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MARITIME DYNAMIC TRAFFIC GENERATOR
Volume II: Electronic Data Processing Program

Franklin D. MacKenzie

JUNE 1975
FINAL REPORT

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16. Abstract

The processor program is designed to move 18,000 merchant vessels along standard routes to their destination and keep statistical records of the ports visited, the five degree squares passed through and the occurrence of casualties. This document presents detail information on the design of the Maritime Dynamic Traffic Generator, the subroutines, the reasoning behind each routine; and how they are related. In addition, there are descriptions of the data preparations and editing the input data used in the generation. Volume I: Summary Documentation-describes the application of the data to the design of a satellite communication service. One of the most useful forms of the data output is a weekly plot, on a world map, of the average, daily vessel density per five degree square. This output is applicable to many related programs in the maritime and is the subject of VolumeIII:Density Data on World Maps.

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PREFACE

The processing program described in this report was created in support of an overall objective at the Transportation Systems Center to define and analyze requirements for a navigation and communication service through a satellite for commercial vessels. The program is sponsored by the Department of Transportation, through the United States Coast Guard, Office of Research and Development. The program supports Government activities designed to promote maritime safety through improved communication service.

The weekly movements of 18,000 vessels were recorded and processed for the calendar year 1972. The ports visited, routes taken and the occurrence of casualties were recorded. The objective of this task was to establish a method to determine the number of potential users of a satellite communication service and the required satellite coverage to provide this service.

The processed program was designed by Paul V. Connolly* assisted by J. Van Etten and T. Talbot of Kentron Hawaii, Ltd.

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1. SUMMARY

1.1 PURPOSE

The purpose of the Maritime Dynamic Traffic Generator is to report, on a weekly basis, the total number of merchant vessels in port and on the high seas, their approximate position, the number of arrivals and departure at each port; and their concentration throughout the world by processing the information that appears in Lloyd's Weekly Shipping Index.

This document presents detailed information on the design of the Maritime Dynamic Traffic Generator and all the subroutines which constitute the package; the reasoning behind each routine; and how they are related. In addition, there are descriptions of the data preparations and editing of the input data used in the generator.

1.2 SCOPE

The Maritime Dynamic Traffic Generator processed the weekly data from the Index for the entire calendar year of 1972. The input data included the shipping reports for 18,000 merchant vessels; it excluded yachts, fishing vessels, coasters and vessels which exclusively traded along the European coast or across the channel to the United Kingdom. This report describes the electronic processing of the data input, the assumptions and the format of the output data.

1.3 CONCLUSIONS

The Maritime Dynamic Traffic Generator is an analytical tool to be used to design and validate a simulation experiment to evaluate the potential advantages of various access schemes.

As vessels travel from one satellite coverage area to another, there will be a hand-over scheme which will modify the ship interrogation lists at each ground station. To aid in the design

of the hand-over scheme the generator will supply the rate of egress into a circular coverage area for any section of the earth.

1.4 RECOMMENDATIONS

The accuracy of the density data output of the Maritime Dynamic Traffic Generator can be increased by using ship routes which change to reflect the seasons.

The Maritime Dynamic Traffic Generator should be validated whenever there is a major change in the shipping routes.

2. INTRODUCTION

The Transportation Systems Center of the Department of Transportation is conducting programs to analyze and define requirements for navigation and communication service through a satellite with commercial vessels. One of these programs had as a goal the development of an analytical tool which could be used to determine the number of potential satellite users and the required satellite coverage. This goal was met with the completion of the Maritime Dynamic Traffic Generator.

The generator is an electronic data processor program which uses the Lloyd's Weekly Shipping Index as a data input source. The 18,000 vessels in the Index are moved along shipping tracks to their destination. All the arrivals, departures and casualties are tabulated. There is a counter for each 5^{o} square of the ocean which keeps a weekly total of the number of vessels passing through. Once a week all this data is printed on world maps and in tables. With this data the satellite channel requirements can be determined and proposed switching schemes to provide the required communication coverage can be evaluated. With the data from the generator it is possible to derive the expected communications traffic volume for restricted oceanic areas as might be "seen" by narrow-beam (2^{o}, 3^{o} or even 5^{o}) satellite antennas. It is also possible to determine how the regional oceanic communications load will vary weekly or seasonally. It is possible to determine the practicality of narrow-beam satellite coverage, either via retrodirective phase arrays, or via multi-feed switched beams using the generator output. The generator establishes a data base on maritime statistics which are specifically oriented toward a satellite system and can be used to verify user requirements. In addition, the generator can be used as a simulator to evaluate concepts which will directly impact on the complexity of the satellite control center such as:

a. System access control
b. Hazard avoidance
c. Weather routing

This document describes the assumptions that were used as well as the subroutines which make up the program.

3. MARITIME DYNAMIC TRAFFIC GENERATOR

3.1 BACKGROUND

In the generator, the world is represented by an array in which each row constitutes 5^{o} of latitude ranging from 85^{o}N to 60^{o}S and each column represents 5^{o} of longitude for 360^{o}. The elements of the array are coded to distinguish between land and ocean. The data input for the generator is the Index, and includes where a vessel sailed from, where it is headed, and possibly a last port of call. The shipping routes were taken from Pilot Charts published by the Defense Mapping Agency Hydrographic Center. To move a vessel from one part of the world to another on the appropriate shipping lane with correct heading, extremely large tables, with lanes and headings from each port to all other ports would have been required. To circumvent this it was decided to group ports within a specified region. There are 15 such groupings based on divisions used by the Lloyd's list of port arrivals and departures. Some of the groupings were geographically large and are further subdivided into sectors within the group by latitude and longitude.

In the real situation ships proceed along lanes that cross and merge. In the generator each crossing is a decision point and the ship's heading is affirmed or changed at these points depending on the destination. A table called Decision Point was constructed. It has 20 entries and each entry consists of a shipping lane and heading for every port grouping.

3.2 DATA INPUT

The input source is a weekly record of the movements and latest reports of all ocean crossing merchant vessels. The data consists of the vessel's name, flag, year built, gross tonnage, port from, port for and the latest report. The latest report includes: arrived, sailed, passed, and reports of casualties. Appendix A contains a description of the card format used for this data and also documentation on the edit programs used to refine

this volume of data (approximately 18,000 cards/week) so as to minimize the amount of erroneous data processed by the Maritime Dynamic Traffic Generator.

3.3 PROGRAM OPERATION

The constants data tape is first loaded. It contains four files. The first file is a description of the world in 5^{o} squares; the second and third file contain the Destination and Decision Point tables, respectively; and the fourth file is a list of all the ports used in the program. A core image of each of these files can be found in Appendix C. A tape containing the previous week's movements is read into the computer. It would be ideal to maintain all the data pertaining to each vessel in the computer at any one time; however, the core limitations allow only 20 computer words per ship saved from one week to the next. The ships are grouped in blocks of 102 ships. Thus the computer holds the data and processes 102 vessels at a time. Once the end of a block of 102 vessels is reached, the next block is read in until all the vessels are processed.

Data cards are read in one at a time from a prestored tape and checked for authenticity; when blanks are encountered in the input, appropriate substitutions from previous entries for this ship are made.

The input is prepared on punched cards from Lloyd's Shipping Index each week. The alphabetical order of the vessels in the index from week to week is essentially the same; however, vessels are scrapped, registrations are changed and new vessels are added which causes the order to change. To conserve the computer storage, the names of the vessels are <u>not</u> kept in the Ship Table. Vessels are identified in the table by flag, year built and gross tonnage.

To obtain a match the input vessel is checked against the ship table for the previous week. The criterion for a match is that two of the three items must agree (flag, year built, and gross tonnage). If there is agreement this vessel will be moved

in the appropriate direction and the ship table will be updated according to the data on the card. If there is a disagreement, five entries prior to and following the vessel will be checked for a match. If no match is possible, the program interprets this as either a new ship or one that has been renamed, and then creates a new entry in the Ship Table at this point.

Card entries of Port from and Port for will be checked against the table entries of the same ship for the Port From and Port For to determine if the voyage has been completed or a new voyage started.

A voyage is complete when the Port From on the card entry is equal to the Port For in the table entry. The days of travel are then computed for this vessel. For example, two reports on the same vessel might read:

Date of Report	Port From	Port For
Jan 7	San Francisco Jan 1	Yokohama
Jan 14	Yokahama Jan 12	India

In this example a voyage would have been completed on Jan. 12 and the days of travel would be 10 days. There is a built-in assumption that if the actual time in port can not be determined, then a two day stay is assumed. There are instances in the index when a vessel is sailing from one port to another in one report, and the following report has the vessel leaving from still another port and heading for a different port.

For example, two reports on the same vessel might read:

Date of Report	Port From	Port For
Jan 7	London Jan 1	Melbourne
Jan 14	Brisbane Jan 13	Los Angeles

From this example it is obvious the vessel went from London to Australia to complete its voyage. However, the days of travel can not accurately be computed since the arrival of the vessel in Melbourne is not dated. In this instance, no days of travel are computed and stored in the table but the ship is moved from

London to Melbourne for a completed voyage, then moved to Brisbane from whence a new voyage will be started. After the voyage status has been determined the latest report is examined. There are four possible latest report codes: AR, SD, PD, and IN. If the code is blank, the ship is assumed to be on high seas and its position is updated on the appropriate track to the date of this report and stored in the Ship Table. The code AR (arrive) followed by a blank entry in the latest report signifies that the ship has arrived at its final destination. If the latest report is not a blank, the ship has arrived at an intermediate stop. A two day stay in port is assumed and the ship then proceeds toward its final destination, having updated its position to the date of the previous report. The code SD (sailed) is checked against the previous entry. If the date of the sailing is prior to the previous report date, and the previous code was AR, for which a two day stay in port was assumed, the stay is eliminated and the true stay calculated. The ship is positioned on the appropriate lane headed for its final destination and its position is updated to the date of this report.

The code PD (passed) signifies that the vessel has passed some prominent landmark, whose location has been previously stored in the memory. The vessel is moved to the position stated in the last report and then updated to a position on a lane consistent with the report date. The code IN (inport) is processed in a similar manner to the arrival code. Weekly counts of the number of arrivals and departures from each port are kept in the Port Table. Total counts for arrivals, departures, and ships on the high seas are also accumulated.

3.3.1 Vessel Movement

There are two categories of vessel movement: new voyages or continued voyages. New voyages start from the port listed in the Port From, ports in the same port group or ports outside of the port group. The processor program must be able to move vessels from each of these to their destinations.

3.3.1.1 New Voyages - If a vessel leaves a port from which it had just completed a voyage, the destination table is searched using the Port From group number and the Port For group number to obtain the lane and heading. If there is a latest report and its group number is not the same as the Port From, the destination table is again entered using the Port From group number and the latest report group number to obtain the track and heading to reach the destination in the latest report. If the track and heading agree for both cases, the track has been validated and the vessel is moved along it.

If the latest report is from the same port group as the Port From, the ship is moved to the latest report but the track is not validated and the vessel is held at this point until the next report.

If the new voyage begins from a port which is different from the port where the previous voyage was completed, the vessel is moved from its arrival port to the departure port without validation.

Vessels can generally move along their respective tracks only if the track has been validated. There are two exceptions to this procedure. First, if the following week's report shows the vessel beginning another new voyage, the previous week's journey is completed using the track and heading selected. Second, if the latest report from the ship has not been received for two report periods, and the Port From and Port For are still the same, the vessel will be moved using the best estimate of track and heading. Its position will be updated to the date of this reporting period.

3.3.1.2 Continued Voyage - Once a vessel is moving on a validated track, its position is monitored by checking the latest report. As it arrives at each of the latest reported ports, its track and heading are further clarified by once again entering the destination table and finding the best possible route to reach its final destination in the shortest time. All ports arrived at or departed from are recorded and summarized at the end of the processing.

3.3.1.3 Sailing Mode - There are two sailing modes in the Maritime Dynamic Traffic Generator: track sailing and free sail. Track sail takes care of the majority of the voyages while free sail handles movements within port groupings.

3.3.1.3.1 Track Mode - In the track mode a ship moves from a point on a track to its destination point by searching the next 5^{o} block of the world map for a match with its current track. The world has been segmented into 5^{o} blocks and each block is coded as land, track, decision point or open water. The ship checks the adjacent block in the direction in which it is heading. If no match is found, a 180^{o} search about the present position is made to locate the match. It is impossible not to find either the designated track or a decision point. If a match is found the vessel then proceeds to the next block and the process is repeated until the prescribed point is reached.

If a decision point is encountered, the generator enters the Decision Point Table with its current position and the port group to which the vessel is heading. At the decision point, the vessel may be assigned a new track and heading or allowed to enter the Free Sail Mode.

3.3.1.3.2 Free Sail Mode - The Free Sail Mode allows a vessel to move essentially in a straight line for short distances. For short distances this mode works well, but for large distances, land obstacles, islands and penninsulas intervene with the straight lane, minimum path limitations. This mode is used in the generator to move vessels in and out of the established shipping tracks and to move vessels within a port grouping. These are generally short distances.

With each mode of sailing, every time a vessel passes a block on the world map it is counted. The counters indicate the number of vessels which have sailed through the region. One output of the generator is a density distribution for each week.

3.4 GENERATOR SUBROUTINES

There are ten subroutines in the generator: Main, Unpack, Store, Group, Move, Point, Julian, Update, Deci and Search. Each of the subroutines is described.

3.4.1 Main

This subroutine initializes all variables, and reads in the four files of the Constant Data Tape and the blocks of 102 vessels from the previous week. The current report is read in one card at a time; the data is checked for authenticity; the blanks are filled where necessary; and the main subroutine calls a number of subroutines to provide information needed to match up the current report with the previous report. In addition to generating the matchup, it checks to see if this is a continuing voyage or a new one. It then checks the latest report for arrivals and departures and records the appropriate entries in the Port Table. The subroutine prints out any errors made during the processing, total arrivals, departures, completed voyages and vessels on the high seas. It lists all ports used during this run and indicates the number of arrivals and departures from each port. It also stores this information on tape along with the distribution of ships on the world map for later processing by the Plot subroutine.

3.4.2 Unpack

This subroutine unscrambles the information contained in the ship table. It takes the 20 packed words representing the current information about a vessel and expands the information into 31 individual words for ease of manipulation by the generator.

3.4.3 Store

The function of this subroutine is to take the updated results of this week's report, compress the computer words into 20 words and store them in the new Ship Table. Each entry counted and when 102 entries have been accumulated the table is transferred to magnetic tape and serves as the input for the Ship Table the following week.

3.4.4 Group

The Group Subroutine assigns the ports into geographic groups. Each port is looked up in Lloyd's Maritime Atlas to find its longitude and latitude to the nearest degree. Next, the first five or six letters of the port name, its longitude and latitude are punched onto cards. These are then processed in a program which determines the position of the port as indicated on the world map used in the generator. In addition, the port is assigned a group number. Each port entry occupies two words. The first word contains the abbreviated port name and the second the port group to which it has been assigned along with its matrix position. This data is contained on the Constant Data Tape which is read into the port table by the Main subroutine.

The group subroutine enters the Port table to find the port name. It then notes the port location within the table and the group number associated with it. This information is then transferred to the Ship Table.

3.4.5 Move

This subroutine is responsible for the movements of a vessel from its current position to its designated position in either the track or free sail mode. From the Ship Table the ship knows its current heading and track and will continue the track until it reaches its destination or encounters a decision point, at which time it may assume a new heading and track.

3.4.6 Point

Ships in the track mode move from one point on a track to another point on a track. The function of this subroutine is to determine these points. Knowing the port from which the ship is sailing and its designated track, this routine determines the minimum path from the port to the established track. The same procedure is used in locating a point on a track for the Port For and the Port From of last call.

3.4.7 Julian

This subroutine converts the dates which were input as months and days into days of the year.

3.4.8 Update

This subroutine controls the movement of the vessel. By comparing the current report with the information provided by the Ship Table regarding the previous week's movements, this subroutine determines whether or not a ship should be moved. The Main subroutine will notify Update if this is a new voyage or an old one to be updated and/or completed and a new voyage to be started.

If the ship is in port and a voyage is to start, the Update subroutine will call Search to find the track and heading to move on. If there is a latest report at this time and it is from the same port group, the Move subroutine is entered in the free sail mode, and the vessel is moved to its latest report. At this time the Point subroutine is called to locate a point on a track near the latest report. The Move subroutine is again entered in the free sail mode and the ship moved to the spot designated by the Point subroutine. The ship is now held at this position until next report or 14 days, since the track has not been validated. A track is validated only when the latest report is from a port group which is different from the Port From group. If the latest report is from a different port group, the Point subroutine is used to determine a point on a track near the latest report. The Move subroutine is then entered and moves the ship along the designated track to that point near the latest report. If the latest report code is AR (arrive) and this is the required port for the move, the subroutine would enter the free sail mode and guide the ship into port and set the inport flag. If this is not the final destination then a two day stay in port is assumed, and the Search subroutine is entered to find the best route from this port to its destination. The vessel is moved along this route. The amount of further movements depends on the latest report date and the date of the Index. Updating to the date of the Index creates the possibility that next week's report will show

the ship as having arrived at a port only a few miles away. In this case, the ship may have already sailed by this port. The generator makes note of this by printed output that will omit movement of this ship this week. The port statistics will still be updated. The latest report codes for SD, sailed and PD, passed are handled in the same manner. If this is an old voyage to be updated, the subroutine first checks whether the track has been validated. If the track has not been validated and the ship has been holding for less than 14 days, it will not be moved and it is stored in the new Ship Table, in the hold category. If the track is not validated and the hold is greater than 14 days, the ship is moved towards its destination on a best estimate of heading and track.

If the voyage has been validated and there is a new latest report, the Point subroutine is called to determine the point on the track near the latest report, and the Move subroutine is called to update the ship's position depending on the latest report code.

If the voyage has been validated and there is no latest report the ship moves on its previously determined track to the date of this report period.

3.4.9 Deci

In the process of updating a ship's position in the Move subroutine the generator occasionally locates a vessel at point where two routes cross or merge. To resolve the choice of routes to continue the voyage, the Deci subroutine was designed. The following parameters are used: the ship's current position, the port group number for which it is destined, and the longitude and latitude of the Port For. Using the Decision Point Table, the Deci subroutine returns to the Move subroutine with an updated track and heading, which will direct the ship to its designated port in the shortest time.

3.4.10 Search

This subroutine is called upon whenever a ship is leaving a port. It provides a service to the Update subroutine. The Update routine notes that a vessel is about to leave port and requests the search subroutine to provide the best possible track and heading to complete the voyage. Update supplies the following data to Search: the Port From group number, the Port For group number, and the longitude and latitude of the Port From. The Search subroutine, using the Destination Table, supplies the track and heading most appropriate to begin the voyage.

3.5 ASSUMPTIONS

The assumptions which were made in the Maritime Dynamic Traffic Generator are:

a. All ships travel at 15 knots.

b. The distance travelled in a 5^{o} square will depend on the heading of a ship. Each 5^{o} square in the world map matrix is 300 Nautical miles along the latitude dimension, (N-S) and varies in the longitude dimension (E-W) depending on the latitude of the square. If a ship is travelling along the diagonal, the diagonal distance of that 5^{o} square will be used.

c. A two day stay in port will be assumed if no arrival or departure date is given in the index.

d. Only tragedies occurring during the week's reporting period will be tabulated.

3.6 OUTPUT FORMAT

The data output formats include tabular and geographical formats.

In addition, the input data can be filtered by flag, age, weight, and by tanker category. This filtering allows a designer to isolate the type of vessel that is a potential user of his

service. This filtering is done on the input data prior to processing the data with the generator.

3.6.1 Tabular

The tabular data on a weekly basis includes the number of tragedies in the sunken, collided, emergency, aground or weather damaged category. The number of departures and arrivals per port and per port group is printed as well as the total arrivals, departures, at-sea and completed voyages.

3.6.2 Geographical

Five options may be obtained individually or in any combination:

a. The maritime traffic density in numbers

b. The port location

c. The number of arrivals and departures for the ports.

d. The ship routes

e. The maritime traffic density in the form of dots.

The traffic densities are daily averages and the arrivals and departures are weekly totals. The above can be plotted on computer printout sheets or on a world map format. There are four projections available:

a. Mercator
b. Equal Area
c. Sterographic
d. Equal Spaced

3.7 COMPUTER REQUIREMENTS

The Marine Traffic Generator in its present configuration requires 32K of core storage. The breakdown of this storage is as follows: the Generator (all 10 subroutines) plus the arrays and variables occupies 21,726 words of core storage; the 7094 system routine occupies 5322 words of core storage, the remaining 5,000 words of core storage are used as input/output buffers.

The Generator was designed and written for the IBM 7094 in Fortran IV. Because of the packing and unpacking of information, care should be exercised when trying to implement this program on another computer.

3.7.1 Computer Operation

There is only one input card needed for the generator. All other information comes from tape. The input card contains the following information.

Col 1 - col 5 - Date of the book to be processed (day of the year)

Col 6 - col 10 - Book number

Col 11 - col 15 - Number of active ports in the port table

Col 16 - col 20 - Digit indicating this is the first in a series of books to be processed (only used for Book 1)

The tape assignments are as follows:

Unit	Contents	Type of Coding
8	log of this week's ship movement	BINARY
10	log of the previous week's movement	BINARY
12	input data cards punched from Lloyd index	BCD
9	Constant data (World Map, Destination, Decision and Port Table)	BINARY
11	Distribution of this week's movement and the arrivals and departure from ports	BINARY

List of most important program variables and their meaning:

CFLG	input flag for this ship
TFLG	table value flag for this ship
CGROSS	input tonnage
TGROSS	table value tonnage
CPFROM	input "Port From"

TPFROM	table value "Port From"
CFDATE	input "From date"
TFDATE	table value "From date"
CPFOR	input "Port For"
TFOR	table value "Port For"
CCODE	input latest report code
TCODE	table value latest report code
CLRPT	input "Latest Report"
TLRPT	table value "Latest Report"
CLDATE	input "Latest Report" date
TLDATE	table value "Latest Report" date
CLGRP	input "Latest Report" group number
TLGRP	table value latest report group number
CFOGRP	input "Port For" group number
TFOGRP	table value "Port For" group number
CFRGRP	input "Port From" group number
TFRGRP	table value "Port From" group number
ICFOR	input "Port For" index to Port Table
IPFOR	table value "Port For" index to Port Table
ICFRM	input "Port From" index to Port Table
IPFRM	table value "Port From" index to Port Table
ICLRT	input "Latest Report" index to Port Table
IPLRT	table value "Latest Report" index to Port Table
YPOS	current latitude position
XPOS	current longitude position
YPREV	previous latitude position
XPREV	previous longitude position
INPORT	inport bit
HEAD	ship's current heading
TRACK	ship's current track
NDPORT	number of days in port
NDTRAV	number of days of travel
VAL	validation bit
IDL	delay counter
HOLD	hold date
DATEU	date of last update

MAP (29,72)	world maps table
PORT (2,3000)	port table
PRTG (2,15)	counters for the port groups as to the number of ships to and from
SHIP (20,112)	previous week's ship movement
NSHIP (20,102)	results of this week's movement
DEST (17,15)	destination tables
DECI (17,15)	decision point table

APPENDIX A
LLOYD'S EDIT ROUTINES

Input data cards are submitted to two edit routines in order to eliminate errors in keypunching, port name identification, incorrect dates, and finally, isolation of unknown ports. Each ship is represented by one card per week making a total of approximately 18,000 data input cards weekly. The card input format is as follows:

Card Input Format

col 1 - col 19	Ship's Name (first 19 characters including blanks)
col 20	Tanker Bit - blank - no tanker - 1 = tanker
col 22 - col 23	Flag
col 25 - col 26	Year Built
col 28 - col 33	Gross Weight
col 35 - col 40	Port From Name
col 42 - col 47	Port From Date
col 49 - col 54	Port For Name
col 56 - col 57	Latest Report Code
col 59 - col 64	Port Name in Latest Report
col 66 - col 71	Date of Latest Report
col 73 - col 74	Tragedy Code

Port names will be punched from the Lloyd's Shipping Index using the first five characters of the port name. If the port is distinguished by a parenthetical name the first letter of the name is punched in column 6. If there is no parenthesis, it must be left blank.

Dates will be punched as a 3 letter month followed by at least one blank and a day of the month.

Tragedy Code signified by a + in the book is recorded only if it occurred during this reporting period.

The codes are:

1) 1 = Sank
2) 2 = Collision
3) 3 = Emergency (fire, engine trouble, broken propeller, etc.)
4) 4 = Aground
5) 5 = Weather
6) 99 = Ship laid up

Lloyd's Edit Number One is designed to identify all alpha and numeric keypunch errors which are not in their proper fields. The data of the cards in error are listed so that the cards can be located and corrected. If a numeric character appears in an alpha field, a 1 is printed (to the right of the ship data) in column 77. If more than one such error appears on a card, the count is increased to the total number of errors.

If an alpha character appears in a numeric field, a 2 is printed in column 79 beside the ship data. If additional errors appear on the same card, the count is doubled until the total is represented. Major data errors should also be eliminated at this time.

Another function of the first edit routine is to identify and list selected port names whose codes are identical when punched according to the rules originally given to the keypunch operators. When this occurs a 3 appears in column 81 on the listing, indicating that one of the port names is of a group with similar names and it must be modified to meet the acceptable code. The port name or names involved are printed in columns 94 thru 120.

In addition, the port names on each data card (cols. 35-64) are checked against the master port tape. If a port name does not match, the unmatched port is indicated by a 0 in column 85, 89, or 93, depending on which of the three is indicated to be in error or unmatched. These port names are subsequently corrected, or identified as unlocatable ports.

Lloyd's Edit Number Two is necessary due to core limits for the number of words available for the master port tape. Port names which do not match a name on the master tape are singled out and listed.

These unmatched port names are changed to a port included on the master tape which is within five latitude-longitude degrees of the unmatched port. There is a small percentage of ports whose location remains unlocatable as of this date.

This is the final data check before input cards are released for the Generator Program.

APPENDIX B
PORT GROUP ASSIGNMENTS

The latitude and longitude position referred to here are the ports portion relative to the World MAP table.

								Port Group
1 ≤	latitude	≤ 5	and	17 ≤	longitude	≤ 19	=	1
1 ≤	"	≤ 4	and	20 ≤	"	≤ 34	=	1
6 ≤	"	≤ 7	and	17 ≤	"	≤ 19	=	2
5 ≤	"	≤ 7	and	20 ≤	"	≤ 23	=	2
8 ≤	"	≤ 11	and	11 ≤	"	≤ 16	=	3
8 ≤	"	≤ 11	and	17 ≤	"	≤ 25	=	4
12 ≤	"	≤ 25	and	11 ≤	"	≤ 21	=	5
6 ≤	"	≤ 17	and	43 ≤	"	≤ 52	=	6
9 ≤	"	≤ 19	and	30 ≤	"	≤ 42	=	6
20 ≤	"	≤ 29	and	38 ≤	"	≤ 59	=	7
18 ≤	"	≤ 19	and	43 ≤	"	≤ 59	=	7
5 ≤	"	≤ 16	and	56 ≤	"	≤ 68	=	8
17 ≤	"	≤ 28	and	3 ≤	"	≤ 10	=	9
11 ≤	"	≤ 16	and	70 ≤	"		=	10
11 ≤	"	≤ 13	and		"	= 69	=	10
12 ≤	"	≤ 16	and			≤ 5	=	10
7 ≤	"	≤ 11	and	1 ≤	"	≤ 5	=	11
8 ≤	"	≤ 10	and	70 ≤	"		=	11
4 ≤	"	≤ 5	and	4 ≤	"	≤ 14	=	12
5 ≤	"	≤ 6	and	70 ≤	"		=	12
		= 5	and	15 ≤	"	≤ 16	=	13
6 ≤	"	≤ 7	and	14 ≤	"	≤ 16	=	13
17 ≤	"	≤ 28	and	72 ≤	"		=	14
17 ≤	"	≤ 28	and		"	≤ 2	=	14
12 ≤	"	≤ 25	and	22 ≤	"	≤ 29	=	15

APPENDIX C
TABLES

PORT TABLE

Word 1	-	Port Name	- alpha
Word 2	-	Bits 6 - 12 - count of the number of ships from this port	- numeric
		Bits 13-19 - count of the number of ships to this port	- numeric
		Bits 20-23 - group number assigned to this port	- numeric
		Bits 24-28 - latitude position* of this port	- numeric
		Bits 29-35 - longitude position* of this port	- numeric

*position in this connotation means location in the World MAP Table

WORLD MAP TABLE

The world is described as a two dimensional array MAP(I,J) where I attains a maximum value of 29 and each element in the row represents 5^{o} of latitude going from 85^{o}N to 60^{o}S. J's maximum value is 72 and each element in the column represents 5^{o} of longitude going from 75^{o}W to 80^{o}W. For example:

J=1 represents the longitude from 79^{o}W to 75^{o}W
J=2 represents the longitude from 74^{o}W to 70^{o}W
J=3 represents the longitude from 69^{o}W to 65^{o}W
J=16 represents the longitude from 4^{o}W to 0^{o}W
J=17 represents the longitude from 1^{o}E to 5^{o}E
.
.
.
J=71 represents the longitude from 89^{o}W to 85^{o}W
J=72 represents the longitude from 84^{o}W to 80^{o}W

Each word in the table has the following format

Bits 0-29 - Count of the number of ships to have entered this 5^{o} area

Bits 30-35- Will contain one of the following

0 - meaning this 5^{o} area is a land mass

1 - meaning this 5^{o} area is open ocean

One of the following letters:

B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
R

} Shipping lane (track)

Or one of the following numbers

2
3
4
5
6
7
8
9
10
11
12 } Decision Point
13
14
15
16
17
18
52
53
54
58

SHIP TABLE

Word 1 - Hold date - time when ship was placed on a track awaiting validation

Word 2 - Gross Weight - taken from card input - alpha

Word 3 - Port From - taken from card input - alpha

Word 4 - Port For - taken from card input - alpha

Word 5 - Last Report - taken from card input - alpha

Word 6 - Last Report date - day of the year - numeric

Word 7 - Port From date - day of the year - numeric

Word 8 - Last Report Code - taken from card input - alpha

Word 9 - Bits 10-14 - ships previous latitude position* - numeric

Bits 15-22 - ships previous longitude position* - numeric

Bits 23-27 - ships current latitude position* - numeric

Bits 28-35 - ships current longitude position* - numeric

Word 10 - Bit 1 - validation bit (1=validated) - numeric

Bit 2 - import bit (1 = ship input) - numeric

Bits 23-25 - count of ship delay - numeric

Bits 30-35 - current ship track - alpha

Word 11 - Number of day inport - numeric

Word 12 - no longer used (spare)

Word 13 - Number of day of travel - numeric

Word 14 - no longer used (spare)

Word 15 - Bits 15-26 - ship's flag - alpha

- Bits 27-35 - ship year built - numeric

Word 16 - Bits 18-23 - "Port From" group number - numeric

Bits 24-35 - "Port From" location in Port table - numeric

Word 17 - Bits 18-23 - "Port For" group number - numeric

Bits 24-35 - "Port For" location in Port table - numeric

Word 18 - Bits 18-23 - "Last Report" group number - numeric

Word 19 - Date of last update - numeric

Word 20 - Date of last move by MOVE routine - numeric

*position in the connotation mean location in the World Map Table.

DESTINATION TABLE

Tracks are specified as a single alpha character. The heading is described as:

N = north
NE = north-east
NW = north-west
S = south
SE = south-east
SW = south-west

FS in the track column specifies the free sail mode.

DESTINATION TABLE

	Port Group 1*			Port Group 3	
	Track	Heading		Track	Heading
1.	FS		1.	J	NE
2.	J	SW	2.	J	NE
3.	J	SW	3.	FS	FS
4.	J	SW	4.	C	E
5.	J	SW	5.	J	SW
6.	J	SW	6.	J	SW
7.	J	SW	7.	C	SW
8.	J	SW	8.	C	SW
9.	J	SW	9.	J	SW
10.	J	SW	10.	C	SW
11.	J	SW	11.	G	W
12.	J	SW	12.	J	NE
13.	J	SW	13.	J	NE
14.	J	SW	14.	C	SW
15.	J	SW	15.	J	SW

*Example if a vessel is in port group one and its destination is in port group two it heads Southwest on track J.

	Port Group 2	
	Track	Heading
1.	N	W
2.	FS	FS
3.	N	W
4.	N	W
5.	N	W
6.	N	W
7.	N	W
8.	N	W
9.	N	W
10.	N	W
11.	N	W
12.	N	W
13.	N	W
14.	N	W
15.	N	W

	Port Group 4	
	Track	Heading
1.	C	W
2.	C	W
3.	C	W
4.	FS	FS
5.	C	W
6.	C	W
7.	C	W
8.	C	W
9.	C	W
10.	C	W
11.	C	W
12.	C	W
13.	C	W
14.	C	W
15.	C	W

	Port Group 5	
	Track	Heading
1.	D	NW
2.	D	NW
3.	D	NW
4.	D	NW
5.	FS	FS
6.	D	SE
7.	D	SE
8.	D	NW
9.	FS	FS
10.	D	NW
11.	D	NW
12.	D	NW
13.	D	NW

	Port Group 5	
	Track	Heading
14.	D	NW
15.	D	SE

Port Group 5 Section 2

Port For	Track	Heading
1	J	NE
2	J	NE
3	J	NE
4	J	NE
5	FS	
6	J	SW
7	J	SW
8	J	SW
9	J	SW
10	J	SW
11	J	NE
12	J	NE
13	J	NE
14	J	SW
15	J	SW

World Map Position
16≤ Latitude

Port Group 7 Section 1

	Track	Heading
1.	O	S
2.	O	S
3.	O	S
4.	O	S
5.	O	S
6.	O	N
7.	FS	
8.	O	N
9.	O	S
10.	O	N
11.	O	N
12.	O	N
13.	O	S
14.	O	N
15.	O	S

World Map Position
18 ≤ Latitude ≤ 21
45 ≤ Longitude ≤ 48

Port Group 7 Section 2

Port For	Track	Heading
1	O	S
2	O	S
3	O	S
4	O	S
5	O	S
6	O	N
7	FS	
8	O	N
9	O	S
10	O	N
11	O	N
12	O	N
13	O	S
14	O	N
15	O	S

World Map Position
22 ≤ Latitude ≤ 23
45 ≤ Longitude ≤ 48

Port Group 7 Section 3

Port For	Track	Heading
1	I	W
2	I	W
3	I	W
4	I	W
5	I	W
6	I	E
7	FS	
8	I	E
9	I	W
10	I	E
11	I	E
12	I	E
13	I	W
14	I	E
15	I	W

World Map Position
24 ≤ Latitude ≤ 27
45 ≤ Longitude ≤ 48

Port Group 7 Section 4

Port For	Track	Heading
1	O	S
2	O	S
3	O	S
4	O	S
5	O	S
6	O	N
7	FS	
8	O	N
9	O	S
10	O	N
11	O	N
12	O	N
13	O	S
14	O	N
15	O	S

World Map Position
18 ≤ Latitude ≤ 21
40 ≤ Longitude ≤ 44

Port Group 7 Section 5

Port For	Track	Heading
1	M	S
2	M	S
3	M	S
4	M	S
5	M	S
6	M	N
7	FS	
8	M	N
9	M	S
10	M	N
11	M	N
12	M	N
13	M	S
14	M	N
15	M	N

Port Group 8

	Track	Heading
1.	L	SE
2.	L	SE
3.	L	SE
4.	L	SE
5.	L	SE
6.	E	SW
7.	FS	FS
8.	FS	FS
9.	L	SE
10.	L	SE
11.	L	SE
12.	L	SE
13.	L	SE
14.	L	SE
15.	L	SE

World Map Position
22≤ Latitude ≤23
39≤ Longitude ≤44

Port Group 7 Section 6

Port For	Track	Heading
1	I	W
2	I	W
3	I	W
4	I	W
5	I	W
6	I	W
7	FS	
8	I	E
9	I	W
10	I	E
11	I	E
12	I	E
13	I	W
14	I	E
15	I	W

Port Group 9

	Track	Heading
1.	J	NE
2.	J	NE
3.	J	NE
4.	J	NE
5.	FS	FS
6.	J	NE
7.	J	NE
8.	J	NE
9.	FS	FS
10.	J	NE
11.	J	NE
12.	J	NE
13.	J	NE
14.	J	SW
15.	FS	FS

Port Group 10 Section 1

	Track	Heading
1.	D	N
2.	D	N
3.	D	N
4.	D	N
5.	D	N
6.	D	S
7.	D	S
8.	D	S
9.	D	N
10.	FS	FS
11.	D	N
12.	D	N
13.	D	N
14.	D	S
15.	D	N

World Map Position
14 ≤ Latitude

Port Group 9 Section 2

Port For	Track	Group
1	F	NW
2	F	
3	F	
4	F	
5	FS	
6	F	SE
7	F	SE
8	F	NW
9	FS	
10	F	NW
11	F	NW
12	F	NW
13	F	NE
14	F	SE
15	FS	

World Map Position
20 ≤ Latitude

Port Group 10 Section 2

	Track	Heading
1.	C	NE
2.	C	NE
3.	C	NE
4.	C	NE
5.	C	NE
6.	C	SW
7.	C	SW
8.	C	SW
9.	C	NE
10.	FS	FS
11.	C	SW
12.	C	SW
13.	C	NE
14.	C	SW
15.	C	NE

World Map Position
Latitude ≤ 15

Port Group 11

	Track	Heading
1.	D	NE
2.	D	NE
3.	D	NE
4.	D	NE
5.	D	S
6.	D	S
7.	D	S
8.	D	S
9.	D	S
10.	D	S
11.	FS	FS
12.	D	NE
13.	D	NE
14.	D	S
15.	D	S

Port Group 12

	Track	Heading
1.	FS	FS
2.	R	SE
3.	R	SE
4.	R	SE
5.	R	SE
6.	D	SE
7.	D	SE
8.	D	SE
9.	D	SE
10.	D	SE
11.	D	SE
12.	FS	FS
13.	R	SE
14.	D	SE
15.	R	SE

Port Group 13

	Track	Heading
1.	J	NE
2.	FS	FS
3.	J	SW
4.	J	SW
5.	J	SW
6.	J	SW
7.	J	SW
8.	J	SW
9.	J	SW
10.	J	SW
11.	D	W
12.	R	NW
13.	FS	FS
14.	J	SW
15.	J	SW

Port Group 14

	Track	Heading
1.	L	NW
2.	L	NW
3.	L	NW
4.	L	NW
5.	L	NW
6.	L	NW
7.	L	NW
8.	L	NW
9.	L	SE
10.	L	NW
11.	L	NW
12.	L	NW
13.	L	NW
14.	FS	FS
15.	L	NW

Port Group 15

	Track	Heading
1.	E	SE
2.	E	SE
3.	E	SE
4.	E	SE
5.	E	SE
6.	E	SE
7.	E	SE
8.	E	SE
9.	E	SE
10.	E	SE
11.	E	SE
12.	E	SE
13.	E	SE
14.	E	SE
15.	FS	FS

DECISION POINT TABLE

Tracks are specified as a single alpha character. The FS in the track column specifies the free sail mode. Depending on the latitude and longitude of the "port for", the DECI routine might decide to use the TM (track mode) rather than the FS mode specified by the Table. The heading is described as:

N = north
NE = north-east
NW = north-west
S = south
SE = south-east
SW = south-west

Decision Table 2*

	Track	Heading
1.	J	NE
2.	J	NE
3.	FS	FS
4.	J	SW
5.	J	SW
6.	J	SW
7.	J	SW
8.	J	SW
9.	J	SW
10.	J	SW
11.	D	W
12.	R	NW
13.	FS	FS
14.	J	SW
15.	J	SW

Decision Table 3

	Track	Heading
1.	J	NE
2.	J	NE
3.	FS	FS
4.	C	E
5.	J	SW
6.	J	SW
7.	C	SW
8.	C	SW
9.	J	SW
10.	C	SW
11.	G	W
12.	J	NE
13.	J	NE
14.	C	SW
15.	J	SW

Decision Table 4

	Track	Heading
1.	J	NE
2.	J	NE
3.	J	NE
4.	J	NE
5.	D	SE
6.	D	SE
7.	D	SE
8.	D	NW
9.	J	SE
10.	D	NW
11.	D	NW
12.	J	NE
13.	J	NE
14.	D	NW
15.	D	SE

Decision Table 5

	Track	Heading
1.	J	NE
2.	J	NE
3.	J	NE
4.	J	NE
5.	FS	FS
6.	F	SE
7.	F	SE
8.	F	NW
9.	FS	FS
10.	F	NW
11.	F	NW
12.	J	NE
13.	J	NE
14.	F	NW
15.	F	SE

*If the vessel is at decision point number two and its destination is in port group 11 it heads West on Track D.

Decision Table 6

	Track	Heading
1.	C	NE
2.	C	NE
3.	C	NE
4.	C	NE
5.	D	SE
6.	C	SW
7.	C	SW
8.	C	SW
9.	F	SE
10.	FS	-
11.*	P	W
12.*	P	W
13.	C	NE
14.	C	SW
15.	D	SE

Decision Table 7

	Track	Heading
1.	D	NE
2.	D	NE
3.	G	E
4.	G	E
5.	D	S
6.	D	S
7.	D	S
8.	D	S
9.	D	S
10.	D	S
11.	FS	FS
12.	D	NE
13.	D	NE
14.	D	NE
15.	D	S

Decision Table 8

	Track	Heading
1.	D	NW
2.	D	NW
3.	D	NW
4.	D	NW
5.	D	NW
6.	E	NE
7.	I	E
8.	D	NW
9.	FS	-
10.	F	NW
11.	D	NW
12.	D	NW
13.	D	NW
14.	D	NW
15.	FS	-

Decision Table 9

	Track	Heading
1.	L	SW
2.	L	SW
3.	L	SW
4.	L	SW
5.	L	SW
6.	FS	SW
7.	M	S
8.	E	NE
9.	L	SW
10.	E	NE
11.	E	NE
12.	L	SW
13.	L	SW
14.	E	NE
15.	E	W

Decision Table 10

	Track	Heading
1.	L	SW
2.	L	SW
3.	L	SW
4.	L	SW
5.	L	SW
6.	FS	-
7.	O	S
8.	H	SE
9.	L	SW
10.	H	SE
11.	H	SE
12.	L	SW
13.	L	SW
14.	H	SE
15.	L	SW

Decision Table 11

	Track	Heading
1.	H	SE
2.	H	SE
3.	H	SE
4.	H	SE
5.	H	SE
6.	H	NW
7.	I	SW
8.	FS	-
9.	H	SE
10.	H	SE
11.	H	SE
12.	H	SE
13.	H	SE
14.	H	SE
15.	H	SE

Decision Table 12

	Track	Heading
1.	I	S
2.	I	S
3.	I	S
4.	I	S
5.	I	S
6.	O	N
7.	FS	-
8.	I	NE
9.	C	NE
10.	C	NE
11.	C	NE
12.	C	S
13.	C	S
14.	FS	-
15.	I	S

Decision Table 13

	Track	Heading
1.	L	SE
2.	L	SE
3.	L	SE
4.	L	SE
5.	L	SE
6.	E	SW
7.	E	SW
8.	FS	-
9.	L	SE
10.	L	SE
11.	L	SE
12.	L	SE
13.	L	SE
14.	L	SE
15.	L	SE

Decision Table 14

	Track	Heading
1.	C	NE
2.	C	NE
3.	C	NE
4.	C	NE
5.	C	NE
6.	H	W
7.	C	SW
8.	L	NW
9.	C	NE
10.	FS	-
11*.	D	N
12*.	D	N
13.	C	NE
14.	L	SE
15.	C	NE

Decision Table 15

	Track	Heading
1.	J	NE
2.	N	E
3.	J	SW
4.	J	SW
5.	J	SW
6.	J	SW
7.	J	SW
8.	J	SW
9.	J	SW
10.	J	SW
11.	J	SW
12.	FS	-
13.	FS	-
14.	J	SW
15.	J	SW

Decision Table 16

	Track	Heading
1.	J	NE
2.	J	NE
3.	J	NE
4.	J	NE
5.	J	NE
6.	L	NW
7.	FS	-
8.	L	NW
9.	J	NE
10.	L	NW
11.	L	NW
12.	J	NE
13.	J	NE
14.	FS	-
15.	FS	-

Decision Table 17

	Track	Heading
1.	D	E
2.	D	E
3.	D	E
4.	D	E
5.	D	SW
6.	D	SW
7.	D	SW
8.	D	SW
9.	D	SW
10.	D	SW
11.	FS	-
12.	FS	-
13.	D	E
14.	D	SW
15.	D	SW

Decision Point 18

	Track	Heading
1.	I	W
2.	I	W
3.	I	W
4.	I	W
5.	I	W
6.	M	N
7.	FS	-
8.	I	E
9.	I	W
10.	I	E
11.	I	E
12.	I	W
13.	I	W
14.	I	E
15.	FS	-

Decision Table 52

	Track	Heading
1.	E	W
2.	E	W
3.	E	W
4.	E	W
5.	E	W
6.	FS	-
7.	FS	-
8.	E	E
9.	E	W
10.	E	E
11.	E	E
12.	E	W
13.	E	W
14.	E	E
15.	E	W

Decision Table 53

	Track	Heading
1.	E	W
2.	E	W
3.	E	W
4.	E	W
5.	E	W
6.	FS	-
7.	FS	-
8.	E	E
9.	E	W
10.	E	E
11.	E	E
12.	E	W
13.	E	W
14.	E	E
15.		W

Decision Table 54

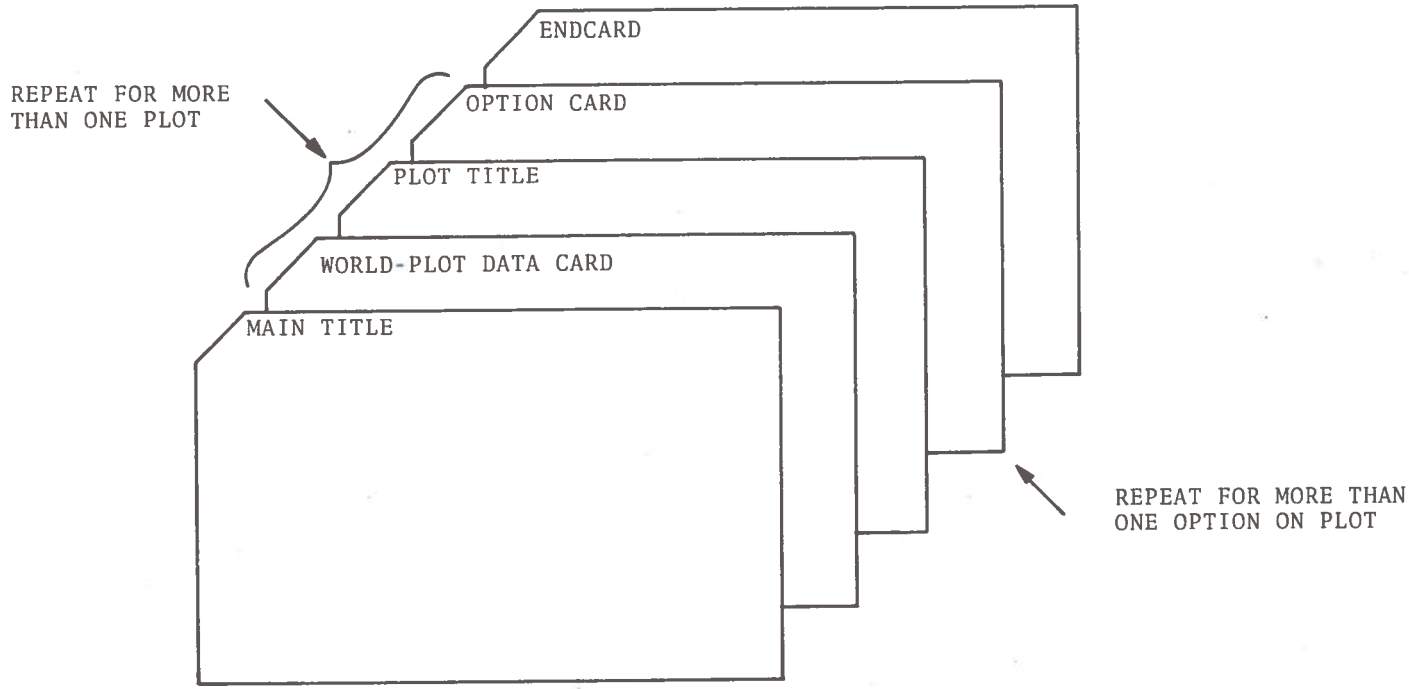
	Track	Heading
1.	O	S
2.	O	S
3.	O	S
4.	O	S
5.	O	S
6.	FS	-
7.	FS	-
8.	O	N
9.	O	S
10.	O	N
11.	O	N
12.	O	S
13.	O	S
14.	O	N
15.	FS	-

Decision Table 58

	Track	Heading
1.	D	N
2.	D	N
3.	D	N
4.	D	N
5.	P	S
6.	D	S
7.	D	S
8.	D	S
9.	P	S
10.	FS	-
11.	D	N
12.	D	N
13.	D	N
14.	D	S
15.	P	S

APPENDIX D

PLOTTING MANUAL



DATA DECK FOR MAIN
PLOT PROGRAM

WORLD-PLOT DATA CARD

Columns		Explanation
8,9	projection number	11-Mercator projection 12-Equal area 13-Stereographic 14-Equal spaced blank - Mercator projection
14-19	central meridian	number (form ±xxx.x) between East and West bound of area to be plotted
20-23	longitude grid density	number (form xx.x) specifying longitude grid spacing (normally 5.)
24-27	latitude grid density	number (form xx.x) specifying latitude grid spacing (normally 5.)
39-43	north boundary	number (form ±xx.x) less than or equal to 80.
44-48	south boundary	number (form ±xx.x) greater or equal to -60.
49-54	east boundary	number (form ±xxx.x) between 180. and -180.
55-60	west boundary	number (form ±xxx.x) between 180. and -180.
71		must contain the number 2
72		must contain the number 1

OPTION-CARD FORMAT

Columns	Explanation
1-4	the word PLOT must appear
5-9	Integer ending in column 9. The file to be processed on the traffic generator data tape
13	the kind of plot to appear on the last map drawn. i.e. 1 - density numbers 2 - port locations 3 - arrival-departure numbers of port locations 4 - ship routes 5 - density dots
14-19	number (form xxx.0) required for option 3 above. If the arrival or departure values are less than this number they will not be plotted.

TITLE CARD FORMAT

The title cards may contain any characters in columns 1-80.

END CARD FORMAT

The characters ENDCARD must appear in columns 1-7.

DATA TAPES REQUIRED FOR EACH OPTION

No option (plot area of world only)

a. scratch on B6 (plot tape)
b. tape #4773 on B7

Option 1 (plot density numbers)

a. scratch on B6 (plot tape)
b. tape #4773 on B7
c. tape #4815 on A6
d. traffic generator data tape on A5

Option 2 (plot port locations)

a. Scratch on B6 (plot tape)
b. tape #4773 on B7
c. tape #4815 on A6

Option 3 (Plot arrivals-departures)
Same set-up at option 1

Option 4 (plot the ship routes)
same set-up as option 2

Option 5 (plot density dots)

a. scratch on B6 (plot tape)
b. tape #4773 on B7
c. tape as output from program DENSITY on B5
d. traffic generator data tape on A5

All of the above data tapes have density 800 BPI and should be mounted with RING OUT.

For a combination of options all of the tapes needed for each option must be mounted.

PROGRAM DENSITY

This program must be run at least once for each weekly output. Its purpose is to compute the locations of the dots in the density dot plot. A data deck, of which only the first card is to be changed, is required.

The format of this card is:

Column	
1-5	Integer (ending in column 5) containing the file to be processed on the traffic generator tape
11-15	A random integer (5 digits-odd) to be changed for every new run

The tapes required for this program are:

the traffic generator data tape on A5
and a user save tape (RING IN) on B5

CONTENTS OF TAPE #4815

This data tape contains three files of the following data in BCD mode.

File 1 - Data required for plotting the density numbers

File 2 - Data required for locating the ports

File 3 - Data required for defining the ship routes

Files 2 and 3 could be changed if more accurate or additional data is required. The addition of port data is straightforward and requires only the latitudes and longitudes.

For additional tracks great circle points need to be calculated, which is the function of the program GREATO.

PROGRAM GREATO

(great circle calculating program)

For this program the end points of the ship routes are required. Each data card contains one pair of points (latitude and longitude of each point) in the format 4F10.3.

The output of this program is a deck of cards that is to be copied onto file 3 of tape 4815.

Port Group 6 Section 1

	Track	Heading
1.	H	SW
2.	H	SW
3.	H	SW
4.	H	SW
5.	H	SW
6.	FS	FS
7.	FS	FS
8.	H	SW
9.	H	SW
10.	H	SW
11.	H	SW
12.	H	SW
13.	H	SW
14.	H	SW
15.	H	SW

World Map Position
6≤ Latitude ≤16
46≤ Longitude ≤52

Port Group 6 Section 2

	Track	Heading
1.	E	W
2.	E	W
3.	E	W
4.	E	W
5.	E	W
6.	FS	FS
7.	FS	FS
8.	E	E
9.	E	W
10.	E	E
11.	E	W
12.	E	E
13.	E	E
14.	E	W
15.	E	E

World Map Position
10≤ Latitude ≤18
30≤ Longtidue ≤38

Port Group 6 Section 3

	Track	Heading
1.	L	SW
2.	L	SW
3.	L	SW
4.	L	SW
5.	L	SW
6.	FS	-
7.	FS	-
8.	L	NE
9.	L	SW
10.	L	NE
11.	L	NE
12.	L	NE
13.	L	SW
14.	L	NE
15.	L	SW

World Map Position
6≤ Latitude ≤16
39≤ Longtiude ≤45

Port Group 6 Section 4

	Track	Heading
1.	E	W
2.	E	W
3.	E	W
4.	E	W
5.	E	W
6.	FS	FS
7.	FS	FS
8.	E	E
9.	E	W
10.	E	E
11.	E	E
12.	E	W
13.	E	W
14.	E	E
15.	E	W

World Map Position
17≤ Latitude ≤18
38≤ Longitude ≤42