5-3-7. Impressions and remarks.

Thanks to the whole-hearted cooperation and strenuous efforts of all the personnel concerned, the hydrographic survey in the Study Area F53 was completed successfully to obtain all the necessary data for preparation of the smooth sheet of survey, based on which Fiji Nautical Chart No.F53 would be prepared.

In parallel with this, all the work for preparation of Fiji Nautical Chart No.F52 were elaborately conducted by JHD in which a counterpart from FHS participated most efficiently throughout the whole process of the preparation.

5-4. FOURTH YEAR (PHASE IV) (F.Y. 1997)

5-4-1. Period of Study

From 15 April 1997 to 20 March 1998.

5-4-2. Objectives

- (1) Preparation of P/O-IV.
- (2) Explanation of P/O-IV to the Fiji Government to reach agreement thereof.
- (3) To conduct hydrographic survey in Study Area F54.
- (4) To prepare Fiji nautical chart No.F53.
- (5) To render technology transfer to Fiji counter personnel during the survey and data processing for Study Area F54.

5-4-3. Pre-work in Japan (From 15 to 30 April 1997)

5-4-3-1. Preparation of P/O-IV

Based on P/O-I and PR/R-III, P/O-IV was drawn up, giving a detailed plan of hydrographic survey to be conducted for Study Area F54, of the pre-work and post-work to be carried out in Japan, as well as of the preparation of Fiji Nautical Chart No.F53.

5-4-3-2. Preparations for survey

Necessary instruments and materials for the survey were made available, tested and sent to Fiji by air.

Computer programmes and boat sheets for facilitating field operation of the survey were also prepared.

5-4-4. Work in Fiji (From 1 May to 9 September 1997)

5-4-4-1. Composition of Study Team

The Study Team consisting of the following personnel was dispatched to Fiji to carry out the work in line with the objectives as aforementioned:

Leader : Mr. Yasuhiro Oyamada

Member : Mr. Masao Kuga

Mr. Masashi Saito (5 May to 10 September 1997)

Mr. Toshiaki Kuroiwa (8 May to 10 September 1997)

Mr. Toshiaki Watanabe (5 May to 10 September 1997)

Mr. Shuhei Hatake (8 May to 10 September 1997)

Mr. Masaji Koyama (as above)

Mr. Shinichi Yamaoka (12 August to 10 September 1997)

5-4-4-2. Diary of work

The diary of the work carried out by the Study Team appears as in Appendix 4-1.

5-4-4-3. Explanation of P/O-IV to Fiji Government and agreement thereof

On 2 May 1997, the Study Team explained P/O-IV to FHS, and discussions followed to reach agreements on P/O-IV in principle. The Minutes of Meeting (M/M) was prepared to describe the matters agreed upon, which was then signed by the representatives of both parties on 2 May 1997.

The copies of P/O-IV and M/M are attached herewith as Appendices 4-2 and 4-3, respectively.

5-4-4-4. Installation of equipment on board R/V TOVUTO and test

Survey equipment, such as echo-sounders, GPS receiver antennas, radio sets, etc. were properly installed on board R/V TOVUTO, and necessary tests were carried out by the time when the survey vessel departed Port of Suva on 13 May 1997 as scheduled.

5-4-4-5. Field work

5-4-4-5-1. General

All the field work was conducted in accordance with the methods, standards and specifications as described in P/O-IV.

5-4-4-5-2. Establishment of survey base

A survey base was established at Tubou, Lakeba, on 14 May 1997.

5-4-4-5-3. Control point survey

(1) Primary shore control point

Control point survey by closed DGPS observation to establish primary shore control points (fixed stations) was carried out at five stations, three at the proposed stations at the survey base and two nearby existing triangulation stations, one at a jetty and the other at the hill top on the other side of the island.

For the purpose of fixing positions of the survey vessel as well as those of auxiliary

shore control points and others, DGPS observations started on 16 May 1997 and continued throughout the survey period at each of the primary shore control points in turn so that the survey vessel would easily be able to receive the signal.

(2) Auxiliary shore stations

Open DGPS observations were conducted for fixing positions of auxiliary control points and others as follows:

Primary shore control points : 5.
Auxiliary shore control points : 155.
Beacons : 12.
Wreck : 2.
Total : 174.

(3) The instrument used was DGPS Trimble 4000SSE.

(4) Duration of observation was as follows:

Primary shore control points : 90 minutes or more.
Auxiliary control points and others : 20 minutes or more.

5-4-4-5-4. Coastlining

Coastlining was conducted in accordance with the procedure described in par. 4-1-2.

5-4-4-5-5. Tidal observation

(1) A tidal observation hut was built on the jetty at Tubou, Lakeba, on 15 May 1997, where three sets of self-recording tide gauges were housed. (cf. figure 8)

(2) The following tide gauges were used:

- (a) Pressure type tide gauge YEO-KAL Model 610 (digital recording).
- (b) Floating type tide gauge model PFT-II (analogue recording).
- (c) Pressure type tide gauge RMD (digital recording).

(3) A tide pole was erected beside the jetty near the hut. Two bench marks (BM) were established near the root of jetty. For determination of the zero of tide gauges, levelling was carried out between the tide pole and BMs.

(4) A continuous 88-day tidal record was obtained from the tide gauges. These tidal records, together with the tidal record obtained from Suva tide station, were used for determination of MSL and DL in the survey area, as well as for tidal reductions to soundings.

5-4-4-5-6. Sounding operation

(1) The sounding operation was conducted in accordance with the procedures described in par. 4-1-1.

(2) The sounding distances covered were as follows:

General area : 1,297km.
Passage area : 1,798km.
Around islands and reefs : 2,699km.
Shoals reported or found : 205km.
Total distance sounded : 5,999km.

- (3) The periods of sounding operation were as follows:
1st voyage : From 16 May to 11 June 1997.
2nd voyage : From 20 June to 15 July 1997.
3rd voyage : From 24 July to 16 August 1997.
4th voyage : From 21 to 26 August 1997.

5-4-4-5-7. Newly found shoal and search for reported shoals

- (1) During the course of sounding, the following shoal was revealed to exist, which was later named as "Cakau-ni-Uwa":
Position : 18° 40.0' S., 178° 18.0' W.
Least depth : 4.9m.
Bottom characteristics : Coral.
- (2) The depths of charted banks and shoals were confirmed as follows:
- (a) Malan Bank (17° 56.7' S., 178° 13.3' W.).
Charted depth : 14.6m.
Least depth confirmed : 15.6m.
- (b) Cobe Bank (18° 09.7' S., 178° 18.9' W.).
Charted depth : 10.9m.
Least depth confirmed : 12.6m.
- (c) Shoal (18° 30.0' S., 178° 27.2' W.).
Charted depth : 17.6m.
Least depth confirmed : 730m(Shoal non-existent).

5-4-4-5-8. Field inspection

Inspection of the field operation for survey methods and instruments on board R/V TOVUTO as well as for the primary shore control point and the tide station, were carried out three times by the staff members of JHA as follows:

- (1) 1st time
Inspector : Mr. Masayoshi Hirao, Acting Director, Research Division, JHA.
Period : From 24 May to 3 June 1997.
- (2) 2nd time
Inspector : Mr. Motoji Kawanabe, Director, Research Division, JHA.
Period : From 5 to 15 July 1997.
- (3) 3rd time
Inspector : Mr. Ryoichi Horii, Deputy Director, Research Division, JHA.

Period : From 9 to 19 August 1997.

5-4-4-5-9. Meeting for conclusion of field work

On 1 September 1997, a meeting for conclusion of the field work in Phase IV was held at FHS, which was attended by the Study Team members, FHS staff and counterpart personnel and the Master of R/V TOVUTO.

The Minutes of Meeting describing items discussed and agreed was prepared and signed by the Leader of Study Team and the Chief Hydrographer of FHS on 2 September 1997. (Appendix 4-4)

5-4-4-5-10. Dismantling of survey instruments and concluding work

On 26 August 1997, R/V TOVUTO was dismantled of survey instruments. From 27 August to 3 September 1997, those instruments were packed and returned to Japan together with data obtained from the survey.

5-4-5. Post-work in Japan (From 10 September 1997 to 20 March 1998)

5-4-5-1. Data processing and preparation of manuscript sheets

5-4-5-1-1. Control point survey

The results of control point survey were processed as described in par. 4-1-6-1, and the control point sheet was prepared in accordance with the specifications described in par. 4-1-7-1.

5-4-5-1-2. Coastlining

For those control points with which aerial triangulations were performed, the results were compiled into the final results of aerial triangulation.

The coast line sheet was prepared in accordance with the specifications described in par. 4-1-7-2

5-4-5-1-3. Tidal observation

(1) Tidal corrections

Tidal corrections to soundings and heights were applied based on the tidal data observed at the Lakeba tide station.

(2) Determination of MSL and DL

As for MSL and DL for soundings, the reference level determination book including computation method and data was compiled.

5-4-5-1-4. Sounding

The sounding data were processed accordingly with the specifications described in par. 4-1-6-4.

Based on the sounding data thus processed, the sounding sheet and the bathymetric

plotting sheet were prepared in accordance with the specifications described in pars. 4-1-7-3 and 4-1-7-4, respectively.

For the areas where close sounding for searching shoals was conducted which made plotting of all fixed positions impossible, they were shown on separate sheets on the scale of 1/10,000.

5-4-5-2. Preparation of smooth sheet of survey

The smooth sheet of survey of the Study Area F54 was prepared in accordance with the specifications described in par. 4-1-8, with the following title:

FIJI ISLANDS
LAU GROUP-SOUTHERN PORTION
LAKEBA PASSAGE TO KABARA

5-4-5-3. Preparation of survey report

The progress and results of survey operation were compiled into the report on the hydrographic survey for the Study in Phase IV and submitted to the Fiji government together with the final products of the survey as listed in Appendix 4-5.

5-4-5-4. Inspection of smooth sheet of survey

The smooth sheet of survey for Study Area F54 thus prepared was duly inspected by JHA for preparation of Fiji Nautical Chart No. F54.

5-4-5-5. Preparation of Fiji Nautical Chart No.F53

For preparation of Fiji Nautical Chart No. F53, all the work from the planning, compilation and drafting work to make the printing plates of Chart No. F53 were conducted by JHD in which a Fiji counterpart was participating on the OJT basis for 183 days from 23 June to 22 December 1997.

5-4-5-5-1. Chart specifications, basic factors and procedures (cf. par. 4-2)

- (1) Chart No : F53.
- (2) Title : FIJI ISLANDS
LAU GROUP-NORTHERN PORTION
NANUKU PASSAGE TO LAKEBA PASSAGE
- (3) Corner coordinates : 17° 59' 33" S, 16° 40' 00" S
179° 25' 00" W, 178° 30' 55" W
- (4) Chart format (Neat line dimensions) : 638.8 × 978.2mm
- (5) Scale : 1:150,000 (at Lat.17° 20' S)
- (6) Graticules graduated : Two parallels of 17° S and 17° 30' S and one meridian of 179° W.
- (7) Chart paper : The same paper as currently used by JHD; size 1,040 × 765mm, weight

140g/m

(8) Existing source materials to be adopted : Depths in lagoon areas were be adopted from the existing BA Chart Nos.440, 441 and 416, as well as from the smooth sheet of survey in Vanua Balavu Lagoon prepared by FHS in 1996.

5-4-5-5-2. Compilation planning

Compilation planning of Chart No.F53 was conducted for 7 days from 30 June to 8 July 1997, in which those items of work described in par. 4-2-1 were carried out.

5-4-5-5-3. Preparation of drawing guide

Based on the planning sheet and the planning note prepared, a drawing guide was prepared on the plastic film for 42 days from 9 July to 12 September 1997, in which those items of work described in par. 4-2-2 were carried out.

5-4-5-5-4. Preparation of chart originals

The chart originals (original drawings) of the black colour plate and magenta colour plate were prepared based on the drawing guide for 40 days from 16 September to 19 November 1997, according to the procedure described in par. 4-2-3.

5-4-5-5-5. Examination of chart originals

From 21 to 28 November 1997, the contents of the chart originals were examined from the viewpoint of navigational safety and comprehensiveness by users.

5-4-5-5-6. Preparation of block correction

Explanation on possible preparation of block correction of the chart for updating was explained to the counterpart from 1 to 5 December 1997.

5-4-5-5-7. Preparation of printing plates

From 8 to 17 December, platemaking was processed according to the procedure described in par. 4-2-6.

5-4-5-5-8. Printing of Chart No.F53

Using the printing plates thus prepared by JHD, 200 copies of the Chart No.F53 were printed.

5-4-5-5-9. Inspection of printed Chart No.F53

The 200 copies of the printed Chart No.F53 were duly inspected by JHA, and sent to the Fiji government from JICA.

5-4-6. Counterpart training in Japan

Counterpart training were conducted in Japan as follows:

- (1) Counterpart training in preparation of nautical chart
Name of counterpart : Mr. Sunil Kumar, Senior Technical Assistant (Cartography)
Period of training : From 23 June to 22 December 1997.
Training conducted by : JICA, Maritime Safety Agency, Aero Asahi Corporation and Asia Air Survey Co., Ltd.
Training schedule : As shown in Appendix 4-6-1.
Training subjects : As shown in Appendix 4-6-1. The training was mainly conducted at JHD on the whole process of preparation of Fiji Nautical Chart No.F53.

- (2) Counterpart training in preparation of smooth sheet of survey
Name of counterpart : Mr. Gerard D. Rokoua, Technical Officer I, Hydrography
Period of training : 17 November to 18 December 1997.
Training conducted by : JICA, Maritime Safety Agency, Aero Asahi Corporation and Asia Air Survey Co., Ltd.
Training schedule : As shown in Appendix 4-6-2.
Training subjects : As shown in Appendix 4-6-2. The training was mainly conducted at Aero Asahi Corporation and Asia Air Survey Co. It was particularly focused on sounding data processing by computer.

5-4-7. Problems encountered and suggestions to the future work

5-4-7-1. Survey instruments

It was found at the beginning of the survey the main echo-sounder Bathy-2000P became unserviceable and replaced by the backup Bathy-1000 with having no further backup echo-sounder. Although the manufacturer of Bathy-2000P in U.S.A. sent instructions to activate the software, it could not become fully operational probably due to software problem.

5-4-7-2. Weather

The weather in the survey area was mostly favourable until late-July, when it turned to be windy and rainy which prevented the survey ship to carry out survey work. However, the recovery of weather in August made the survey work to be concluded as scheduled eventually.

5-4-7-3. Plotter

In comply with the suggestion made at the concluding meeting of survey work last year, JICA provided a plotter for the field work of survey. It arrived in FHS early August and technology transfer to FHS counterpart personnel in operating the plotter was sufficiently made in the latter part of the survey.

It was believed that with the use of this equipment the survey work by FHS would be benefitted in gaining both more accurate and speedier data processing in the future.

5-4-8. Impressions and remarks

Thanks to the whole-hearted cooperation and strenuous efforts of all the personnel concerned, the hydrographic survey in the Study Area F54 was completed to obtain all the necessary data for preparation of the smooth sheet of survey, based on which Fiji Nautical Chart No.F54 would be prepared. Thus, the entire hydrographic survey aimed at in the Study were completed successfully.

5-5. FIFTH YEAR (PHASE V) (F.Y. 1998)

5-5-1. Objectives

The objectives of the Study in Phase V were as follows:

- (1) To survey and analyze the existing status of the organization, facilities and activities of FHS.
- (2) To make an analytical study of the results and findings of the survey and analysis in (1) above.
- (3) Based on the relevant data and information obtained by the survey and analytical study thereof on the current conditions and problems in operation and management system of hydrographic surveying and nautical charting in FHS, to make any recommendation for possible improvement of such system.
- (4) To prepare a Draft Final Report (DF/R) including the results of (2) and (3) above, and to discuss and finalize DF/R between the Government of Fiji and JICA.
- (5) To prepare Fiji Nautical Chart No.F54, where technology transfer would be made to Fiji counterpart personnel.
- (6) To prepare Final Report (F/R) containing the results of (2) and (3) with its Summary and the report covering the whole work and products of the Study, and to submit F/R to the Fiji Government by JICA together with the printed copies of Fiji Nautical Chart No.F54.

5-5-2. Study period

- (1) Pre-work in Japan
From 15 to 24 May 1998.
- (2) Work in Fiji
From 25 May to 1 July (1st Stage) and from 2 to 8 November 1998 (2nd Stage).
- (3) Post-work in Japan
From 2 July to 1 November 1998 (1st Stage) and from 9 November 1998 to 31 March 1999 (2nd Stage).
- (4) Preparation of Nautical Chart No.F54.
From June 1998 to March 1999.

5-5-3. Flow and schedule of work

The flow and schedule of work were as shown in Appendices 1 and 2, respectively, of P/O-V (cf. Appendix 5-1).

5-5-4. Progress of work in Phase V

5-5-4-1. Pre-work in Japan (1st Stage)

5-5-4-1-1. Planning

Based on the materials, data and information collected by the JICA Preparatory Study Team as well as by the Study Team during Phases I and IV, a detailed plan for implementation of the Study in Phase V was worked out.

5-5-4-1-2. Preparation of Plan of Operation (P/O-V)

P/O-V for Phase V work for the Study was prepared on the basis of S/W as well as the detailed plan in par. 5-2-1-1 above. P/O-V described a substantial guideline of the work as to methods, types and amount of work, etc. to be conducted in Japan and in Fiji, including those items for which co-operation to be requested from the Fiji side.

5-5-4-2. Work in Fiji (1st Stage) (From 25 May to 1 July 1998)

5-5-4-2-1. Composition of Study Team

The composition of the Study Team was as follows:

Leader : Mr. Yasuhiro Oyamada

Adviser : Mr. Katsuji Chiba (JHD), from 15 June to 1 July 1998,

Mr. Shinobu Inazumi (JHD), from 15 June to 1 July 1998.

5-5-4-2-2. Diary of work

The diary of work carried out is as shown in Appendix 5-2-1.

5-5-4-2-3. Explanation of P/O-V and consultation

P/O-V thus prepared was submitted to FHS for explanation by the Study Team Leader, and consultation was held to reach agreements on the content, and M/M describing the matters discussed and agreed was prepared and signed by the Chief Hydrographer of FHS and the Study Team Leader.

The copies of P/O-V and M/M appear as Appendices 5-1 and 5-3-1, respectively.

5-5-4-2-4. Survey and analysis of the existing status of the operation and management system for hydrographic surveying and nautical charting in Fiji

- (1) A survey were made to the existing status of the organization, human resources, facilities and equipment, recent work results, financial status, maintenance, arrangements and storage of nautical charts and relevant data and information, chart publication plan, etc. of FHS that is responsible for the planning, maintenance, production and management

of nautical charts.

- (2) The items of materials, data and information collected for the survey were as follows:
- (a) Organization of FHS and Marine Department.
 - (b) Number, academic and professional background and job descriptions of the staff and employees of FHS.
 - (c) Number, type and make of the equipment and instruments:
 - survey vessel
 - control point survey
 - hydrographic survey
 - oceanographic observation
 - cartographic work including printing
 - (d) Results of work of FHS in the recent years:
 - Hydrographic surveys carried out
 - Charts issued and/or sold
 - Publications issued and/or sold, including Notices to Mariners and Navigational Warnings
 - (e) Amount of budgetary allotments and expenditures with breakdowns according to items
 - (f) Maintenance, servicing and storage of charts and relevant materials and data
 - (g) Chart publication planning (domestic and international)
 - (h) Other relevant information.
- (3) Those materials, data and information thus collected were analyzed to clarify the existing status of the all aspects of FHS.

5-5-4-2-5. Appraisal of analysis and preparation of recommendation

The results of the analysis were appraised by the Study Team, based on which the Study Team drew up pertinent recommendations for publication of nautical charts to be required for the Fijian waters, in particular, those to meet short-term requirements (cf. Volume I of the Final Report).

5-5-4-2-6. Analysis of vital points

Any vital point for possible publication of those charts according to the recommendation in par. 5-5-4-2-5 above were brought out and analyzed by the Study Team.

5-5-4-2-7. Preparation of Draft Final Report

Aiming at improving the current situation thus analyzed, the Study Team drew up those recommendations that would be practicable and adaptable in Fiji, and the Study Team drafted a Draft Final Report (DF/R) including the results of analysis, appraisal and

recommendations.

The DF/R thus drafted was discussed by the FHS and the Study Team, and agreed in principle. The M/M in this regard was prepared and signed by the Chief Hydrographer of FHS and the Study Team Leader. (cf. Appendix 5-3-2)

5-5-4-3. Work in Fiji (2nd Stage) (From 2 to 8 November 1998)

5-5-4-3-1. Composition of Study Team

Leader : Mr. Yasuhiro Oyamada
Adviser : Dr. Kunio Yashima (JHD)

5-5-4-3-2. Diary of Work.

The diary of work at the second stage is shown in Appendix 5-2-2.

5-5-4-3-3. Discussion for finalisation of DF/R

The DF/R was reviewed by the FHS and Study Team for finalisation at a meeting held in Suva. It was agreed that the DF/R was to be finalized for publication in due course, and M/M in this regard was prepared and signed by the Chief Hydrographer of FHS and the Study Team Leader (cf. Appendix 5-3-3)..

The finalized DF/R constitutes Volume I of the Final Report (F/R).

5-5-5. Post-work in Japan

5-5-5-1. Preparation of Final Report

Upon receipt of the comments on the DF/R from the Fiji side, the Study Team prepared the Volumes I and II of the Final Report (F/R) with incorporating necessary amendments.

The contents of F/R are as follows:

- (1) Volume I (Titled as "Main Report Volume I - Recommendations for the Improvement of Operation and Management System of Hydrographic Surveying and Nautical Charting in Fiji):
 - (a) Results of analysis of the existing status of operation and management system of hydrographic surveying and nautical charting in Fiji.
 - (b) Appraisal of the results in (a) and recommendations for improvement of the system.
 - (c) Summary of (a) and (b) above.
- (2) Volume II (Titled as "Main Report Volume II - Study Progress Report"):

Report on the whole work and products of the Study from Phase I to Phase V.

5-5-5-2. Submission of F/R

The F/R, Volumes I and II thus finalized, are to be submitted to the Government of Fiji

from JICA by the end of fiscal 1998.

5-5-5-3. Preparation of Nautical Chart No. F54

The preparation of Chart No.F54 was undertaken by JHD after receipt of the results of the hydrographic survey and other relevant materials and data from JICA. Throughout the period of the preparation, a counterpart from FHS participated in the work as counterpart training.

5-5-5-3-1. Chart specifications, basic factors and procedures (cf. par. 4-2)

- (1) Chart No. : F54.
- (2) Title : FIJI ISLANDS
LAU GROUP-SOUTHERN PORTION
LAKEBA PASSAGE TO KABARA
- (3) Corner coordinates : 19° 05' 00" S, 17° 47' 00" S
179° 08' 00" W, 178° 12' 00" W
- (4) Chart format (Neat line dimensions) : 657.4 × 959.4mm
- (5) Scale : 1:150,000 (at Lat.18° 25' S)
- (6) Graticules graduated : Two parallels of 18° 15' S and 18° 45' S, and one meridian of 178° 45' W
- (7) Chart paper : Size 1,052 × 730mm, weight 140g/m
- (8) Existing source materials to be adopted : Depths in lagoon areas will be adopted from the existing BA Charts Nos. 416 and 441.

5-5-5-3-2. Compilation planning

A planning sheet and a planning note for Chart No. F54 were prepared as the results of compilation planning carried out from 23 to 29 July 1998, in accordance with the procedure described in par. 4-2-1.

5-5-5-3-3. Preparation of drawing guide

Based on the planning sheet and the planning note prepared, a drawing guide was prepared from 30 July to 29 September 1998, in accordance with the procedure described in pars. 4-2-2.

5-5-5-3-4. Preparation of chart originals

The chart originals (original drawings) of the black colour plate and magenta colour plate were prepared based on the drawing guide from 30 September to 24 November 1998, in accordance with the procedure described in par. 4-2-3.

5-5-5-3-5. Verification and examination of chart originals

From 25 November to 1 December 1998, the contents of the chart originals were examined from the viewpoint of navigational safety and comprehensiveness by users.

5-5-5-3-6. Preparation of block correction

Explanation on possible preparation of correction blocks for updating the chart was given to the counterpart from 2 to 8 December 1998.

5-5-5-3-7. Preparation of printing plates

From 9 to 16 December 1998, platemaking was processed in accordance with the procedure described in par. 4-2-6.

5-5-5-3-8. Printing of Chart No. F54

Using the printing plates thus prepared by JHD, 200 copies of the Chart No. F54 were printed.

5-5-5-3-9. Inspection of printed Chart No. F54

Each and every copy of the 200 copies of the printed Chart No. F54 was duly inspected by JHA.

5-5-6. Counterpart trainings in Japan

Counterpart training were conducted in Japan as follows:

(1) Counterpart training in preparation of nautical chart

Name of counterpart : Mr. Yauka Daventa Soro, Technical Officer I (Cartography)

Period of training : From 20 July to 19 December 1998.

Training conducted by : JICA, Maritime Safety Agency, Aero Asahi Corporation and Asia Air Survey Co., Ltd.

Training schedule : As shown in Appendix 5-6-1.

Training subjects : As shown in Appendix 5-6-1. The training was mainly conducted at JHD on the whole process of preparation of Fiji Nautical Chart No.F54.

(2) Counterpart training in operation and management of hydrographic surveying and nautical charting

Name of counterpart : Mr. Felix Ranchor Maharaj, Chief Hydrographer

Period of training : 5 to 20 September 1998.

Training conducted by : JICA, Maritime Safety Agency, Aero Asahi Corporation and Asia Air Survey Co., Ltd.

Training schedule : As shown in Appendix 5-6-2.

Training subjects : As shown in Appendix 5-6-2. The training mainly consisted of exchanging comments and discussions on the matters of mutual concern as well as observing various related facilities at Aero Asahi

Corporation, Asia Air Survey Co., JHD, Maritime Safety School
(Hydrographic Course) in Maizuru and Hydrographic Department of
5th Regional Maritime Safety Headquarters in Kobe.

6. IMPRESSION AND REMARKS

At the final stage of the Study, recommendations for improvement of operation and management system of hydrographic activities were prepared from the practical point of view so that they would be materialized without difficulty under the present condition of Fiji.

To this work the four years' experience in the actual survey work of the Study in Fiji with the cooperation of the Fiji Hydrographic Service have been very useful to grasp all the aspects of the FHS's activities.

Thanks to the contributive cooperation of the Chief Hydrographer and other staff of FHS, it is considered that the recommendations finally prepared are practicable ones under the current conditions of Fiji, so that the operation and management system may further be developed and become more useful to the shipping and other maritime activities of this country.

It is firmly believed that the modern instruments and technique transferred to the FHS and its staff during the Study will greatly help their efforts to materialize the targets aimed at by those recommendations.

The three nautical charts, Nos. F52, F53 and F54, certainly give the concrete expression to the praiseworthy technical cooperation and friendly relationship between the Fiji Islands and Japan.

FIGURES

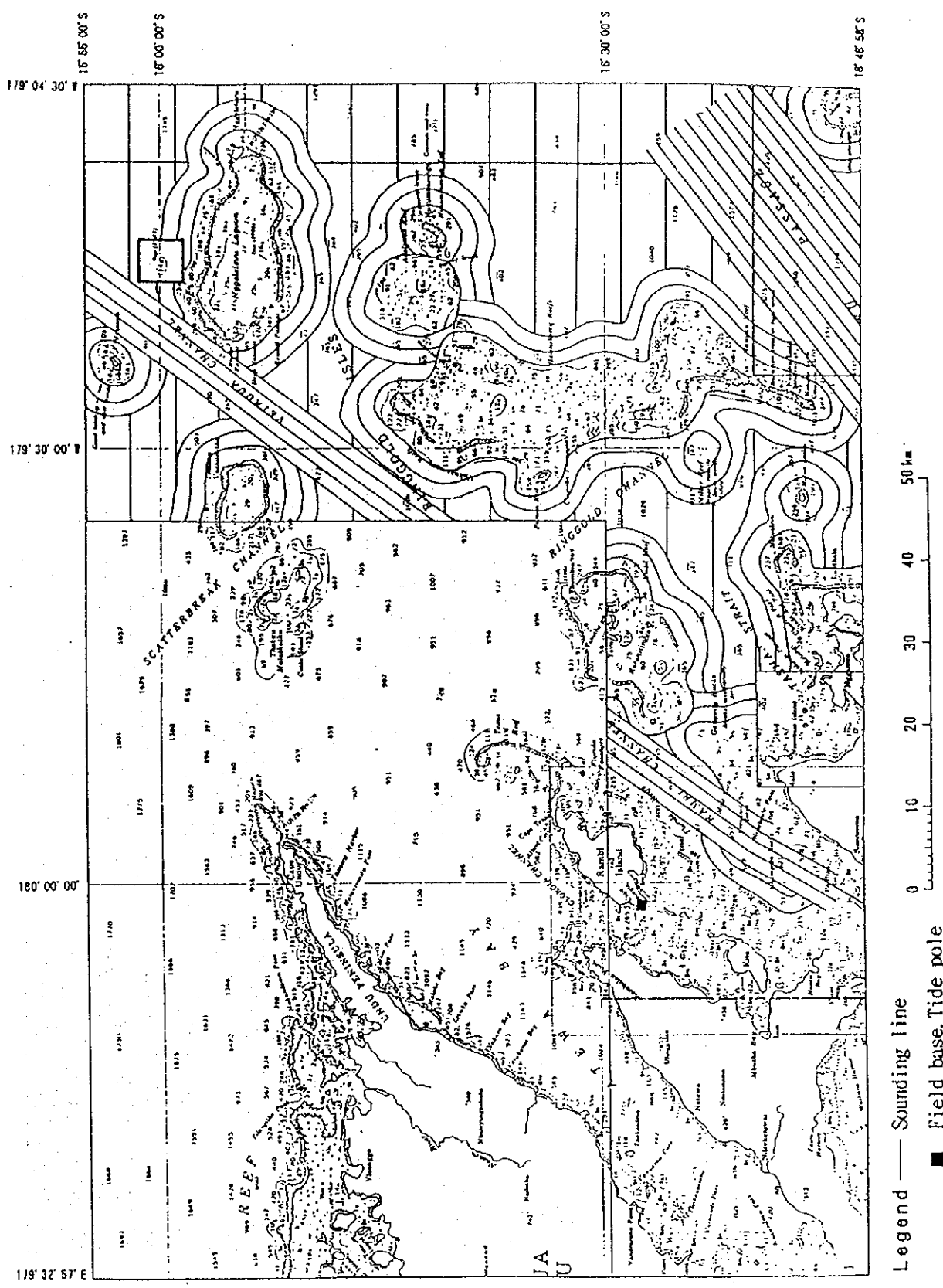
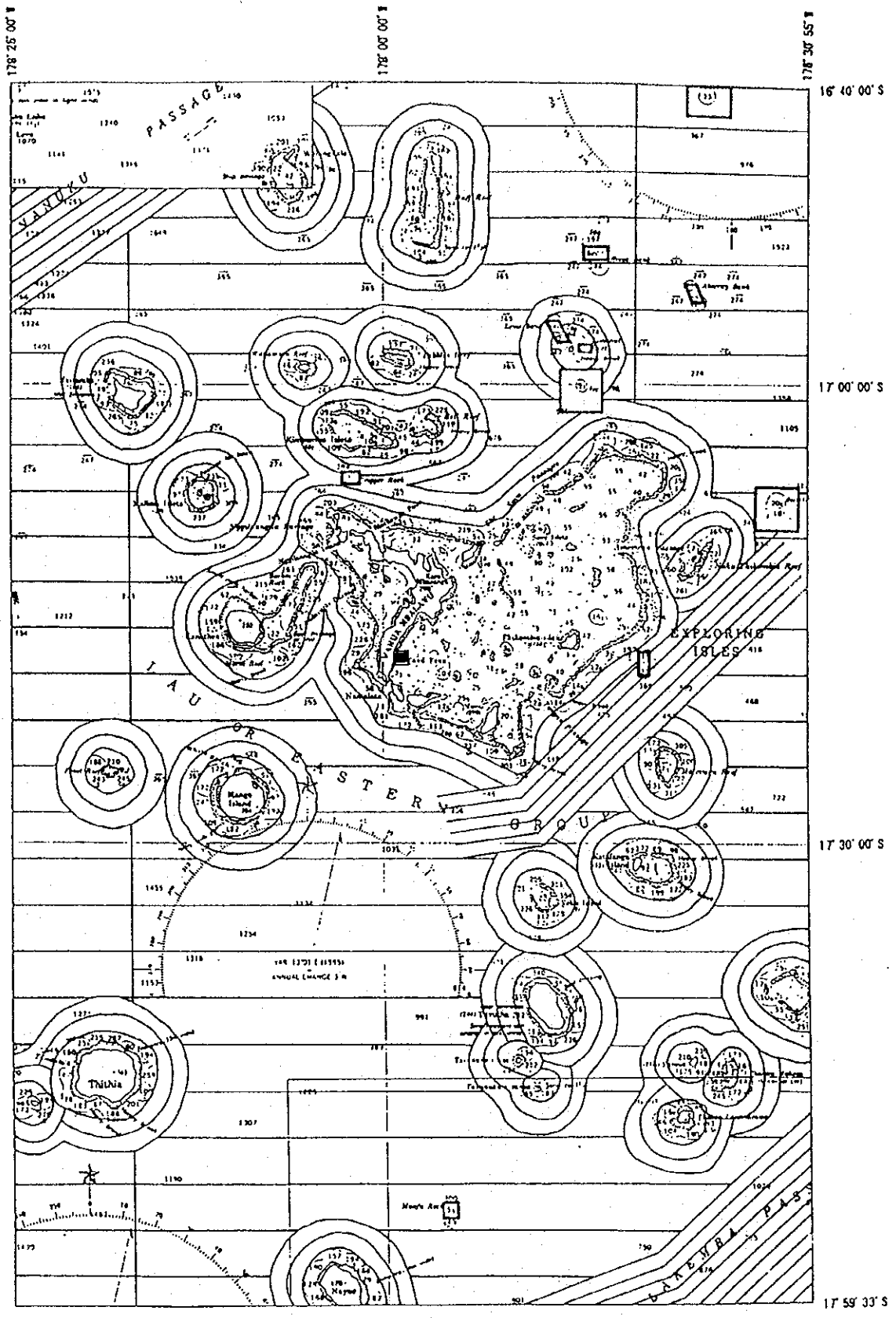


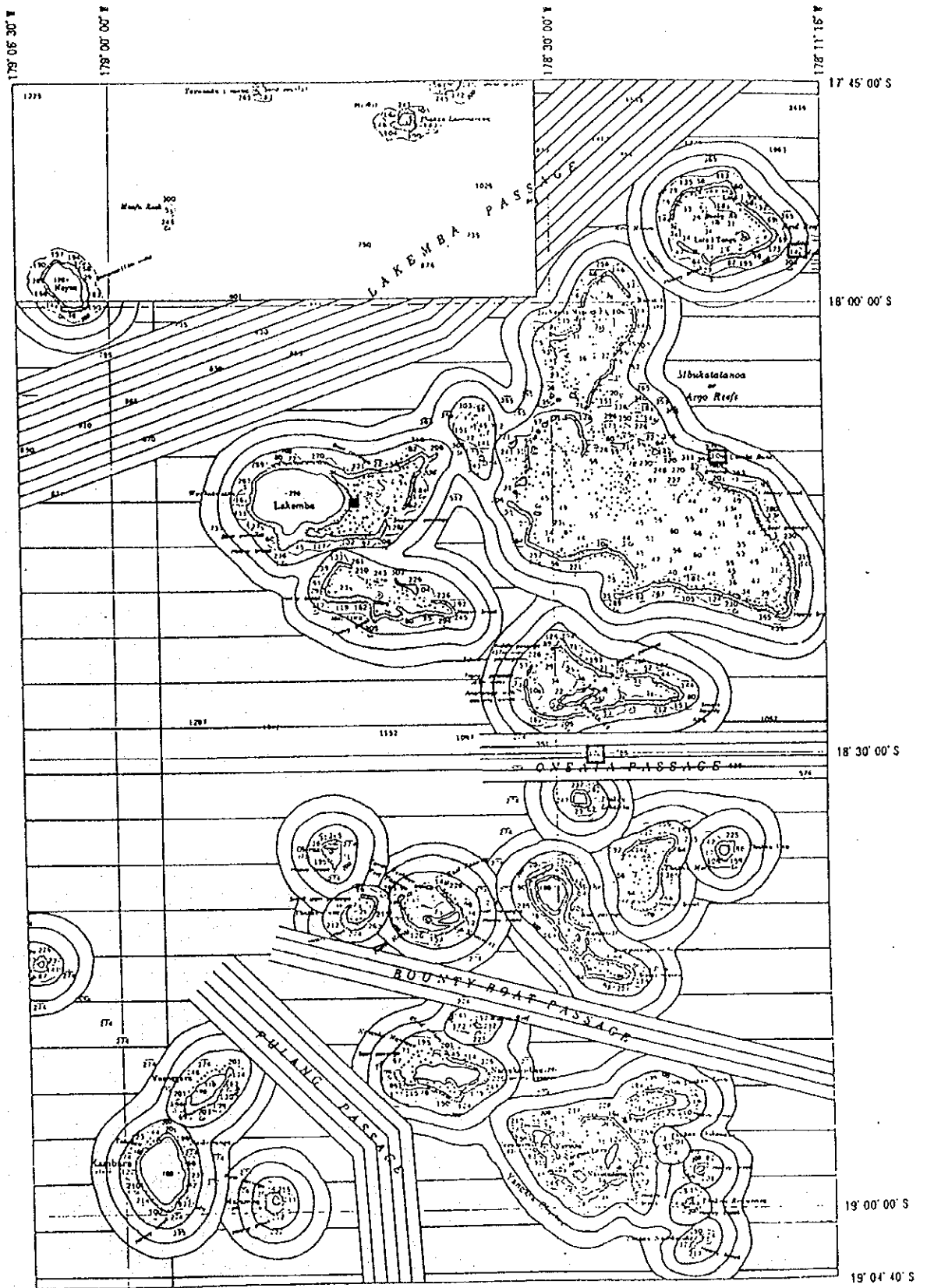
Figure 1. Study Area F52



- Legend
- Sounding line
 - Field base, Tide gauge
 - Shoal/Reported depth



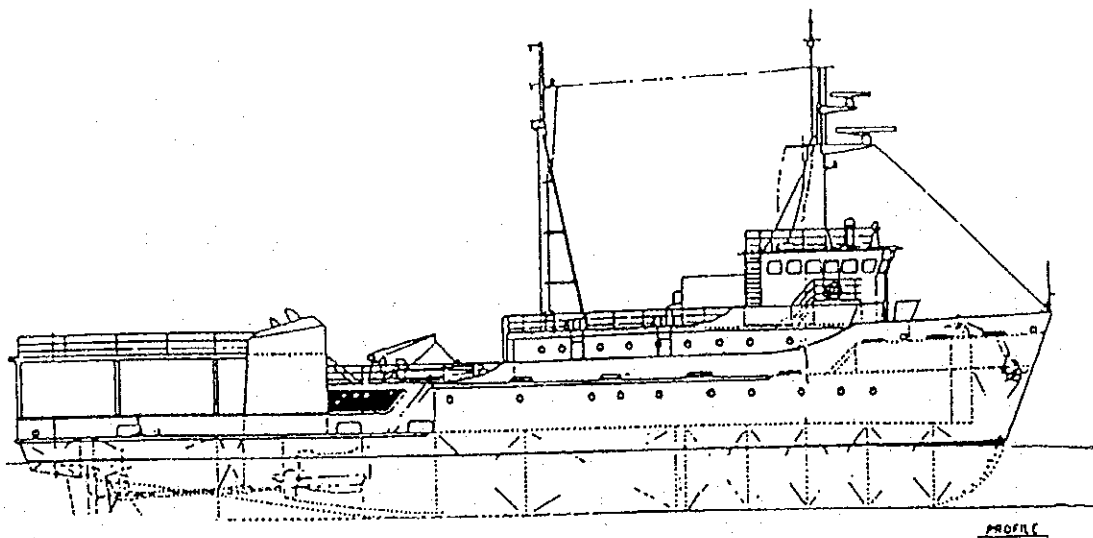
Figure 2. Study Area F53



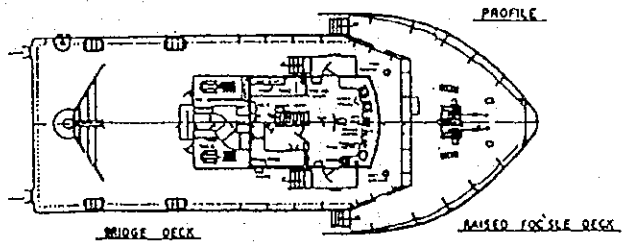
- Legend — Sounding line
 ■ Field base, Tide pole
 □ Shoal depth



Figure 3. Study Area F54



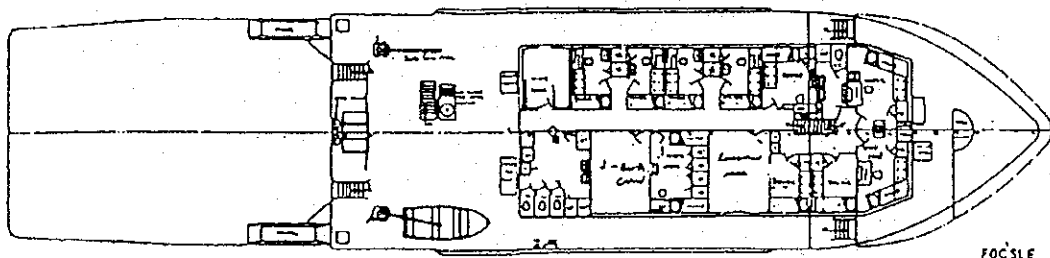
PROFILE



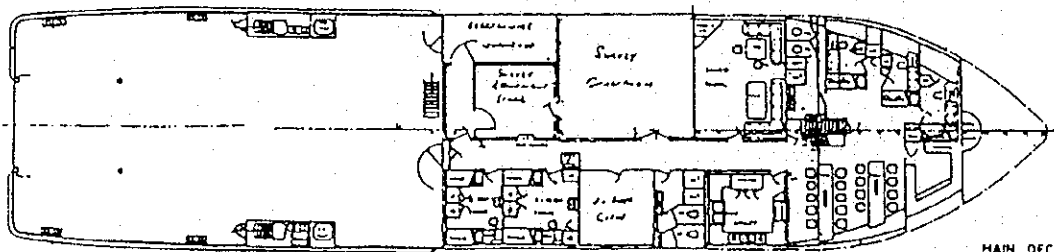
PROFILE

MIDGE DECK

RAISED FOC'SLE DECK



FOC'SLE



MAIN DECK

Figure 4. R/V TOVUTO

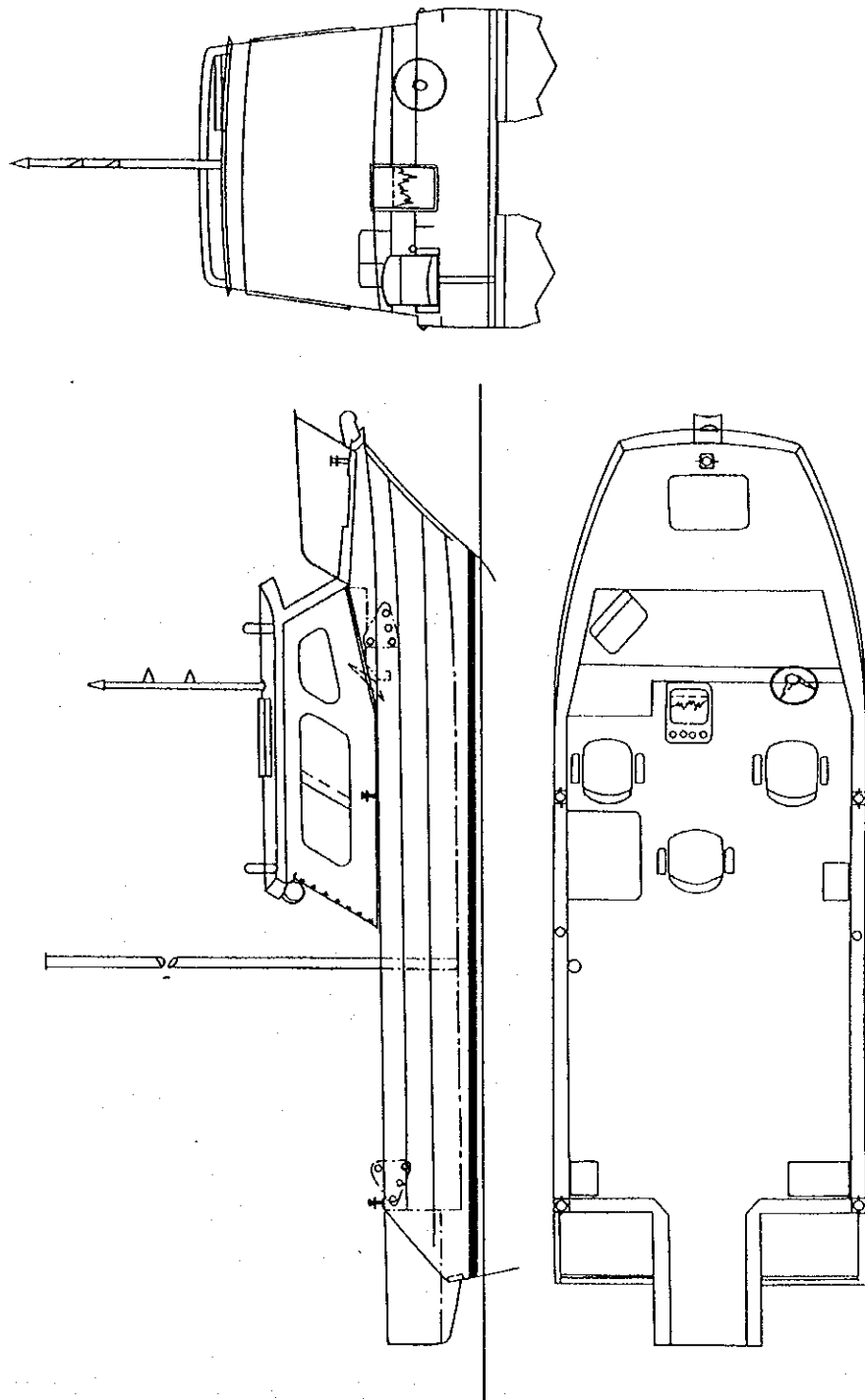
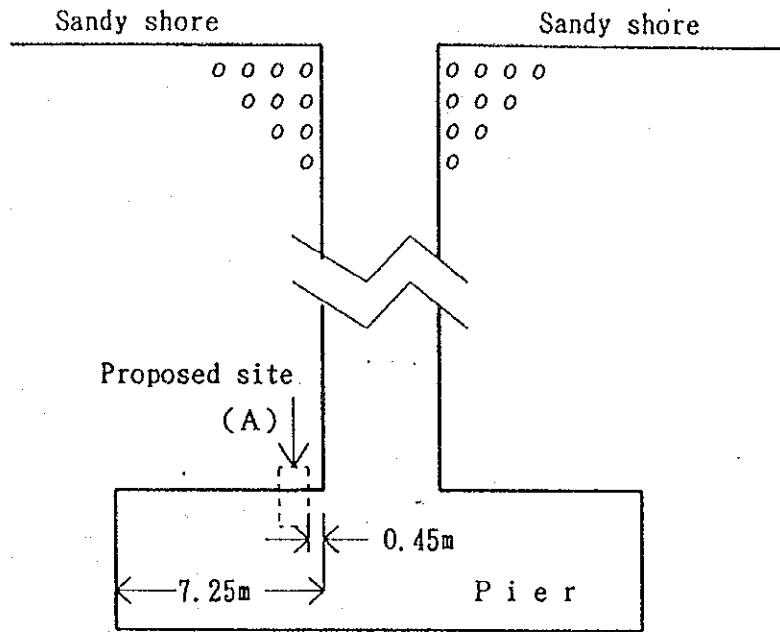


Figure 5. Survey Motor Boat BABALE



Profile at (A)

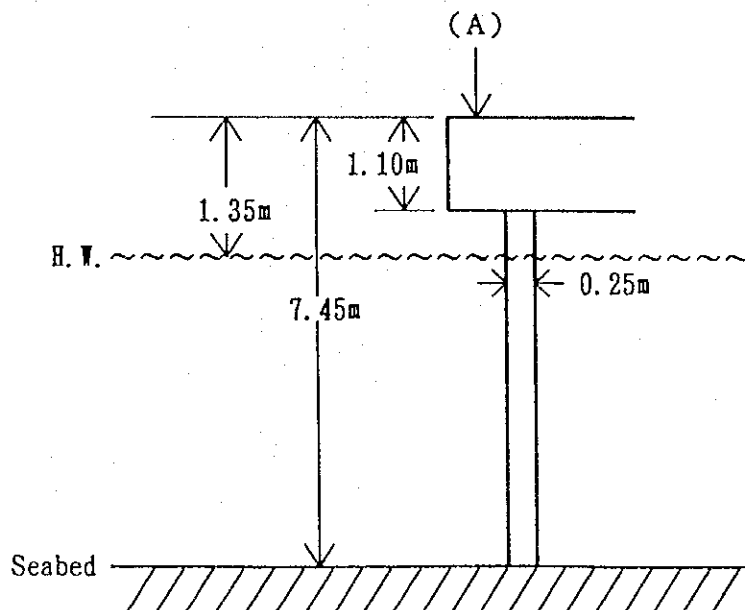
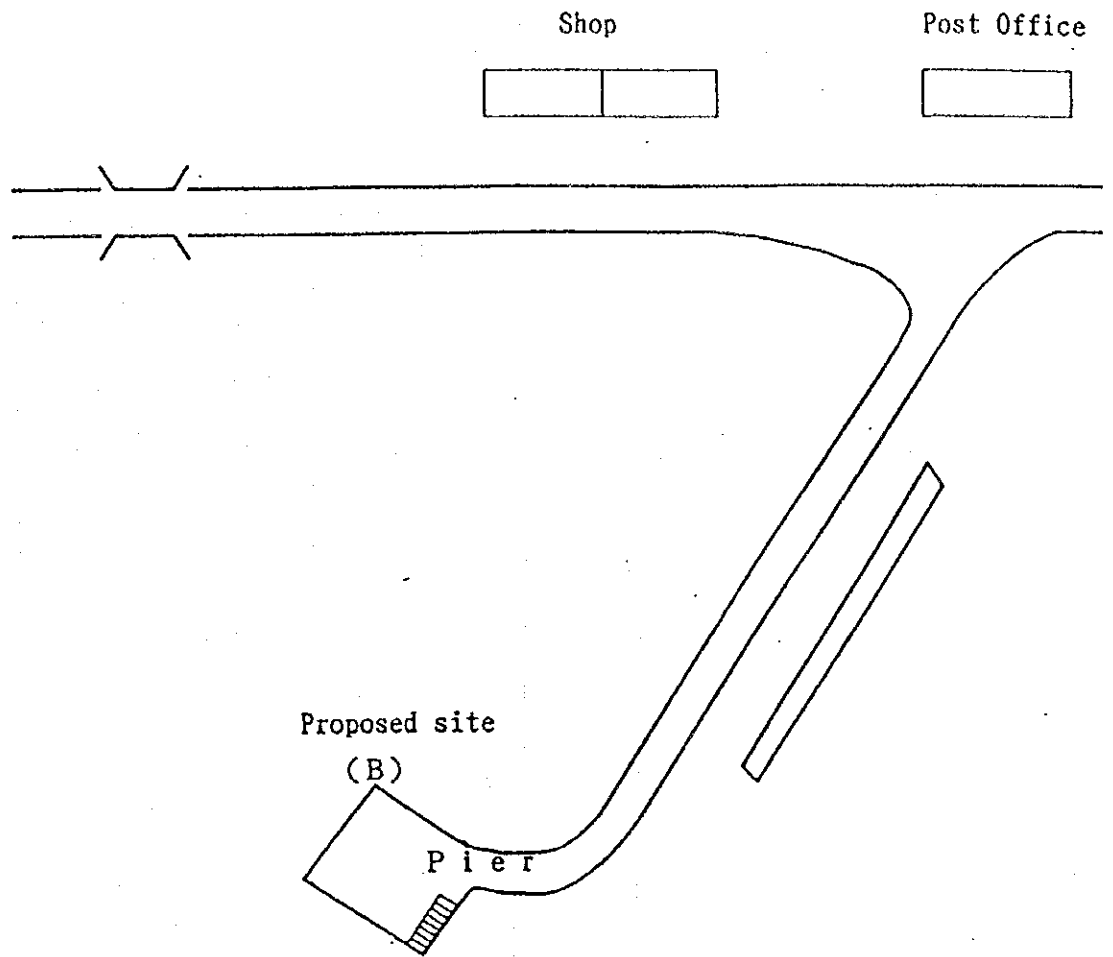


Figure 6. Tide Station at Lomaloma, Vanua Balavu



Profile at (B)

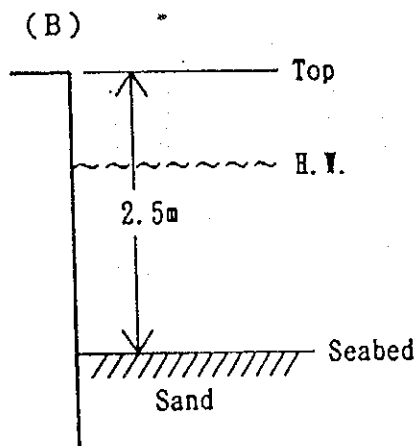


Figure 7. Tide Station at Nuku, Rabi

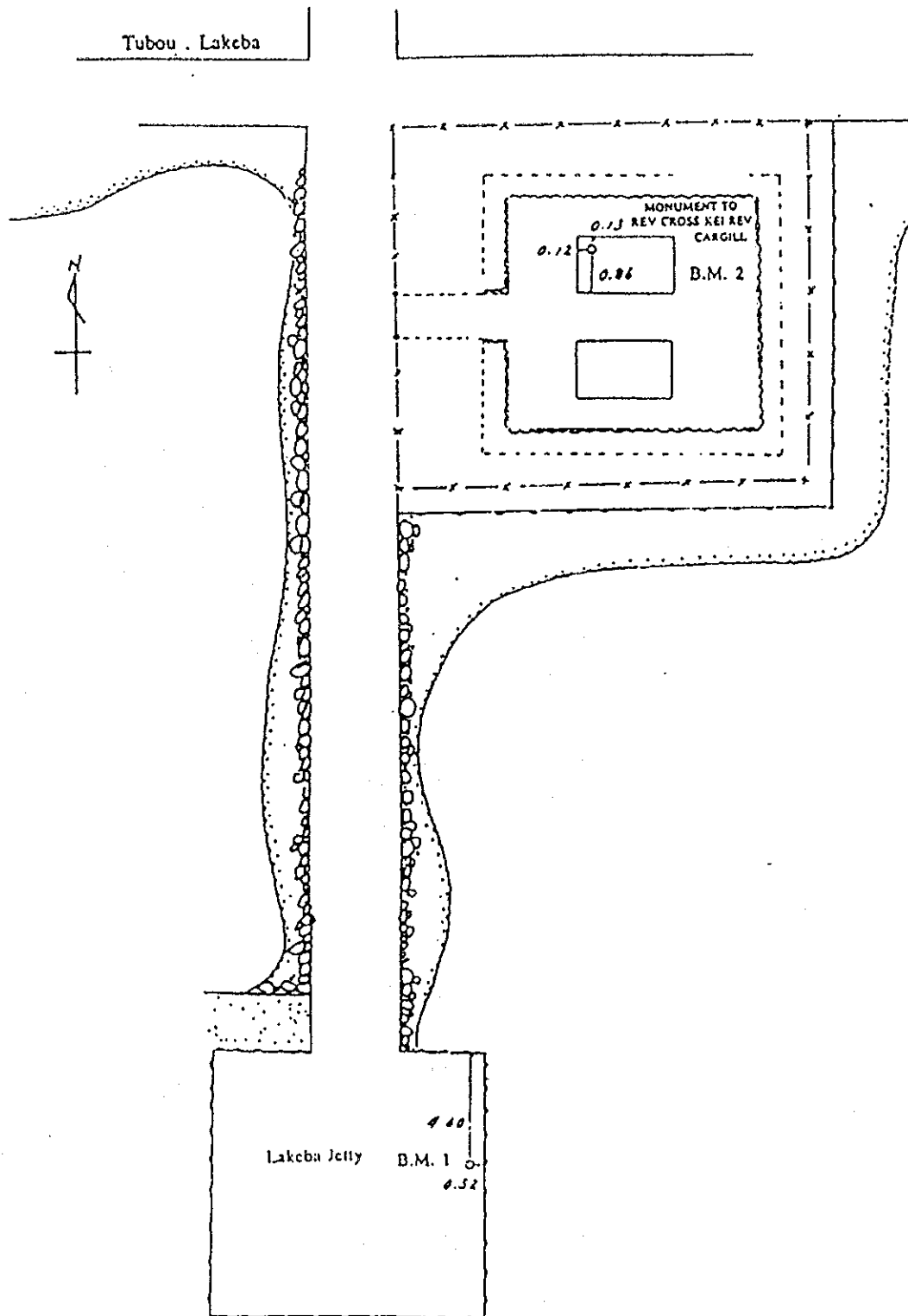


Figure 8. Tide Station at Tubou, Lakeba

APPENDICES

DIARY OF WORK

No. of Day	Date	Location	Work carried out
1	23/1 (Mon)	Lv. Narita	Study Team left Narita for Suva.
2	24 (Tue)	Ar. Suva Suva	Arrived in Suva via Nadi. Courtesy visit to Embassy of Japan and JICA Fiji Office. Visit to FHS to deliver P/O.
3	25 (Wed)	"	Explanation and consultation of P/O at FHS. Visit to DLS to request for supply of aerial photographs, land maps and control point data.
4	26 (Thu)	"	Explanation and consultation of P/O and discussion on selection of equipment at FHS.
5	27 (Fri)	"	Preparation of M/M and discussion on selection of equipment at FHS. Signing of M/M at Ministry of Infrastructure, Public Works and Transport.
6	28 (Sat)	"	Test for retrieval of tidal data from Suva tide station. Kawasaki left Suva for Japan.
7	29 (Sun)	"	Rest.
8	30 (Mon)	"	Discussion on selection of equipment at FHS. Visit to R/V TOVUTO. Collection of control point data at DLS.
9	31 (Tue)	"	Discussion on selection of equipment at FHS. Visit to agents for survey equipment in Suva.
10	1/2 (Wed)	"	Discussion on selection of equipment at FHS. Consultation at JICA Fiji Office.
11	2 (Thu)	"	Discussion on selection of equipment and collection of data at FHS. Hamasaki left Suva for Japan.
12	3 (Fri)	"	Consultation with Master of R/V TOVUTO at FHS. Preparation of list of selected equipment at JICA Fiji Office.

13	4/2 (Sat)	"	Market research of materials and expendables for survey operations in and around Suva.
14	5 (Sun)	"	Rest. Tanaka left Suva for Japan.
15	6 (Mon)	"	Consultation on daily life on board R/V TOVUTO at FHS. List of selected equipment and quotations submitted to JICA Fiji Office.
16	7 (Tue)	Suva V.B.	Visit to DLS for arrangements on collection of aerial photographs. Kuga and Saito moved from Suva to Lomaloma, Vanua Balavu (V.B.). Courtesy visit to the Chief of Lomaloma village.
17	8 (Wed)	Suva V.B.	Consultation on survey planning at FHS. Visit to SOPAC and Mineral Resources Department for collection of bathymetric charts. Reconnaissance at Lomaloma for location of tide station, control points and accommodation facilities.
18	9 (Thu)	Suva V.B.	Consultation on survey planning at FHS. Visit to R/V TOVUTO. Reconnaissance at Lomaloma and in V.B. lagoon for control points and general condition.
19	10 (Fri)	Suva Rabi	Consultation on survey planning at FHS. Collected aerial photographs at DLS. Kuga and Saito left Lomaloma and arrived at Nuku, Rabi. Collection of information on Rabi.
20	11 (Sat)	Suva Rabi	Checking of aerial photographs. Market research for consumables necessary for survey. Reconnaissance at Nuku for location of tide pole, control points and accommodation facilities.
21	12 (Sun)	Suva Taveuni	Rest. Kuga and Saito moved from Nuku to Malavu, Taveuni.

22	13/2	(Mon)	Suva	Arrangements for collection of additional aerial photographs at DLS. Consultation on survey planning at FHS.
			Taveuni	Reconnaissance at Taveuni for accommodation facilities, control points, etc.
23	14	(Tue)	Suva	Study on living conditions on R/V TOVUTO and survey planning at FHS.
			Taveuni	Reconnaissance at Taveuni for control points.
24	15	(Wed)	Suva	Collection of quotations of various items necessary for Phase II work at FHS and agents. Kuga and Saito moved from Malavu to Suva.
25	16	(Thu)	"	Study and discussion on echo sounder and Phase II work and arrangements of materials and data collected at FHS. Test for retrieval of tidal data from Suva tide station.
26	17	(Fri)	"	Collection of aerial photographs at DLS. Courtesy visit to Embassy of Japan and JICA Fiji Office for report. Arrangements and packing of collected materials and data at FHS.
27	18	(Sat)	"	Preparation for returning to Japan.
28	19	(Sun)	"	Rest.
29	20	(Mon)	Auckland	Study Team left Suva for Auckland.
30	21	(Tue)		Left Auckland and arrived at Narita.

PLAN OF OPERATION
FOR
THE STUDY ON THE PREPARATION OF NAUTICAL CHARTS
IN
THE NORTHERN LAU ISLANDS REGION
IN
THE REPUBLIC OF FIJI

JANUARY 1995

THE JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

I. INTRODUCTION	1
II. OBJECTIVES OF THE STUDY	2
III. OVERALL PLAN OF THE STUDY	3
1. General	3
2. Tentative schedule of the Study	3
2-1. THE STUDY IN PHASE I (F.Y.1994)	5
2-1-1. Pre-work in Japan	5
2-1-1-1. Collection and study of relevant information and data available	5
2-1-1-2. Preparation of P/O	5
2-1-2. Work in Fiji	5
2-1-2-1. Explanation of P/O to the Fiji Government and consultation	5
2-1-2-2. Acquisition of source materials	5
2-1-2-3. Confirmation of survey implementation and support systems	5
2-1-2-4. Reconnaissance of survey site	5
2-1-3. Post-work in Japan	6
2-1-3-1. Drawing of coastlines	6
2-1-3-2. Preparation of Progress Report	6
2-2. THE STUDY IN PHASE II (F.Y.1995)	6
2-2-1. Pre-work in Japan	6
2-2-1-1. Planning and preparations	6
2-2-1-2. Preparation of P/O	6
2-2-1-3. Procurement, examination and dispatch of equipment	6
2-2-2. Work in Fiji	6
2-2-2-1. Explanation of P/O to Fiji Government and consultation	6
2-2-2-2. Preparations for field survey and procedural work	7
2-2-2-3. Field work	7
2-2-2-3-1. Control point survey	7
2-2-2-3-2. Coastlining	8
2-2-2-3-3. Tidal observation	8
2-2-2-3-4. Sounding operation	9
2-2-2-3-4-1. Position fixing	9

2-2-2-3-4-2. Sounding	10
2-2-3. Post-work in Japan	14
2-2-3-1. Data processing	14
2-2-3-2. Preparation of manuscript sheets	15
2-2-3-3. Preparation of smooth sheet of survey	15
2-2-3-4. Inspection of smooth sheet of survey	15
2-2-3-5. Preparation of Progress Report	15
2-3. THE STUDY IN PHASE III (F.Y.1996)	15
2-3-1. Work in Fiji	15
2-3-1-1. Tidal observation	15
2-3-1-2. Co-operation in technology transfer in Vanua Balavu lagoon survey	16
2-3-2. Post-work in Japan	16
2-3-2-1. Projection of nautical charts	16
2-3-2-1-1. Chart specifications common to the three charts to be produced	16
2-3-2-1-2. Compilation planning	18
2-3-2-1-3. Preparation of Drawing Guide	19
2-3-2-1-4. Preparation of Chart Original	19
2-3-2-1-5. Verification and inspection of Chart Original completed	19
2-3-2-1-6. Platemaking	20
2-3-2-1-7. Chart printing	20
2-3-3. Production of Nautical Chart No.F2	20
2-4. THE STUDY IN PHASE IV (F.Y.1997)	21
2-4-1. Work in Fiji	21
2-4-1-1. Tidal observation	21
2-4-2 Post-work in Japan	21
2-4-2-1. Production of Nautical Chart No.F6	21
2-5. THE STUDY IN PHASE V (F.Y.1998)	21
2-5-1. Work in Fiji	21
2-5-1-1. Survey of the existing status of the operation and management system for hydrographic surveying and nautical charting in Fiji	22
2-5-2. Post-work in Japan	22
2-5-2-1. Drafting of recommendation	22
2-5-3. Production of Nautical Chart F7	22

2-5-4. Preparation of Final Report	23
2-5-5. Submission of Final Report	23
2-6. Final products of the Study	24
2-6-1. Re: Smooth Sheets of Survey and Nautical Charts	24
2-6-2. Re: Reports	24
IV. ORGANIZATION	25
1. Study team	25
2. Equipment and instruments	25
3. Work schedule	25
3-1. Daily schedule	25
3-2. Weekly schedule	25
3-3. Monthly schedule	25
4. Safety measures	25
V. IMPLEMENTATION PLAN OF THE STUDY IN PHASE I (F.Y.1994)	26
1. Pre-work in Japan	26
1-1. Collection and study of relevant information and data available	26
1-2. Preparation of Plan of Operation (P/O)	26
2. Work in Fiji	26
2-1. Explanation of P/O to the Fiji side and consultations	26
2-2. Acquisition of source materials	26
2-3. Confirmation of survey implementation and support systems	26
2-4. Reconnaissance of survey sites	27
2-5. Study team	27
3. Post-work in Japan	27
3-1. Drawing of coastlines	27
3-2. Preparation of Progress Report	27
VI. UNDERTAKING OF THE GOVERNMENT OF FIJI	28
VII. UNDERTAKING OF JICA	30
VIII. TASK OF FHS	31
IX. OTHERS	32
Appendix 1 - Flow of Work of the Study	
Appendix 1 add.1 - Process of Chart Production under the Study	
Appendix 2 - Tentative 5-year Schedule of the Study Work Schedules (Phase I ~ Phase V)	
Appendix 3 - Organization of Field Study Team	
Appendix 4 - Field Tasks of Study Team Members	
Appendix 5 - List of Survey Equipment and Instruments(Phase II~ Phase IV)	
Appendix 6 - Emergency Communication Network	

I. INTRODUCTION

The Government of the Republic of Fiji requested the Government of Japan for technical cooperation in "The Study of the Preparation of Nautical Charts in the Northern Lau Islands Region in the Republic of Fiji" (hereinafter referred to as "the Study").

In response to the request, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Study Team to Fiji from February 15 to March 15, 1994, for the purpose of materializing the Study.

The JICA Preparatory Study Team exchanged views and discussions with the Fiji authorities concerned, including the Fiji Hydrographic Service (hereinafter referred to as "FHS") of the Ministry of Public Works, Infrastructure and Transport, and conducted a reconnaissance of the Study area during the period.

These discussions and the reconnaissance resulted in preparation of the Scope of Work for the Study (hereinafter referred to as "S/W"), which was duly signed by the representatives of both parties on March 15, 1994.

This Plan of Operation (hereinafter referred to as "P/O") is prepared in accordance with S/W, describing the outline of the Study to be carried out by JICA, a tentative overall plan of the five-year programme of the Study and the implementation plan for the first Fiscal Year 1994 (Phase I) as well as the undertakings of both the Government of Fiji and JICA.

The Study shall be carried out according to this P/O, and also to the results of consultations between FHS and the JICA Study Team to be held as necessary during the implementation of the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are as follows:

1. To prepare three Fiji nautical charts, Nos.F2, F6 and F7, each on the scale of 1:150,000, covering the Northern Lau Islands region;
2. To report the recommendation for improvement of operation and management system of hydrographic surveying and nautical charting in Fiji; and
3. To promote technology transfer through the implementation of the Study with a view to enabling the Fiji counterpart personnel to improve their technique in hydrographic surveying and nautical charting.

III. OVERALL PLAN OF THE STUDY

1. General

- (1) The Study will comprise five Phases, i.e. Phase I (First Year - F.Y.1994) to Phase V (Fifth Year - F.Y.1998).
- (2) The Study area and the chart coverage are as shown in Fig.1, where;

F2:	16° 46' 58" S	15° 55' 00" S
	179° 32' 57" E	179° 04' 30" W
F6:	17° 59' 33" S	16° 40' 00" S
	179° 25' 00" W	178° 30' 55" W
F7:	19° 04' 40" S	17° 45' 00" S
	179° 06' 30" W	178° 11' 16" W

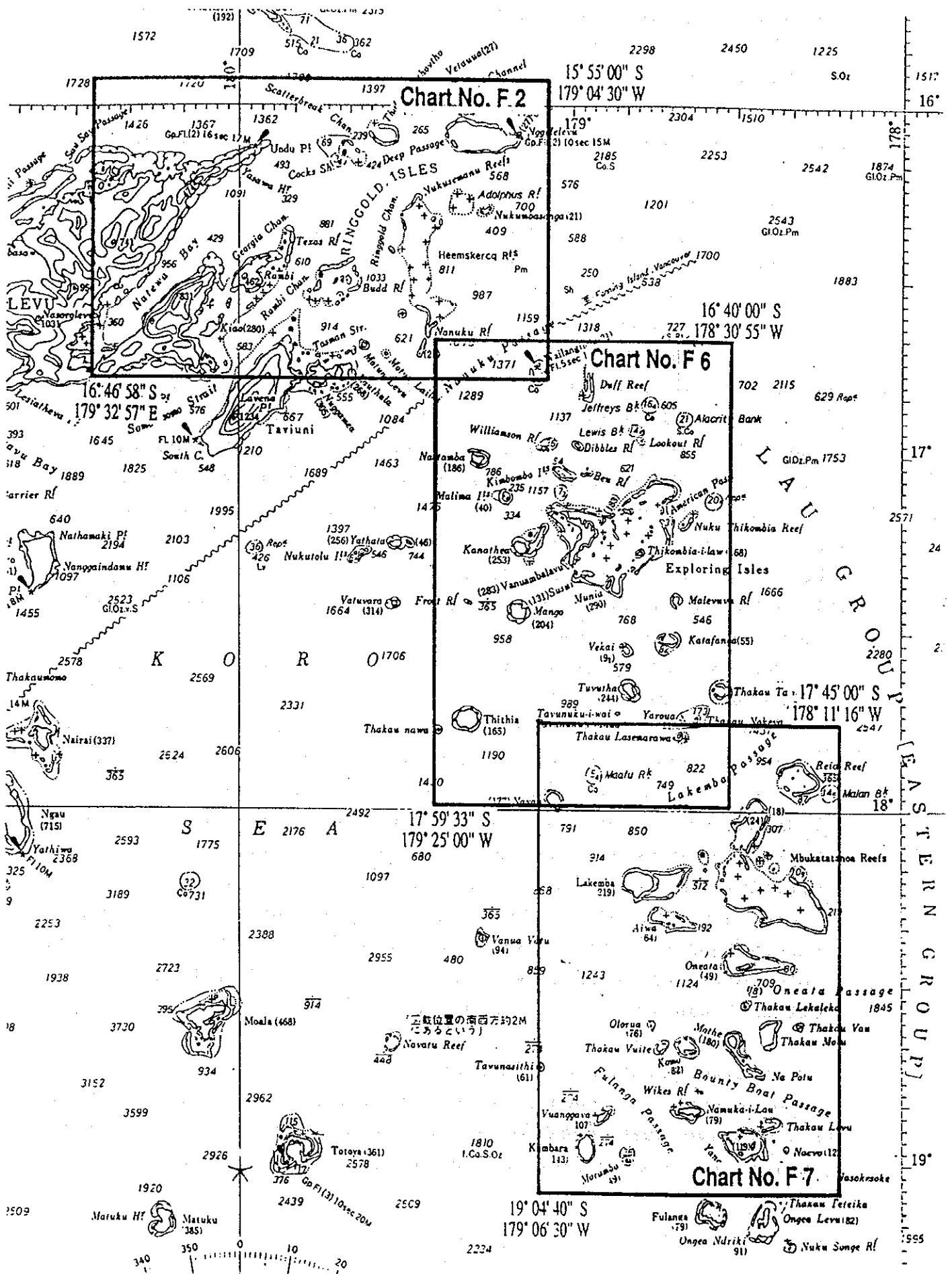
- (3) The flow of work of the Study is as shown in Appendix 1.
- (4) As for hydrographic survey standards and nautical charting specifications, the International Hydrographic Organization (IHO) Standards for Hydrographic Surveys (S-44) as well as the Chart Specifications of the IHO should in principle be applied to the hydrographic surveying and nautical charting to be carried out under the Study.
- (5) Technology transfer to the FHS counterpart personnel will be effectuated as follows:
 - The technology transfer will principally be on the basis of on-job training (OJT).
 - For facilitating the technology transfer, manuals and instructions for survey methods as well as for handling survey instruments will be prepared in English.
- (6) Since the nautical charts to be produced under the Study will be published by the Government of the Republic of Fiji as its official nautical charts, the nautical charting work will be implemented by the Hydrographic Department, Japan Maritime Safety Agency (hereinafter referred to as "JHD"), which is the sole official authority for preparing and publishing the official nautical charts in Japan.

2. Tentative schedule of the Study

The tentative schedule of the Study for five years as well as the tentative work schedule of each Phase appear as in Appendix 2, which are briefly explained as in the following:

Fig. 1

STUDY AREA AND CHART COVERAGE



2-1. THE STUDY IN PHASE I (F.Y.1994)

2-1-1. Pre-work in Japan

2-1-1-1. Collection and study of relevant information and data available

All available information and data will be collected and studied to work out a detailed plan of the hydrographic survey to be conducted.

Those to be collected will include existing nautical charts, topographic maps, aerial photographs, index maps of control points, information on availability of smooth sheets of survey and other source materials, and meteorological and oceanographical data related to the Study area.

2-1-1-2. Preparation of P/O

The P/O is to cover the whole operation and work to be conducted for the Study, the resulted products for overall period of five years and the implementation plan of the Study in Phase I (First year - F.Y.1994) as well as the undertakings of both the Government of Fiji and JICA.

2-1-2. Work in Fiji

2-1-2-1. Explanation of P/O to the Fiji Government and consultation

The P/O thus prepared will be explained to the relevant authorities of the Fiji Government including FHS, and consultations with FHS will be held to reach agreements for smooth implementation of the Study.

2-1-2-2. Acquisition of source materials

Aerial photographs and other materials necessary for drawing coastlines of islands and atolls to be shown on the three nautical charts will be acquired.

2-1-2-3. Confirmation of survey implementation and support systems

The capability, facilities and maintenance condition of the survey vessel and survey boats to be used from Phase II onward as well as the performance of survey instruments aboard will be checked and confirmed. Retrieval of tidal data from Suva Tide Station will also be examined and confirmed.

2-1-2-4. Reconnaissance of survey site

Reconnaissance of proposed sites for survey operation bases, tide stations and control points will be conducted at the islands

of Rabi and Vanua Balavu.

2-1-3. Post-work in Japan

2-1-3-1. Drawing of coastlines

Utilizing the aerial photographs (scale 1/50,000) acquired, coastlines of islands and atolls within the coverages of Charts F2, F6 and F7 will be drawn on transparent plastic sheets, which will then be reduced to the scale of 1/150,000. The delineation of coastlines of the northeastern part of Vanua Levu will not be done as they will be adopted from the existing nautical charts.

2-1-3-2. Preparation of Progress Report

The work carried out during Phase I, problems encountered and solved, tasks for future work, etc. will be compiled into a Progress Report to be submitted to the Fiji Government.

2-2. THE STUDY IN PHASE II (F.Y.1995)

2-2-1. Pre-work in Japan

2-2-1-1. Planning and preparations (Common to Phase II through Phase IV)

Based on the information, data and materials collected by the JICA Preparatory Study Team as well as during previous Phases, planning and preparatory work will be done prior to carrying out field survey. Preliminary study will be made on the topography according to the aerial photographs, and detailed survey plan will be worked out to facilitate the field operations.

2-2-1-2. Preparation of P/O (Common to Phase II through Phase V)

Based on the P/O prepared in Phase I, P/O for the current Phase will be prepared taking into account the significant points of the Progress Report of the previous Phase, describing the details of survey as to methods, amount of work, accuracies, etc. and the survey products from the current Phase as well as those items for which co-operation from the Fiji side is requested.

2-2-1-3. Procurement, examination and dispatch of equipment (Common to Phase II through Phase IV)

Equipment and instruments necessary for the current Phase will be procured, examined and dispatched by air to Fiji.

2-2-2. Work in Fiji

2-2-2-1. Explanation of P/O to the Fiji Government and consultation (Common to Phase II through Phase V)

The P/O thus prepared will be submitted to the Fiji Government for explanation, and consultations will be held to reach agreements on the content.

2-2-2-2. Preparations for field survey and procedural work
(Common to Phase II through Phase IV)

The Study Team will proceed to implementation of the Study without delay after arrival in Fiji by completing procedural work for customs clearance of survey instruments and materials and establishing a survey base in Suva and a field operation base in the survey site.

2-2-2-3. Field work (Common to Phase II through Phase IV)

2-2-2-3-1. Control point survey

	Phase II	Phase III	Phase IV	Remarks
Primary shore control point for fixing ship's positions and secondary control points	Rabi	Vanua Balavu	Lakeba	Closed DGPS observation with 2 or more existing control points
Lighthouses	3	---	---	Open DGPS observation
Secondary stations for coastlining, landmarks and conspicuous objects	As required	As required	As required	with the primary or existing control point

- (1) The grid system employed is the Fiji Map Grid with the ellipsoid of reference WGS-72 and the origin of coordinates 17° 00' 00" S, 178° 45' 00" E.
- (2) Positions in control point survey will be fixed by DGPS observation, in principle.
- (3) The primary shore control point will be selected at one or more places for the survey area in each Phase.
- (4) Secondary stations for coastlining will be selected three or more per an island or atoll where landing is feasible, and in case of an extensive island or atoll, at a rate one every 10cm on the sheet as a standard.
- (5) Specifications for GPS observation will be as follows:
 - The performance of the GPS receiver:

Receivable frequency : 1,575.42MHz (L1) and 1,227.6MHz (L2)
Capability : $\pm(5\text{mm}+1\times 10^{-6}\times D)$ or more, where D is distance
(km)

- Observation will be made to more than four satellites with a good health status and at an elevation angle of more than 15 degrees.

- Duration of observation will be:

Primary control point : 90 minutes or more

Secondary stations : 30 minutes or more

(6) The accuracy of the primary shore control point shall be 1 part in 10,000. Where the survey is extensive, the relative positioning error shall be no more than 0.25mm at the scale of survey.

(7) The accuracy of secondary stations shall be no more than 0.5 mm at the scale of survey.

2-2-2-3-2. Coastlining

(1) For delineation of coastlines, pricking will be made at selected points on contact print aerial photographs (scale : 1/50,000) after confirming the conformity between picture and actual topography.

(2) Coastlining will be carried out at the portion of a coastline which is found considerably changed from the aerial photograph picture.

(3) For a conspicuous object useful to navigation with unknown height, measurement of its height will be carried out where feasible.

2-2-2-3-3. Tidal observation

(1) Establishment of tide station

- A self-recording tide gauge will be set at the pier of Vanua Balavu.

- As a temporary tide station, a tide pole will be erected at Rabi in Phase II and at Lakeba in Phase IV.

(2) Continuous observation of tides will be conducted at Vanua Balavu tide station throughout the sounding period, and observation of tides around three sets of succeeding high waters and low waters at the temporary tide station.

(3) In order to determine the zero of tide gauge, a bench mark (BM) will be firmly established nearby on land, and levelling will be carried out between the tide gauge and BM.

- (4) Adjustment of clock of the tide gauge and tidal height will be carried out at least once every day.
- (5) The data obtained from the auxiliary tide station will be compared to the data from Suva tide station and Vanua Balavu tide station to obtain time difference and height difference of the survey area.
- (6) Determination of the Mean Sea Level (MSL) and the Datum Level for Soundings (DL) will be made as follows:
- Suva being the standard port, the necessary tidal data recorded at Suva tide station will be retrieved by connecting a personal computer to it.
 - The MSL at Vanua Balavu tide station will be computed by using the following equation:

$$A = A' + (A_o - A'o)$$
 where A_o : MSL at Suva tide station
 $A'o$: Short term MSL at Suva tide station
 A : MSL at Vanua Balavu tide station
 A' : Short term MSL at Vanua Balavu tide station
 - For computation of short term MSL, tidal data from more than one-month observation will be used.
 - DL will be approximately the level of Lowest Astronomical Tide (LAT).
 - The DL at Vanua Balavu tide station (area F6) will be obtained by harmonic analysis of the tidal data and compared to the existing value.
 - The MSL and DL of the areas F2 and F7 will be determined from the tidal data at Suva tide station, Vanua Balavu tide station and the data obtained from the tide pole at Rabi (area F2) and Lakeba (area F7).

2-2-2-3-4. Sounding operation

2-2-2-3-4-1. Position fixing

- (1) Ship's positions will be fixed by DGPS observation with simultaneous observation on the ship and at the primary shore control point. Real time processing will be feasible for the observation.
- (2) The interval between the position fixes at the scale of survey shall be 2cm or less in case of a linear sounding line, and in case of a curved sounding line, shall be such that maintains the plotting error of any cut-in sounding to be

within a circle with a radius 1.5mm.

2-2-2-3-4-2. Sounding

(1) The sounding lines planned in the areas F2 (Phase II), F6 (Phase III) and F7 (Phase IV) are as shown in Fig.2, Fig.3 and Fig.4, respectively.

(2) Sounding distance planned

Phase II	Phase III	Phase IV	Remarks
2,970km	5,980km	5,606km	Excluding those in V.B.lagoon

Note : Supplementary sounding and resounding will be conducted as necessary.

(3) Sounding line intervals

Deep water areas : 3M

Shipping routes : 1.5km

Around islands and atolls : 1M

Reported shoals, shoals and banks: 200m or less (with Side-scan Sonar)

(4) The echo-sounder aboard R/V TOVUTO or the one provided by the Study Team will be used for sounding.

(5) In shallow waters where R/V TOVUTO is difficult to navigate, SMB BABALE will be used with a four-beam echo-sounder for shallow water use provided by the Study Team, whose specifications are as follows:

Frequency : 90 ~ 230kHz

Direction angle of transducer : 8 degrees or less

Paper speed : 20mm/min or faster

Assumed sound velocity : 1,500m/sec

Recording accuracy : $\pm (0.1 + \text{Depth} \times 10^{-3})$ or more

Minimum reading : 0.1m

(6) Correction to soundings

- Tidal reduction to soundings will be made to the depths of 200m or less.

- Correction to soundings for underwater sound velocity will be made by bar-check method down to depths of 50m, and by the echo-sounding correction tables to deeper depths.

(7) The accuracy of sounding shall be as follows:

Depths shallower than 30m : Less than 0.3m

Depths deeper than 30m : Less than 1% of the depth

(8) For confirmation of the least depth of a shoal, recordings of echo-sounder and Side-scan Sonar will be compared, and if any

Fig. 2

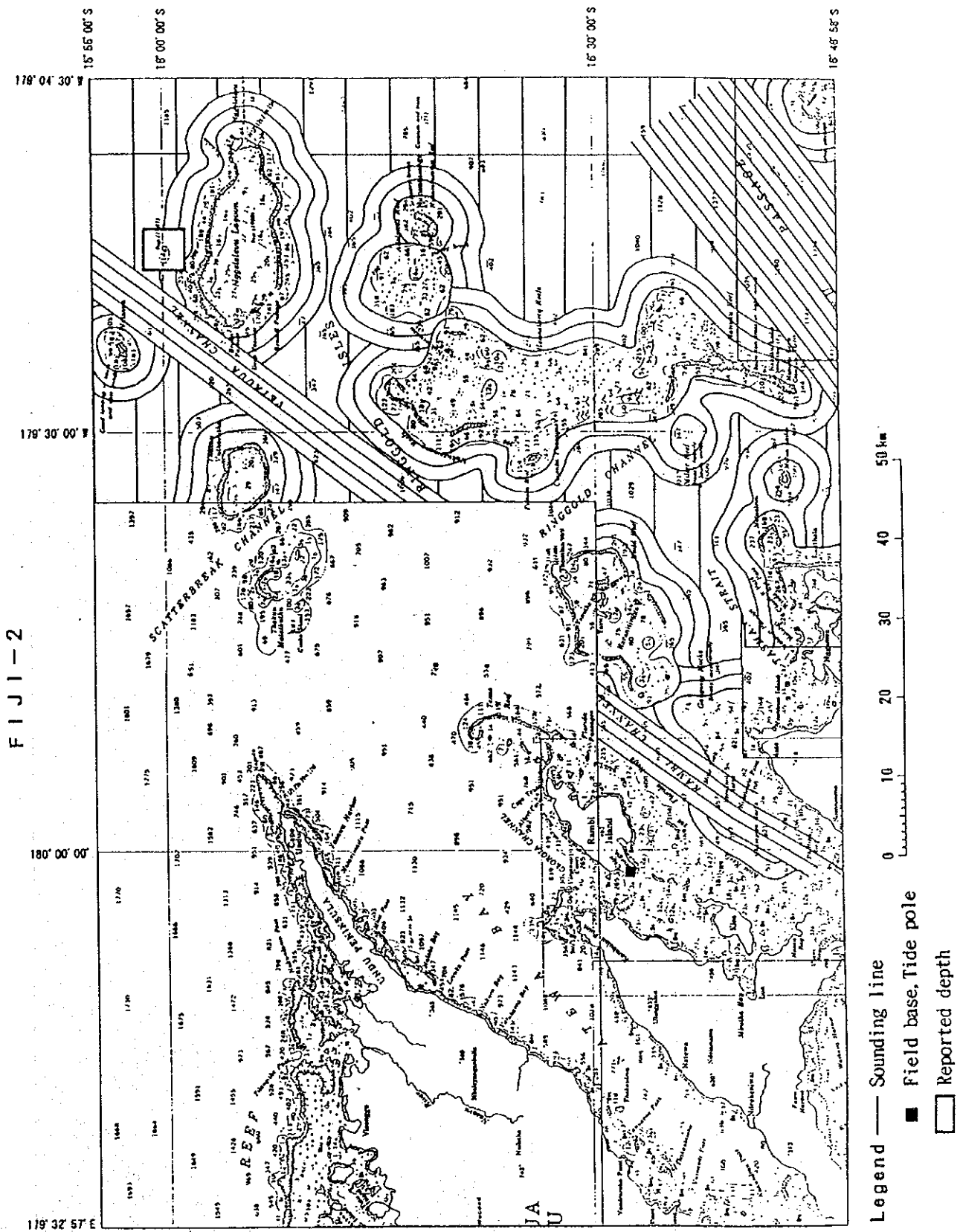
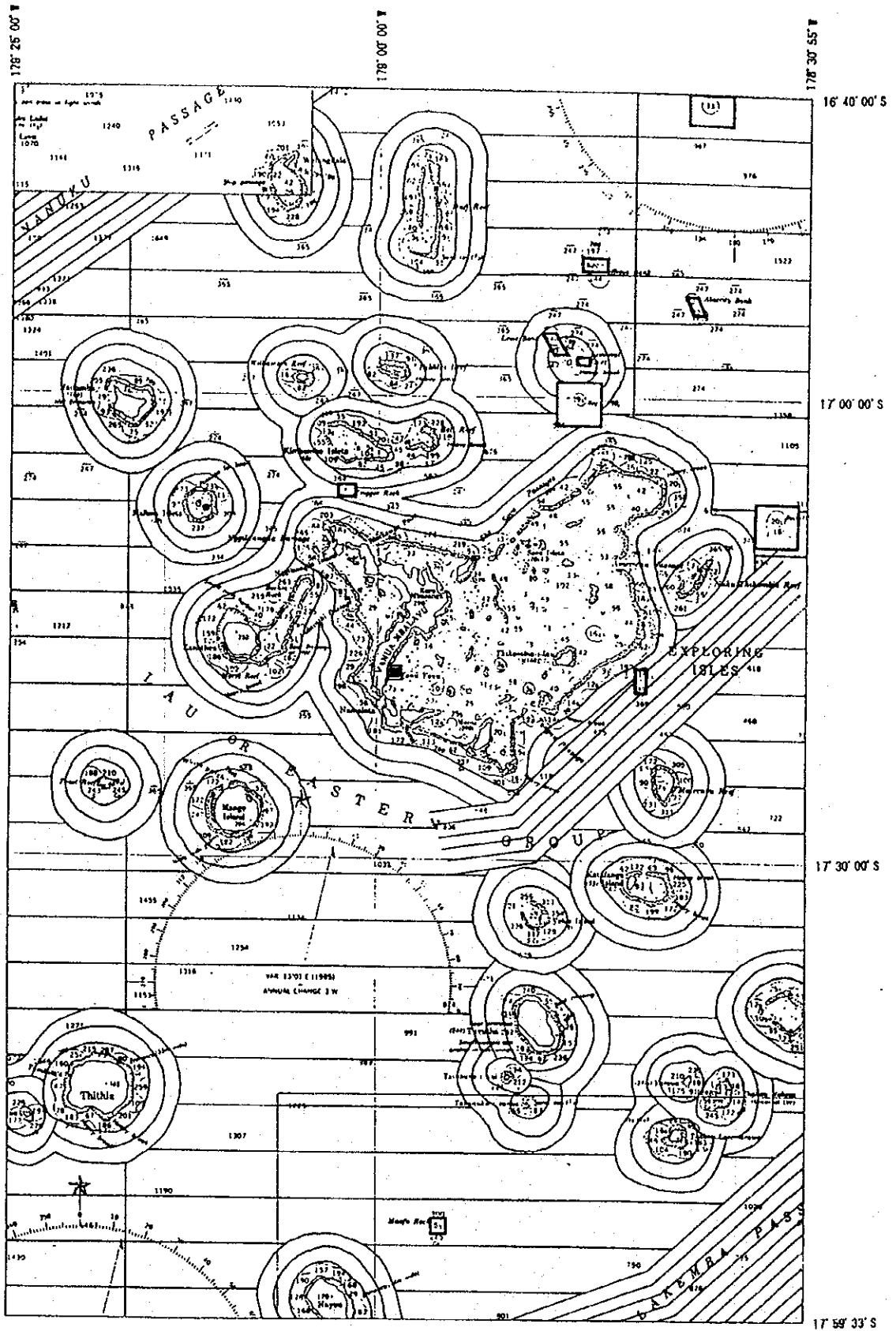


Fig. 3

FIJI-6

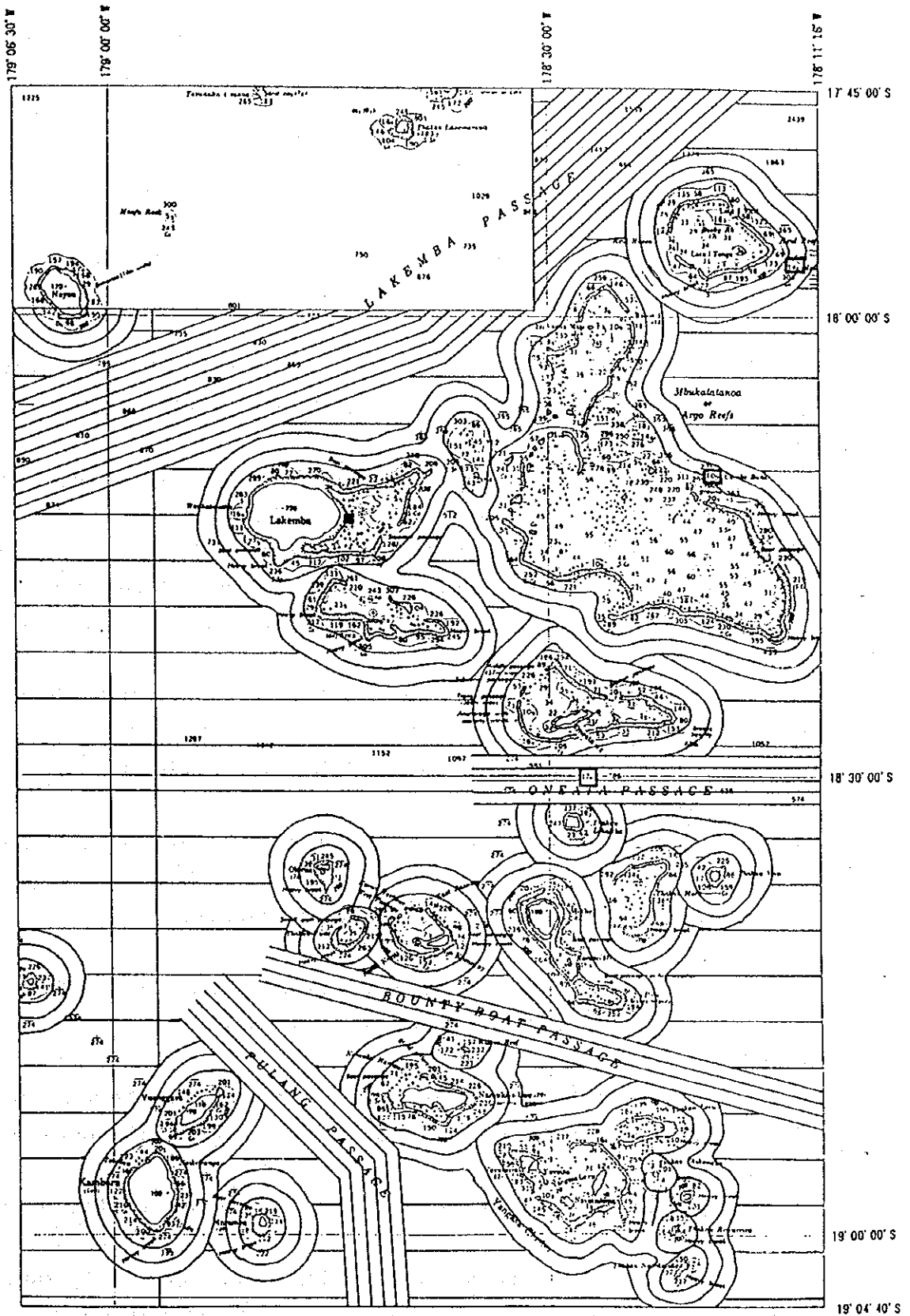


- Legend — Sounding line
 ■ Field base, Tide gauge
 □ Shoal/Reported depth



Fig. 4

FIJI-7



- Legend — Sounding line
 ■ Field base, Tide pole
 □ Shoal depth



shallower water is likely to exist, interlines will be sounded.

(9) Supplementary sounding or resounding will be conducted as follows:

- In case where sounding line intervals have become more than 20% wider than the planned interval, interline sounding will be conducted.
- In case where a depth of less than 30m is likely to exist in between the sounding lines which is considered to be dangerous to navigation, supplementary sounding will be conducted to confirm the least depth.
- Resounding will be conducted in such waters where the echogram shows an extraordinary record, illegible record, or lack of record.
- In case where the difference between soundings at the crossing point of a principal sounding line and a cross-check sounding line exceeds twice the value of the accuracy of sounding, resounding will be carried out when the previous sounding data are considered to have exceeded an allowable error.

2-2-3. Post-work in Japan (Common to Phase II through Phase IV)

2-2-3-1. Data processing

Data processing will be carried out as follows:

(1) Control point survey

Computation of control points will be performed by a computer.

(2) Coastline survey

Data for drawing coastlines will be processed.

(3) Tidal observation

Tidal data will be processed to obtain the zero of the tide gauge, MSL and DL with reference to BM on land.

(4) Sounding

- Soundings will be read out to 0.1m order for those shallower than 31m, and to 1m order for deeper ones, disregarding the fractions.
- Soundings of shallower than 200m will be corrected for tidal heights.
- Soundings for which bar-check was carried out, the reading-scale prepared from the results of bar-check will be used for underwater sound velocity correction, while for deeper soundings the correction tables will be used.

2-2-3-2. Preparation of manuscript sheets

- (1) Control point sheet
- (2) Coastline sheet
- (3) Sounding sheet
- (4) Bathymetric plotting sheet

2-2-3-3. Preparation of smooth sheet of survey

- (1) The smooth sheet will be produced on the scale of 1/150,000.
- (2) As for the projection of the smooth sheet, Transverse Mercator Projection will be adopted.
- (3) Depth contours to be drawn will be those of 2m, 5m, 10m, 20m, 200m and every 1000m.
- (4) Drawing of various data will be made in accordance with the Specifications adopted by JHD, and IHO Chart Specifications where there is no Japanese specification.

2-2-3-4. Inspection of smooth sheet of survey

The smooth sheet of survey thus prepared will undergo inspection by the Japan Hydrographic Association in due course.

2-2-3-5. Preparation of Progress Report (Common to Phase II through Phase IV)

Progress Report incorporating the progress of work up to the current phase as well as problems encountered and solved and tasks for future work will be prepared and submitted to the Fiji Government.

2-3. THE STUDY IN PHASE III (F.Y.1996)

2-3-1. Work in Fiji

2-3-1-1. Tidal observation

(1) Establishment of tide station

- A self-recording tide gauge will be set at the pier of Vanua Balavu.

- Levelling will be conducted between the tide gauge and the Bench Mark (BM) established in Phase II to find the relationship with the value obtained in Phase II.

(2) Determination of Mean Sea Level (MSL) and Datum Level for soundings (DL)

The MSL and DL for the area F6 will be determined by the data from the Vanua Balavu tide station, based on the data processing in the same manner as in Phase II and compared to the previous values.

2-3-1-2. Co-operation in technology transfer in Vanua Balavu lagoon survey

(1) Co-operation by experts

Two Japanese experts will join FHS survey team for their hydrographic survey in the lagoon of Vanua Balavu (Exploring Isles) to render technology transfer to Fiji counterpart personnel. The survey area is as shown in Fig.5.

(2) Provision of equipment

The Study Team will provide the FHS survey team with survey equipment as follows:

- Survey launch : About 5 tons (locally chartered)
- Positioning system : Available for real time data processing
- Four-beam echo sounder for shallow water use : Equivalent to the one to be equipped aboard SMB BABALE.
- Side-scan Sonar : Equivalent to the one to be used in Phase II.

2-3-2. Post-work in Japan

2-3-2-1. Production of nautical charts (Common to Phase III through Phase V)

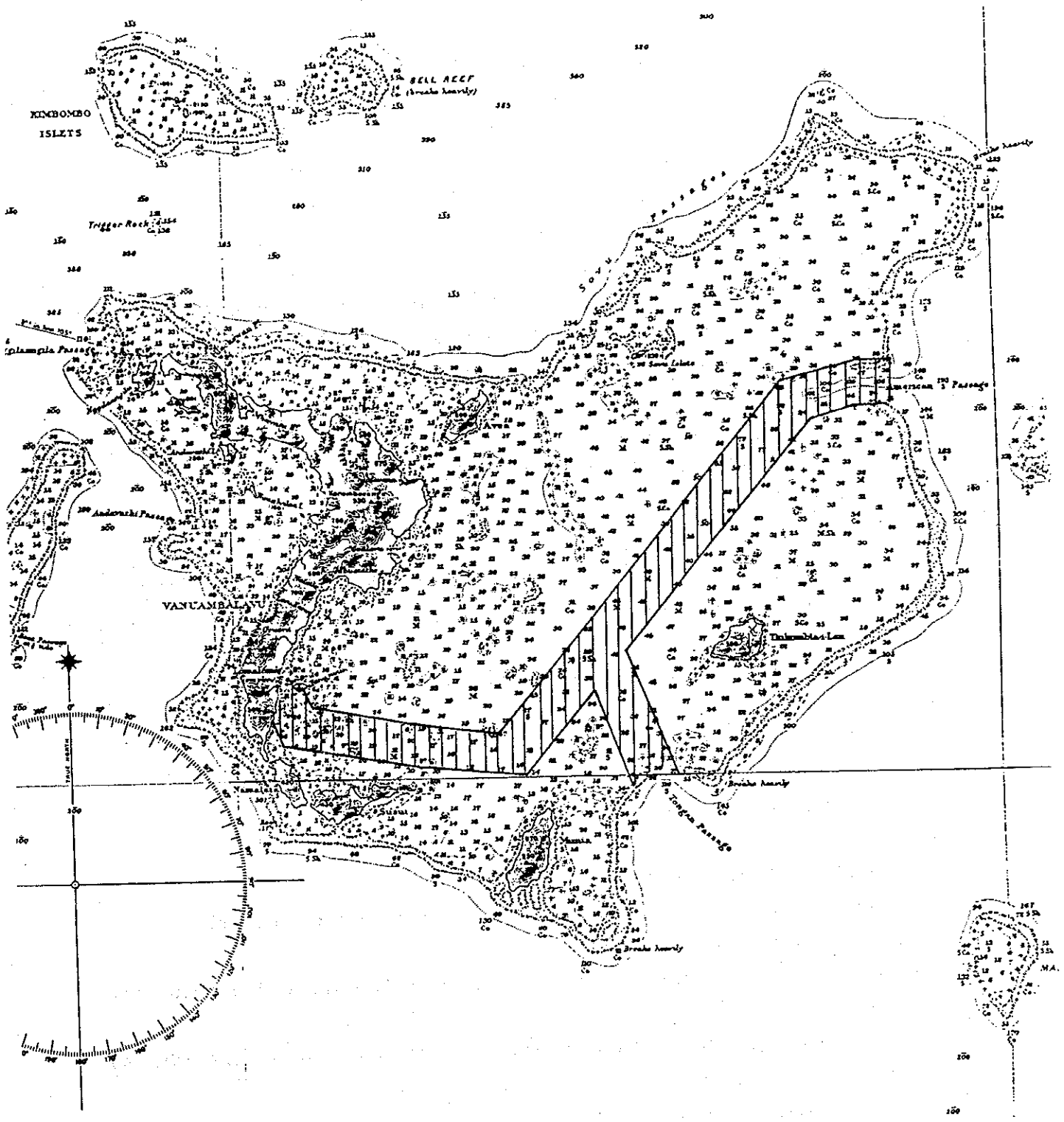
The production of nautical charts Nos.F2, F6 and F7 will be undertaken by JHD upon receipt of the results of the hydrographic surveys and other relevant materials and data from JICA.

2-3-2-1-1. Chart specifications common to the three charts to be produced


- i. Projection: Mercator Projection
- ii. Geodetic system: Fiji Geodetic Datum (FGD), which is equivalent to WGS 72
- iii. Chart scale: 1:150,000
- iv. Chart paper: The same paper as currently used by JHD; size 1,085 x 765mm, weight 140g/m²
- v. Unit of measure for depths: In metres and reduced to Chart Datum, which is approximately the level of Lowest Astronomical Tide (LAT)
- vi. Unit of measure for heights: In metres and above Mean High Water Springs
- vii. Title block including:
 - Title of the chart
 - FHS seal
 - General geographical area and specific geographical reference

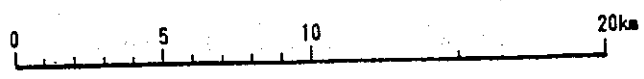
Fig. 5

HYDROGRAPHIC SURVEY IN VANUA BALAVU LAGOON



Legend

 Study area



- Chart scale
 - Unit of measure for depths and heights
 - Name and date of the horizontal datum used
 - Name of the projection used
- viii. Graticules: Every 15 minutes of latitude and longitude
 - ix. Graduation in the borders: Every 0.2 minute
 - x. Source diagram : Showing source material data
 - xi. Conversion table: For metres/fathoms/feet
 - xii. Compass roses: Three compass roses on each chart

2-3-2-1-2. Compilation planning

Based on the results of hydrographic surveys as well as the existing data and information collected, the planning sheet and the planning note will be prepared for each chart.

(1) Preparation of planning sheet

The following items will be indicated on the planning sheet:

- i. Borders and neatlines of the chart
- ii. Graticules
- iii. Graduation
- iv. Information on and the coverage of the existing data to be adopted on the chart
- v. Chart title
- vi. Notes to be given in the title block
- vii. Chart number
- viii. Tidal notes
- ix. Cautionary notes
- x. Submarine cables
- xi. Source diagram
- xii. Geographical names
- xiii. Other data and information to be adopted on the chart

(2) Preparation of planning note

The planning note will be prepared, listing or indicating the following items:

- i. Type of the chart (new chart or new edition of the chart) to be produced
- ii. Ellipsoid of reference
- iii. Chart scale and projection
- iv. Coverage and neatline dimensions, as well as the corner coordinates
- v. Units of measures
- vi. List of source materials to be adopted

vii. Use of colours

viii. Positions of compass roses, as well as magnetic variations and their annual change

ix. Other data and information as well as directions and instructions necessary for compilation of the chart

2-3-2-1-3. Preparation of Drawing Guide

Based on the planning sheet and the planning note prepared, the Drawing Guide will be prepared on the plating film exactly on the same scale as that of the chart to be produced.

2-3-2-1-4. Preparation of Chart Original

(1) Chart drawing

The original drawing (Chart Original) of the chart which is a manuscript for platemaking will be prepared based on the Drawing Guide prepared, in conformity with the IHO Chart Specifications. The chart original will be prepared on the plastic sheets by the scribing method, and sounding figures, chart symbols, compass roses, and geographical names and various type faces which are to be given on the chart will be prepared by phototypesetting and stuck up on the plastic sheets.

(2) Two sheets of the chart original will be prepared, one for black colour and the other for magenta colour.

2-3-2-1-5. Verification and inspection of Chart Original completed

The Chart Original (original drawing) will be checked for consistency, accuracy and adequacy according to the contents of the drawing guide. The chart representation will also be examined. Items to be checked and inspected include the following:

(1) The format as a nautical chart.

(2) The original drawing is examined to ensure that it does not exceed maximum possible printing size.

(3) Whether the original drawing is drafted in accordance with the Chart Specifications of the IHO.

(4) Whether the contents are adequately checked to suit the purpose of the chart.

(5) Whether the representation of the chart is comprehensive to users.

(6) Ensure that it is checked up to the latest Notice to Mariners affecting the chart to be printed.

The charted information has to be updated according to additional data and Notices to Mariners. Such additions or amendments will be incorporated or made on the original drawing up to the time of the platemaking process.

2-3-2-1-6. Platemaking

(1) Preparation of original plates

By using the Chart Original completed, the following original plates (negative films) will be prepared:

- i. Original plate for black colour (for chart borders and neatlines, coastlines, geographical names, etc.)
- ii. Original plate for magenta (for distinguishing information superimposed)
- iii. Original plate for buff (for land tint)
- iv. Original plate for blue (for shallow water)

(2) Preparation of machine plates

By using each of four original plates (negative films) prepared, the machine plates will be prepared by printing negative images on the PS plates, for which the final checking and inspection will be made.

2-3-2-1-7. Chart printing

(1) Using the printing plates made from the chart original prepared by JHD, 200 copies of the nautical charts will be printed.

(2) Printing specifications

- Type of printing : Offset printing
- Colour : In four colours

(3) Inspection

The contents of the printed charts will undergo inspection by the Japan Hydrographic Association.

2-3-3. Production of Nautical Chart No.F2

Basic factors and principles will be as follows:

- (1) Corner coordinates: $16^{\circ} 46' 58'' S$, $15^{\circ} 55' 00'' S$
 $179^{\circ} 32' 57'' E$, $179^{\circ} 04' 30'' W$
- (2) Scale: 1:150,000 (at Lat. $16^{\circ} 20' S$)
- (3) Graticules: Every 15 minutes of latitude and longitude
- (4) Graduation of latitude and longitude on the chart borders:
Every 0.2 minute
- (5) Graticules graduated: One parallel of $16^{\circ} 20' S$
Two meridians of 180° and $179^{\circ} 30' W$

(6) Existing source materials to be adopted:

For compilation of Chart No.F2, the existing copies of the smooth sheets covering the area concerned, the Charts Nos.F50 and F51 as well as BA Chart No.495 will be adopted for the areas other than those where the hydrographic survey will be carried out under the Study.

2-4. THE STUDY IN PHASE IV (F.Y.1997)

2-4-1. Work in Fiji

2-4-1-1. Tidal observation

(1) Establishment of tide station

A tide station will be established at Vanua Balavu and tidal observation will be conducted in the same manner as in the previous Phase.

(2) Erection of tide pole and observation

A tide pole will be erected at Lakeba.

(3) Determination of MSL and DL

The MSL and DL for the area F7 will be determined by comparison between the data from Lakeba tide pole observation and those from the Suva and Vanua Balavu tide stations.

2-4-2 Post-work in Japan

2-4-2-1. Production of Nautical Chart No.F6

Basic factors and principles will be as follows:

(1) Corner coordinates: $17^{\circ}59'33''S$, $16^{\circ}40'00''S$

$179^{\circ}25'00''W$, $178^{\circ}30'55''W$

(2) Scale: 1:150,000 (at Lat. $17^{\circ}20'S$)

(3) Graticules: Every 15 minutes of latitude and longitude

(4) Graduation of latitude and longitude on the chart borders:

Every 0.2 minute

(5) Graticules graduated: Two parallels of $17^{\circ}S$ and $17^{\circ}30'S$

One meridian of $179^{\circ}W$

(6) Existing source materials to be adopted:

For compilation of Chart No.F6, depths in lagoon areas will be adopted from the existing BA Charts Nos.440, 441 and 416. For the area in Vanua Balavu, the results of the hydrographic survey to be carried out during the Study will be adopted.

2-5. THE STUDY IN PHASE V (F.Y.1998)

2-5-1. Work in Fiji

2-5-1-1. Survey of the existing status of the operation and management system for hydrographic surveying and nautical charting in Fiji

- (1) Survey will be made to the existing status of the organization, human resources (number of personnel, expertise, capacity), facilities and equipment (survey vessels, instruments for control point survey, hydrographic survey, oceanographic observation, nautical charting), recent work results, financial status, maintenance, arrangements and storage of nautical charts and relevant data and information, chart publication plan, etc. of FHS which is responsible for the planning, maintenance, production and management of nautical charts in Fiji.
- (2) Analytical study of the results and findings of the survey will be made by JHO.
- (3) Discussions will be held afterwards between FHS and Study Team to finalize the draft Final Report on the recommendation prepared by JHD.

2-5-2. Post-work in Japan

2-5-2-1. Drafting of recommendation

Based on the relevant data and information obtained by the survey and analytical study thereof on the current conditions and problems in operation and management system of hydrographic surveying and nautical charting in FHS, drafting of recommendation will be performed by JHD for discussion with FHS afterwards.

2-5-3. Production of Nautical Chart No.F7

Basic factors and principles will be as follows:

- (1) Corner coordinates: $19^{\circ} 04' 40'' S$, $17^{\circ} 45' 00'' S$
 $179^{\circ} 06' 30'' W$, $178^{\circ} 11' 16'' W$
- (2) Scale: 1:150,000 (at Lat. $18^{\circ} 20' S$)
- (3) Graticules: Every 15 minutes of latitude and longitude
- (4) Graduation of latitude and longitude on the chart borders:
Every 0.2 minute
- (5) Graticules graduated: Two parallels of $18^{\circ} 15' S$ and $18^{\circ} 45' S$
One meridian of $178^{\circ} 45' W$
- (6) Existing source materials to be adopted:

For compilation of Chart No.F7, depths in lagoon areas will be adopted from the existing BA Charts Nos.416 and 441.

2-5-4. Preparation of Final Report

- (1) Recommendation for improvement of the operation and management system of hydrographic surveying and nautical charting in Fiji

Comments on the Draft Final Report will be received from the Fiji side within one month after the submission, and the Final Report will be prepared by incorporating any corrections and additions as necessary.

- (2) Report on the Whole Work of the Study

Based on the Progress Reports prepared in Phases I to V, the Report on the Whole Work of the Study will be compiled.

2-5-5. Submission of Final Report

The Final Report composed of the Report on the Whole Work of the Study and the Recommendation for Improvement of the Operation and Management System of Hydrographic Surveying and Nautical Charting in Fiji will be submitted to the Government of Fiji together with the Final Products of the Study as undermentioned.

2-6. Final Products of the Study

2-6-1. Re : Smooth Sheets of Survey and Nautical Charts

Work	Product	Ph.I	Ph.II	Ph.III	Ph.IV	Ph.V
Coastline drawing	Coastline sheets	■F2, 6, 7				
Control point survey	Final results		■F2	■F6	■F7	
	Control point sheet		■F2	■F6	■F7	
Coastlining	Coastlining data		■F2	■F6	■F7	
	Coastline sheet		■F2	■F6	■F7	
Tidal observation	Marigram		■F2	■F6	■F7	
	Results of levelling		■F2	■F6	■F7	
	DL determination book		■F2	■F6	■F7	
Sounding	Sounding record		■F2	■F6	■F7	
	Position fixing record		■F2	■F6	■F7	
	Sounding sheet		■F2	■F6	■F7	
	Bathymetric plotting sheet		■F2	■F6	■F7	
Smooth sheet of survey	Smooth sheet of survey		■F2	■F6	■F7	
	Inspection certificate		■F2	■F6	■F7	
Nautical chart	Nautical chart			■F2	■F6	■F7
	Inspection certificate			■F2	■F6	■F7

Note : F2, F6 and F7 indicate the chart number or the area thereof.

2-6-2. Re : Reports (Number of copies to be produced)

Product	Ph.I	Ph.II	Ph.III	Ph.IV	Ph.V
Plan of Operation (English)	27	27	27	27	27
Progress Report (English)	27	27	27	27	
Draft Final Report (DF/R) (English)					27
Summary of DF/R (English) (Survey and analysis of hydrographic surveying and nautical charting in Fiji)					27
do. (Japanese)					7
Final Report (F/R) (English) (Recommendation for improvement)					60
Summary of F/R (English)					60
do. (Japanese)					20
Report on the Whole Work of Study (English)					60

IV. ORGANIZATION

1. Study Team

The organization of the Team and the task of each member in the field will be as shown in Appendices 3 and 4, respectively.

2. Equipment and instruments

Survey equipment and instruments to be used in the Study will be as shown in Appendix 5.

3. Work schedule

Daily, weekly and monthly work schedule will, in principle, be as follows:

3-1. Daily schedule

The work aboard the survey vessel will be for 12 hours by two shifts.

3-2. Weekly schedule

Working days will be Monday through Saturday. There will be no work on Sunday.

3-3. Monthly schedule

The survey vessel will return to Port of Suva once every 30 days in the field for rest and replenishment for four days.

4. Safety measures

- (1) The safety measures including an emergency communication network (Appendix 6) will be prepared and distributed among Study Team members.
- (2) The weather forecast from Suva Radio and Radio Fiji will be watched continually to grasp daily weather and sea conditions so that safe operation of the survey vessel may be secured.
- (3) In case of emergency or avoiding any danger to navigation, all the Study Team members will be under the command of the master of the survey vessel.
- (4) Every effort shall be exerted for safe custody of the survey instruments and materials.

V. IMPLEMENTATION PLAN OF THE STUDY IN PHASE I (F.Y.1994)

1. Pre-work in Japan

1-1. Collection and study of relevant information and data available

In order to frame an execution plan of the hydrographic survey and nautical charting of the Study area, collection and study will be made as to existing nautical charts, topographical maps, aerial photographs, lists/maps showing geographical names, list of lights and other aids to navigation, index maps of control points, information on the availability of nautical charts and smooth sheets of survey, Notices to Mariners concerned and meteorological and oceanographic data relevant to the Study area.

1-2. Preparation of Plan of Operation (P/O)

The P/O will be prepared to describe the plan of operation for the whole period of the Study including the purpose, work process, details of each item of survey work together with the amount and accuracy, cooperation requested from the Fiji side (provision of counterpart personnel, survey vessels, equipment, materials, etc.), survey results according to the items of work both in Japan and in Fiji for each year and the whole period of Study. Also included will be the implementation plan of the study in Phase I, and undertakings of both the Government of Fiji and JICA.

2. Work in Fiji

2-1. Explanation of P/O to the Fiji side and consultations

The P/O thus prepared will be submitted to the Fiji side and explanation will be given as to the whole Study and the Study in the first year, and consultations will be held to reach agreements on the P/O.

2-2. Acquisition of source materials

Aerial photographs and other materials necessary for drawing coastlines of islands and atolls for the whole Study area will be acquired.

2-3. Confirmation of survey implementation and support systems

The capability, facility and maintenance condition of the survey vessels to be used for the survey from the second year onward, as well as the performance of survey equipment and

instruments aboard will be checked and confirmed. The method for retrieving tidal data from Suva tide station will also be examined and confirmed.

2-4. Reconnaissance of survey sites

To facilitate the work in Phase II onward, reconnaissance of the sites for establishing survey bases and tide stations at Rabi and Vanua Balavu will be made as to e.g. communications conditions, commercial electricity, lodging facilities, availability of materials and expendables for survey operations as well as to various procedural matters necessary for execution of field work.

2-5. Study team

2-5-1. The Study Team will comprise the following personnel:

Mr. Yasuhiro OYAMADA (Aero Asahi Corporation): Leader

Mr. Masao KUGA (Asia Aerial Survey Company): Hydrographic survey

Mr. Masashi SAITO (Aero Asahi Corporation): Control point survey

Mr. Hiromi HAMASAKI (JHD): Nautical charting

Mr. Hideo TANAKA (JHD): Survey instrumentation

Mr. Mitsuyoshi KAWASAKI (JICA): Study management

3. Post-work in Japan

3-1. Drawing of coastlines

Prior to coastlining in the survey site, coastlines of islands and atolls in Charts Nos. F2, F6 and F7 will be drawn by using the aerial photographs (on the scale of 1/50,000) on a transparent plastic sheets, which will then be reduced to the scale of 1/150,000.

As for the northeastern part of Vanua Levu on Chart F2, the drawing will not be made as the coastlines on the existing nautical charts are to be adopted.

3-2. Preparation of Progress Report

A Progress Report of Phase I will be prepared to describe the progress of work, problems encountered and solved, tasks to the future work, etc., and submitted to the Fiji side.

VI. UNDERTAKING OF THE GOVERNMENT OF FIJI

1. To facilitate smooth conduct of the Study, the Government of Fiji shall take necessary measures:

- (1) to secure the safety of the Japanese Study Team (hereinafter referred to as "the Team");
- (2) to permit the members of the Team to enter, leave and stay in Fiji for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees;
- (3) to exempt the members of the Team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into and out Fiji for the conduct of the Study;
- (4) to exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study;
- (5) to provide necessary facilities to the Team for unrestricted re-export of equipment and machinery brought into Fiji for the conduct of the Study;
- (6) to provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Fiji from Japan in connection with the implementation of the Study;
- (7) to secure permission for entry into private properties or restricted area for the implementation of the Study;
- (8) to secure permission for the Team to take all data and documents (including maps and aerial photographs) related to the Study out of Fiji to Japan;
- (9) to provide medical services as needed. Its expences will be chargeable on the members of the Team; and
- (10) to secure permission to use telecommunication facilities for the execution of the Study.

2. The Government of Fiji shall bear claims, if any arises, against the members of the Team resulting from, occuring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

3. FHS shall act as a counterpart agency to the Team and also as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. FHS shall, at its own expense, provide the Team with the followings, in co-operation with other organizations concerned:

- (1) Available data (including maps and aerial photographs) and information related to the Study;
- (2) Counterpart personnel;
- (3) Suitable office space with necessary equipment in Suva if necessary;
- (4) Credentials or identification cards if necessary;
- (5) Surveying vessels with crew; and
- (6) Appropriate number of vehicles and drivers when required.

VII. UNDERTAKING OF JICA

For implementation of the Study, JICA shall take the following measures:

1. To dispatch, at its own expense, the Team to Fiji; and
2. To pursue technology transfer to the Fiji counterpart personnel in the course of the Study.

VIII. TASK OF FHS

In addition to the items described in VI.4. above, the task of FHS shall be as follows:

- (1) To maintain public relations for local authorities and people on the Study.
- (2) To facilitate acquisition by the Team of necessary materials, data and information such as maps and aerial photographs.
- (3) To make negotiations and arrangements for hiring local manpower to assist the work of the Team.

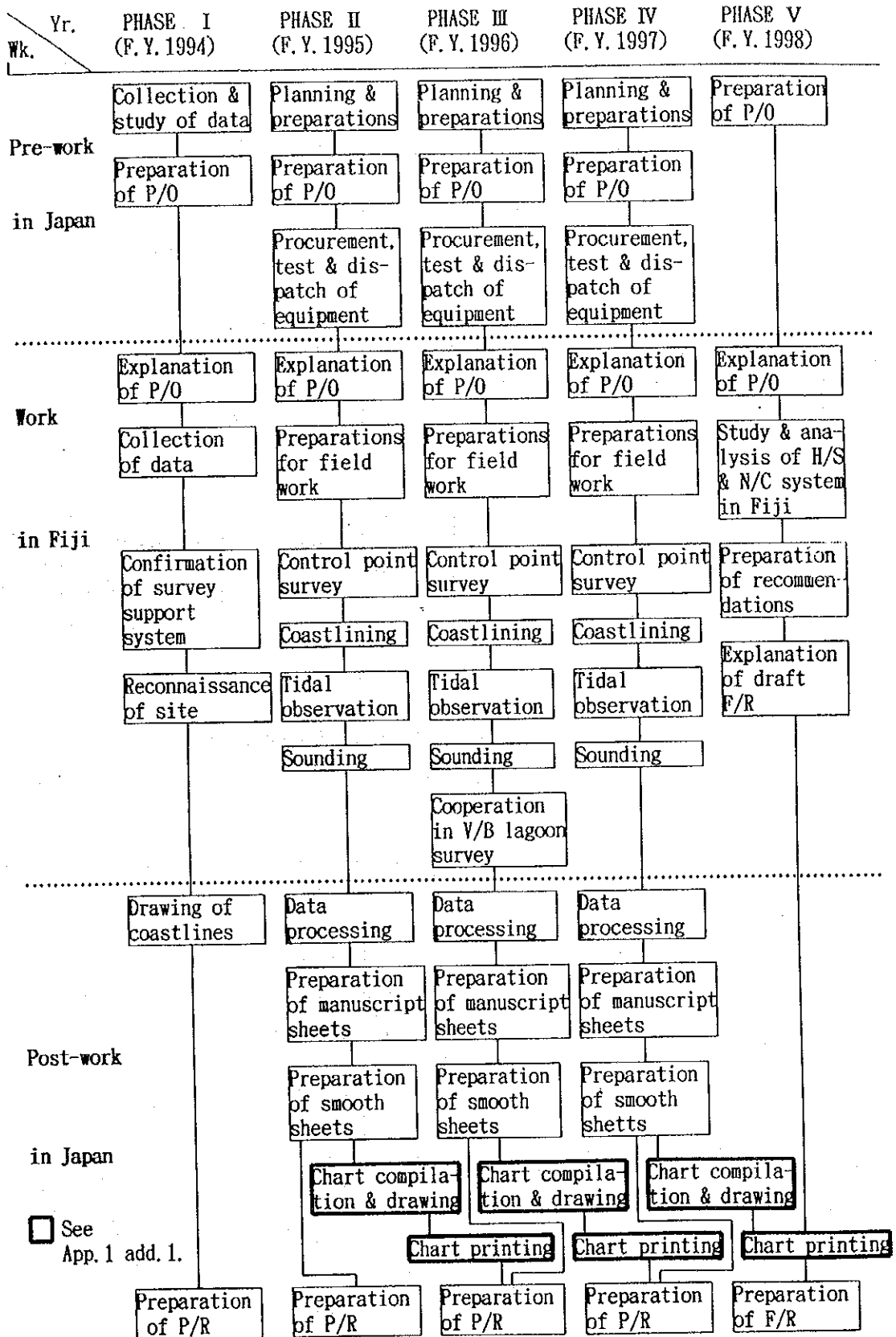
IX. OTHERS

The Team will inform FHS of their working schedule prior to commencement of the field work. Any changes in the schedule will be communicated to FHS without delay.

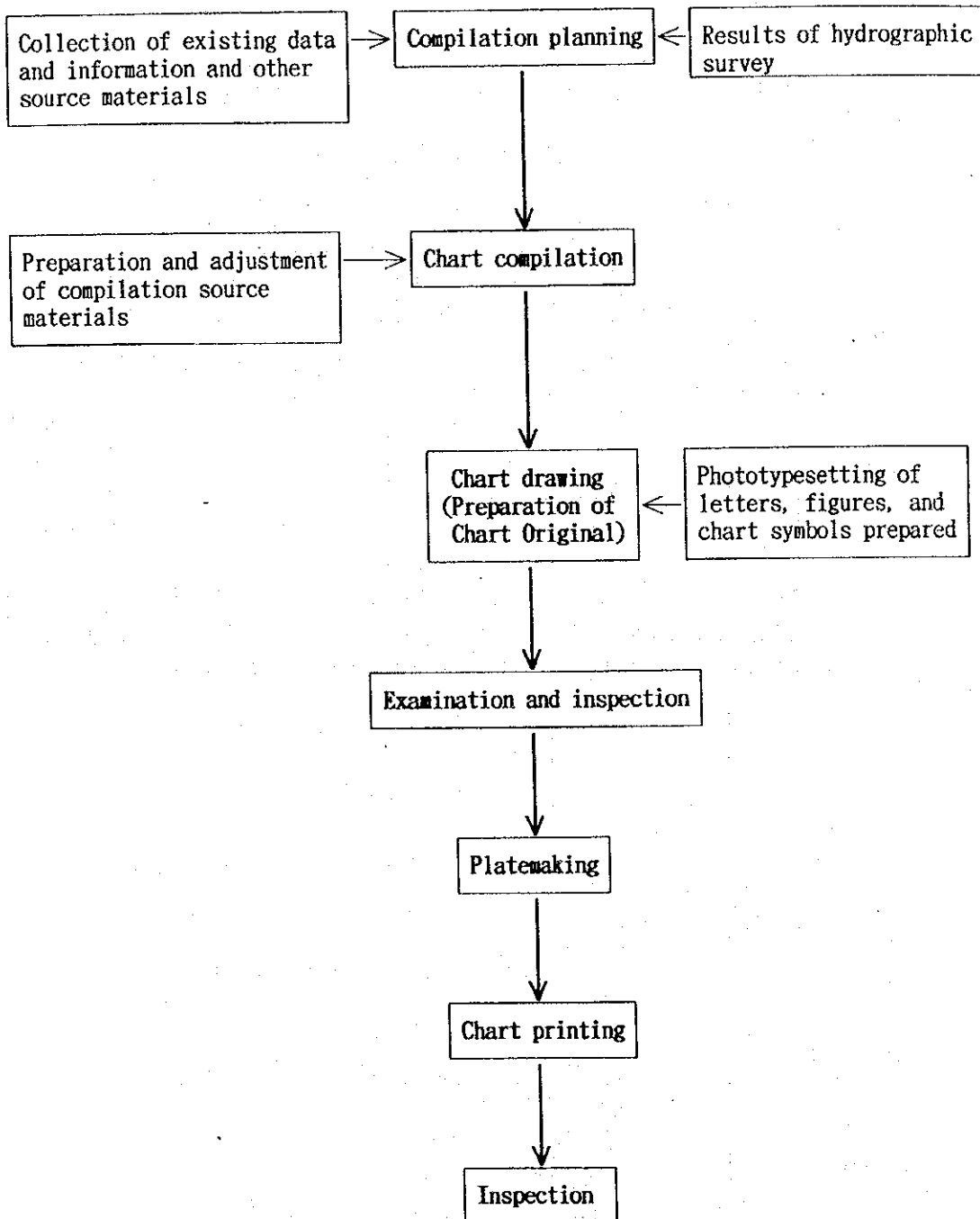
Appendix 1

FLOW OF WORK OF THE STUDY

(N. D.: Plan of operation H/S: hydrographic survey N/C: nautical charting
V/B: Vanua Balavu P/R: Progress Report F/R: Final Report)



Process of Chart Production under the Study



Appendix 2

TENTATIVE 5-YEAR SCHEDULE OF THE STUDY

Item \ Year	F. Y. 1994 (Phase I)	F. Y. 1995 (Phase II)	F. Y. 1996 (Phase III)	F. Y. 1997 (Phase IV)	F. Y. 1998 (Phase V)
	7 10 1	7 10 1	7 10 1	7 10 1	7 10 1
Analysis of existing data	□				
Preparation of P/O	□	□	□	□	□
P/O discussion	■	■	■	■	■
Coastline drawing	□				
Control point survey		■	■	■	
Coastlining		■	■	■	
Tidal observation		■	■	■	
Sounding		■	■	■	
Preparation of smooth sheet		□	□	□	
Preparation of PR/R		□	□	□	
Chart compilation			□	□	□
Chart drawing			□	□	□
Platemaking			□	□	□
Chart printing			□	□	□
Analysis of operation & management system					■
Preparation of recommendation(DF/R)					■
Discussion of DF/R					■
Preparation of F/R -Survey report -Recommendation					□ □

□ : Pre-work in Japan ■ : Work in Fiji □ : Post-work in Japan
P/O : Inception Report PR/R : Progress Report DF/R : Draft Final Report
F/R : Final Report

WORK SCHEDULE (PHASE I)

1994-1995 Work item	Dec.	Jan.	Feb.	Mar.
Analysis of existing data	□			
Preparation of P/O	□			
Discussion of P/O		■		
Acquisition of source materials		■		
Confirmation of survey system		■		
Reconnaissance of survey site		■		
Drawing of coastlines			▨	▨
Preparation of Progress Report				▨
Report		P/O△		PR/R△

:Pre-work in Japan
 :Work in Fiji
 :Post-work in Japan

WORK SCHEDULE (PHASE II)

1995-1996 Work item	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Planning & Preparations		□										
Preparation of P/O			□									
Procurement, test & dispatch of survey instruments			□									
Discussion of P/O			■									
Preparations & procedural work			■									
Control point survey				■	■	■						
Coastlining				■	■	■						
Tidal observation				■	■	■						
Sounding				■	■	■						
Data processing						▨	▨					
Preparation of manuscript sheets							▨	▨				
Preparation of smooth sheet									▨			
Preparation of Progress Report											▨	
Report			P/O△									PR/R△
Inspection of smooth sheet										▨	▨	▨

:Pre-work in Japan
 :Work in Fiji
 :Post-work in Japan

WORK SCHEDULE (PHASE III)

1996-1997 Work item	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Planning & preparations		□										
Preparation of P/O			□									
Procurement, test & dispatch of survey instruments			□									
Discussion of P/O			■									
Preparations & procedural work			■									
Control point survey			■■■■■									
Coastlining			■■■■■									
Tidal observation			■■■■■									
Sounding			■■■■■									
Co-operation in V. B. lagoon survey				■■■■								
Data processing								□□□□□□□□				
Preparation of manuscript sheets									□□□□□□□□			
Preparation of smooth sheet										□□□□□□□□		
Preparation of Progress Report												□□□
Report			P/O△									PR/R△
Chart compilation		□□□□□□□□□□										
Chart drawing					□□□□□□□□□□							
Platemaking								□□□□□□□□				
Chart printing										□□□□		
Inspection of printed chart											□	

:Pre-work in Japan
 :Work in Fiji
 :Post-work in Japan

WORK SCHEDULE (PHASE IV)

1997-1998	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Work item												
Planning & preparations		□										
Preparation of P/O			□									
Procurement, test & dispatch of survey instruments			□									
Discussion of P/O			■									
Preparations & procedural work			■									
Control point survey				████████████████████								
Coastlining				████████████████████								
Tidal observation				████████████████████								
Sounding				████████████████████								
Data processing								▤▤▤▤▤▤▤▤				
Preparation of manuscript sheets									▤▤▤▤▤▤▤▤			
Preparation of smooth sheet										▤▤▤▤▤▤▤▤		
Chart compilation				▤▤▤▤▤▤▤▤▤▤								
Chart drawing							▤▤▤▤▤▤▤▤▤▤					
Platemaking										▤▤▤▤▤▤▤▤		
Chart printing											▤▤▤▤▤▤▤▤	
Preparation of Progress Report												▤▤▤▤
Report				P/O△								PR/R△
Inspection of smooth sheet		▤▤▤▤▤▤▤▤▤▤										
Inspection of printed chart												▤

:Pre-work in Japan
 :Work in Fiji
 :Post-work in Japan

WORK SCHEDULE (PHASE V)

1998-1999 Work item	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Preparation of P/O			□									
Discussion of P/O			■									
Analysis of surveying & charting system			■									
Preparation of recommendation(DF/R)				■								
Discussion of DF/R								■				
Chart compilation			▨									
Chart drawing							▨					
Platemaking										▨		
Chart printing											▨	
Preparation of Final Report -Survey report -Recommendation												▨
Report			P/O△				DF/R△					F/R △
Inspection of smooth sheet		▨										
Inspection of printed chart												▨

:Pre-work in Japan
 :Work in Fiji
 :Post-work in Japan