

MEMORANDUM
RM-5517-ISA
JANUARY 1968

AD 666956

A MODEL FOR
SIMULATING UNDERWAY REPLENISHMENT
SHIP OPERATIONS

T. W. Sikes

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THE OFFICE OF THE ASSISTANT SECRETARY
OF DEFENSE/INTERNATIONAL SECURITY AFFAIRS

The **RAND** Corporation
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T. W. Sikes

Rand Corporation
Santa Monica, California

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PREFACE

This Memorandum describes the model that was the principal analytic tool in T. W. Sikes, The Role of WESTPAC Bases in Support of the Seventh Fleet: POL and Ordnance (U), RM-5055-ISA, The RAND Corporation, August 1966 (Secret). The model simulates the operation of underway replenishment ships, both oilers and ammunition ships, supporting Navy task forces at sea under various assumptions about operating radius from base, ships' characteristics, and intensity of combat activities. In response to a number of requests from the Navy and the Office of the Secretary of Defense, this Memorandum explicitly spells out the workings of the model in an effort to make it more widely available as a research tool to those who may be interested.

SUMMARY

Since publication of T. W. Sikes, The Role of WESTPAC Bases in Support of the Seventh Fleet: POL and Ordnance (U), RM-5055-ISA, The RAND Corporation, August 1966 (Secret), the author has had inquiries concerning the simulation model that is the principal tool of that analysis. In response to the inquiries, this Memorandum describes the model. The model simulates the operation of underway replenishment ships supporting Navy task forces at sea. It gives quantitative answers to questions like, "How many oilers and ammunition ships would be required to support a certain pattern of carrier task force operations under various assumptions about operating radius from base, ships' characteristics, and intensity of combat activities?"

The model can analyze as many as 32 cases in a single run. Each case is represented by a data deck which includes, among other things, a 90-day carrier task force employment schedule. Throughout the 90 days of iterations, detailed daily records are kept of the location, activity status, receipts or issues, and inventories of all oilers and carrier task groups in the system. For all cases examined, the computer print-out tabulates this information by oiler number and task group number for each day.

Unlike most computer simulations, this model possesses no built-in stochastic features. All input data, including demand and performance factors, are predetermined and must remain constant throughout the 90-day period examined. Likewise the pattern of task force operations and the dates of unreps must be specified in advance. This is not so severe a limitation as it might seem, however, since randomization of input factors can be accomplished manually when preparing the data deck.

The facility to accommodate 32 cases per simulation run has been determined to be adequate to perform a variety of sensitivity analyses. The model was originally written to simulate the movement of oilers between the support base and task forces at sea. Both the computer output headings and the wording of this Memorandum borrow heavily from the terminology of POL resupply. Nevertheless, by substituting "hundreds of tons of ordnance" for "thousands of barrels of NSFO," the user can easily simulate the movement of ammunition ships instead of oilers.

The execution time on an IBM 7044, exclusive of compilation, loading, and system overhead, is about 20 sec \pm 10 per case examined.

The model is written in FORTRAN IV. The object program occupies approximately 8,600 words of core, and COMMON requires another 16,400. The program has been revised somewhat since it was initially written two years ago, and the current version does not make as efficient use of storage as it would if some of the excess variables in COMMON were eliminated by reprogramming. The payoffs for such a project were not considered worth the resources required, however, particularly since the system employed on RAND's IBM 7044 (IBSYS) requires under 6K of core and, after allowances are made for I/O, a little over 1,600 unused words of the 32K core remain.

As a vehicle for assessing underway replenishment support requirements, the model can be used in a variety of contexts. Those studying new generations of oilers and ammunition ships would find it very useful in quantifying the productivity gains associated with, for example, a 20-percent increase in the speed or cargo capacity of unrep ships. The model can also be used to estimate the additional logistics force required by a lengthened support radius from base. Another application would arise in evaluating the effect on logistics ship requirements of changes in task force consumption rates. In general, the model can be used to assess changes in unrep ship requirements arising from any variation in one or more of the assumptions on which the input data are based. A detailed list of these assumptions appears in the section on input data.

The FORTRAN card deck for the model is available from RAND upon request.

ACKNOWLEDGMENTS

Special thanks for assistance in developing the simulation model are due Olivia Wright, who coded the original version. Much credit is also due Janice Enokawa, who revised the original version and helped immeasurably in the checkout and documentation of the simulation as it now stands. Without the support of these and others, this work would not have been possible. The author assumes responsibility for any errors that remain.

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GLOSSARY OF SELECTED VARIABLES
APPEARING IN FORTRAN LISTING OF MODEL

ARTDEM(I)	A demand cumulator (see Sec. V)
BBLSJ(I)	JP-5 inventory for the I th CTG
BBLSN(I)	NSFO inventory for the I th CTG
BJP5(I)	JP-5 consumption rate of I th ship class on standby days (MBBLS day)
BNSFO(I)	NSFO consumption rate of I th ship class on standby days (MBBLS day)
BOARDJ(I,J)	Amount of JP-5 aboard the I th oiler on day J
BOARDN(I,J)	Amount of NSFO aboard the I th oiler on day J
B1	NSFO consumption rate adjustment factor for CTG's on standby days
B2	JP-5 consumption rate adjustment factor for CTG's on standby days
CHECK	Used in DECISN to indicate whether oiler is retained on station (=1) or refilled (=0)
CJP5(I)	Capacity of JP-5 for the I th ship class
CNSFO(I)	Capacity of NSFO for the I th ship class
CTGCP1(I)	Total NSFO capacity of the I th CTG
CTGCP2(I)	Total JP-5 capacity of the I th CTG
DAYDEM	A demand cumulator (see Sec. V)
DEMNDJ(I)	Current JP-5 demand for the I th CTG
DEMNDN(I)	Current NSFO demand for the I th CTG
DIST(I)	Distance of I th unrep location from base, in nautical miles
DRWDNJ(1)	JP-5 on board the I th CTG on an unrep day, after the day's consumption has been deducted from previous inventory but before the unrep; as a percentage of CTG capacity
DRWDWN(1)	NSFO on board the I th CTG on an unrep day, after the day's consumption has been deducted from previous inventory but before the unrep; as a percentage of CTG capacity
DWEATH	Oiler speed degradation factor
GRPUSE(I)	Amount NSFO consumed per day by AO in transit (see Sec. III, Subdeck 4)
JOKER	Output control character
KSANDY	Case counter
KSCR1	Counter initialized at 0 and set at 1 when case analyses are over and final summary is to be printed

KTG	Master carrier task group index
L	Oiler number (except in subroutine MATRX3)
LASTLO(I)	Location of previous unrep for I th CTG
LASTUN(I)	Day of previous unrep for I th CTG
LGROUP(I)	CTG number (occurs only in subroutine READ)
LO(I)	The unrep location to which the I th oiler is assigned
LOC(I)	Unrep location number (occurs only in subroutine READ)
LOCATN(I,J)	Unrep location for J th CTG on day I
MCLASS(I)	Ship class number of I th ship class appearing in Subdeck 2 (used in Subdeck 2 of subroutine READ and in subroutine MATRX3)
MGROUP(I)	CTG number (used in subroutine READ)
MSTATS(I,J)	Activity status of I th oiler on day J
NACTVY(I,J)	Activity status on day I for the J th CTG
NCHECK	When set equal to 1, indicates error in CTG activity code, as detected in subroutine CONSMF
NCLASS(I,J)	Ship class number for J th ship class appearing in composition of I th CTG (used in Subdeck 3 of subroutine READ and in subroutine MATRX3)
NCODE(I)	Current activity scheduled for I th CTG
NDAY	Master day index
NEXTLO(I)	Indicates location of next scheduled unrep for I th CTG
NEXTUN(I)	Indicates next unrep day for I th CTG
NGROUP	Total number of CTG's for this case
NLOC	Total number of unrep locations for which support radii were read in
NOILRS(I)	Oiler number of I th oiler in list (used only in Subdeck 4 of subroutine READ)
NPLACE	Location of CTG unrep currently under consideration
NWAY(I)	I th oiler's one-way transit time between its assigned unrep location and base
OILJP5(I)	JP-5 capacity of I th oiler
OILNSF(I)	Gross NSFO capacity of I th oiler
PCENT	Percentage controlling return of AO to base, if Rule 1 is used
PRCNTJ(I)	Amount of JP-5 currently aboard I th CTG, as a fraction of capacity
PRCNTN(I)	Amount of NSFO currently aboard I th CTG, as a fraction of capacity

QTY(I,J)	The number of the J th ship class in the CTG composition list that are in the I th CTG (used in Subdeck 3 of subroutine READ and in subroutine MATRX3)
RATE1B(I)	NSFO consumption rate of I th CTG on standby days (MBBLS/day)
RATE2B(I)	JP-5 consumption rate of I th CTG on standby days (MBBLS/day)
RATE1S(I)	NSFO consumption rate of I th CTG on strike days (MBBLS/day)
RATE2S(I)	JP-5 consumption rate of I th CTG on strike days (MBBLS/day)
RATE1T(I)	NSFO consumption rate of I th CTG on transit days (MBBLS/day)
RATE2T(I)	JP-5 consumption rate of I th CTG on transit days (MBBLS/day)
RATE1U(I)	NSFO consumption rate of I th CTG on unrep days (MBBLS/day)
RATE2U(I)	JP-5 consumption rate of I th CTG on unrep days (MBBLS/day)
RULE	Return rule to be used in DECISN (see Sec. V)
SJP5(I)	JP-5 consumption rate of I th ship class on strike days (MBBLS/day)
SNSFO(I)	NSFO consumption rate of I th ship class on strike days (MBBLS/day)
S1	NSFO consumption rate adjustment factor for CTG's on strike days
S2	JP-5 consumption rate adjustment factor for CTG's on strike days
TBASE	Number of days required at base for oiler turnaround
TJP5(I)	JP-5 consumption rate of I th ship class on transit days (MBBLS/day)
TNSFO(I)	NSFO consumption rate of I th ship class on transit days (MBBLS/day)
TOTDEM	A demand cumulator (see Sec. V)
T1	NSFO consumption rate adjustment factor for CTG's on transit days
T2	JP-5 consumption rate adjustment factor for CTG's on transit days
UJP5(I)	JP-5 consumption rate of I th ship class on unrep days (MBBLS/day)
UNSF0(I)	NSFO consumption rate of I th ship class on unrep days (MBBLS/day)
U1	NSFO consumption rate adjustment factor for CTG's on unrep days
U2	JP-5 consumption rate adjustment factor for CTG's on unrep days
VELMAX(I)	Maximum sustained speed of I th oiler, in knots

XNEEDS(I)	Amount NSFO needed by 1 th oiler for reserve and loiter at unrep location (see page 12)
ZJP5(I)	JP-5 on board 1 th CTG at the beginning of the ninety days, as a fraction of capacity
ZNETN(I)	Net NSFO capacity of the 1 th oiler
ZNSFO(I)	NSFO on board 1 th CTG at the beginning of the ninety days, as a fraction of capacity

GLOSSARY OF TERMS APPEARING IN TEXT

AE	Ammunition ship
AO	Oiler
CTG	Carrier Task Group
JP-5	Jet fuel
MBBLS	1000 barrels of 42 U.S. gallons each
MSTS	Military Sea Transport Service
NSFO	Navy special fuel oil (black oil)
POL	Petroleum, oil, and lubricants
unrep	Underway replenishment
WESTPAC	Western Pacific

I. INTRODUCTION

The simulation described here assesses requirements for underway replenishment ships that supply POL to carrier task forces at sea. The model was written to simulate oiler operations. Yet the program has been used with equal success in evaluating ammunition ship requirements.

This description and the computer output headings rely exclusively on the terminology of POL resupply. The operation of underway replenishment ships which transfer provisions and general supplies to the fleet at sea is less well suited to this type of simulation because (a) their cargo is much less homogeneous, (b) the rate of demand for a single class of commodity does not predictably control the cycling of the ship between base and replenishment area, and (c) a greater (but less predictable) fraction of the total cycle time is spent standing by partially filled in the unrep area.

Let us begin, in this section, with a general review of the environment that the model simulates. Following sections then describe what the model does, the input, the output, and how the model functions.

As many as twenty carrier task forces are operating at sea, and are supplied with POL via unrep at eight or less locations by a fleet of oilers cycling back and forth between base and replenishments. Throughout a 90-day simulation a force employment schedule spells out day-by-day the activities of each carrier task group, including the dates and location(s) of its unreps.

- (a) Bases are supplied with fuel in adequate quantities by MSTs and/or commercial ships. The only segment of the POL pipeline dependent upon Navy oilers is that between task forces deployed to forward areas and the nearest available theater base.
- (b) All Navy oilers in the theater will shuttle back and forth between the underway replenishment areas and the fueling base. Extended delays and maintenance work requiring more than the assumed (constant) turnaround time at base must be provided for by manual assessments outside the model.

- (c) No oilers will be permitted to take on fuel at sea via consolidation, either with MSTS/commercial tankers or with other oilers.
- (d) Consolidation of fuel among combatants of the same task group takes place between unrep days as needed.
- (e) Task group demand for NSFO is the controlling factor in oiler movements and transactions. At the close of every replenishment day, all NSFO demands of the recipient task group must be filled; i.e., each task group will top off with NSFO on each of its unrep days. On these occasions, task groups will also top off with aviation fuel if the amount on board the oiler permits. (Thus aviation fuel resupply takes place in a passive way, insofar as determining oiler movements is concerned. Nevertheless, with the payload of AO's allocated in proportion to the usage of the respective commodities, see RM-5055-ISA, numerous computations confirm that the demand for JP-5 and AVGAS is adequately met.)
- (f) First preference in filling task group NSFO demands will be given to partially filled oilers standing by at the location. If none are available, a full oiler will be dispatched from the base in time to meet the demand. If no oiler is available at the base, additional oilers are introduced into the system at the base as needed, up to a maximum of forty oilers.
- (g) When an oiler has sailed from a base to an unrep location, it may not visit another unrep location before returning to base; thus no triangular routes are permitted. (Fortunately, for most fleet deployments, this somewhat artificial restriction does not inflate the assessment of support requirements.)
- (h) Net deliverable capacities of oilers are used in the inputs. (See Sec. II.) Oilers and their escorts hold enough fuel to enable them to make the round trip to the unrep areas without drawing upon the oiler's net cargo.
- (i) At the close of each day, every non-empty oiler that has off-loaded fuel during that day will decide whether to return to base or to remain on location partially filled until the next unrep at that location. Two alternative rules are available for that decision. Under rule 1 the oiler will remain on station if the percentage of NSFO on board exceeds the pre-specified critical percentage and if there are other unrep days scheduled at this location in the not-too-distant future, namely, if the wait would not exceed the total cycle time.

Under rule 2, which is a more efficient decision mechanism, the oiler will remain in the area if the amount of NSFO it can deliver by doing so, divided by the number of days of loiter involved, is greater than the oiler's NSFO capacity divided

by the cycle time between the base and the location in question. (Cycle time includes the round-trip transit time plus the time at base plus the "normal" on-station time at the location.) Thus the oiler decides whether to return to port or to remain in the area on the basis of which alternative yields the highest productivity, as measured in average number of barrels of NSFO delivered per day.

II. WHAT THE SIMULATION DOES

Answers to the question, "What does this simulation do?" are given in the following three sections. Reading this brief section provides a partial answer. A more detailed answer can be obtained by studying the two following sections on input data and output formats: the program generates the outputs shown from the general assumptions listed above and the specific assumptions of the input decks. Finally, a verbal flow chart (Sec. V) describes in moderate detail the listing of the program itself, which appears in the Appendix.

The model is written to accommodate as many as 32 independent cases in a single run. Each case is represented by a data deck which includes, among other things, a 90-day carrier task force employment schedule such as the ones illustrated in Fig. 1. Computations are made to determine the number of oilers required to support the specified force employment schedule.

Explained briefly, the computations consist of daily iterations of the activities of carrier task groups and oilers. First, to get a new amount-on-board figure for each task group at sea, the daily consumptions of NSFO and JP-5 are computed and subtracted from the inventories at the close of the previous day. Next, if an unrep is scheduled for a task group, the percentage drawdown (i.e., the amount on board immediately prior to unrep, as a percentage of capacity) is recorded and the task group is replenished from partially filled oilers in the area or from a full oiler dispatched from the base in time to make the unrep. If no oiler is available at base, another is introduced into the system. (When a new oiler is introduced in the system on an unrep day, say day N, its status for the days immediately preceding the unrep is changed from "not yet in system" to "enroute to unrep location." This permits arrival at the location in time to make the unrep on day N. See cards 260-296.) Beginning with none in the system on Day 1, oilers are introduced in this manner, as needed, so that every unrep is completed on schedule. Empty oilers (and those near enough empty to satisfy the criterion of assumption 1) are sent back to the base, refilled, and

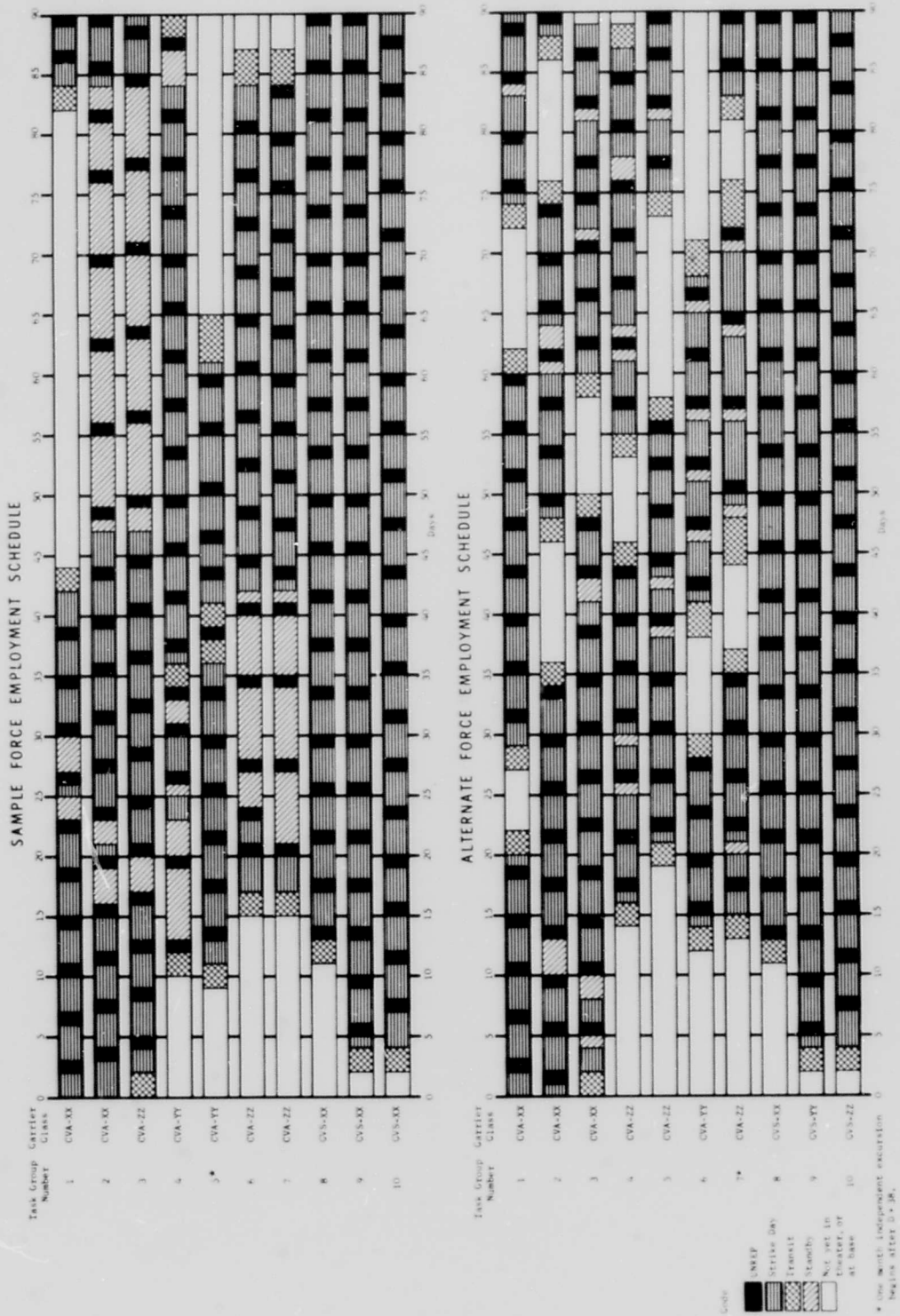


Fig. 1 -- Illustrative carrier task force employment schedules

returned to the same location if and when they are needed there. Throughout the ninety days of iterations, detailed daily records are kept of the location, activity status, receipts or issues, and inventories of all oilers and carrier task groups in the system.

For all cases examined, the computer printout tabulates this information by oiler number and task group number for each day. These outputs are illustrated in full in Sec. IV. For illustrative purposes the data contained in Fig. 14, a Summary of Oiler Utilization, are rearranged in Fig. 2. (It should be noted that this figure contains information only on an oiler's daily activity status; data on oiler inventories and amounts delivered, along with all data on carrier task groups, are contained in other sections of the printout.)

The problem of what number shall be used to measure oiler requirements becomes apparent as we study Fig. 2. Part of the problem is the model's inability to reassign oilers to alternate unrep locations upon completion of refueling at base if they are not needed promptly (or at all) at the location from which they have just returned. For example, in Fig. 2 oiler 8 was never needed again to support the main force after day 30. Had the computer been able to reassign it to support the Indian Ocean excursion, introducing oiler 11 on day 37 could have been avoided altogether. Similarly, introducing oiler 12 into the system could have been avoided by assigning oiler 2 to the Indian Ocean excursion, beginning on day 46.

At the bottom of Fig. 2, the numbers labeled "oilers in use" are daily totals of oilers that are in the system and engaged in some form of productive activity; only those labeled "not yet in system" or "not needed today for any type of activity" are excluded from this count.

In reality, if all oilers are identical (as we are assuming them to be, for the moment), any one at base can be directed to any unrep location regardless of where that oiler might have been on its previous voyage. With this reassignment capability it can be shown that for any summary of oiler utilization such as Fig. 2, the oilers required to support an operation are no greater than the largest number appearing in the "oilers in use" series. (Remember that if the critical assumption of reassignment capability is to be valid, it is almost essential

that all oilers in the system be identical in speed and cargo capacity. More on this point later.) Thus one obvious measure of oiler requirements is the largest number of this series, hereafter referred to as "oilers in use, peak day." In Fig. 2, this number is ten.

Upon taking a closer look, however, we see that the system required ten oilers on only 2 of the 90 days; for the other 88 days, nine or less would have sufficed. In the real world, a variety of measures could (and probably would) be employed to juggle the oilers' activity schedule for two days in order to get by with one less oiler. Such corner-cutting devices might include a one-day reduction in speed for some task group, or a one-day postponement of a certain unrep, or a hurry-up turnaround at base for some oiler, or other similar measures on a once-only basis.

Nevertheless, it is not strictly correct to say that nine oilers are sufficient when the data say otherwise. For one thing, to engage in such corner-cutting raises the difficult question of just how much is permissible; that line is not easy to draw. The point is that the obvious crudities of this measure suggest the need for some supplementary index of mobile support requirements. A finer index can be derived by examining the requirements over several days of peak activity. A method was arbitrarily adopted for doing this: pick the ten highest numbers appearing in the "oilers in use" series and average them; the result is termed "average number of oilers in use, peak ten days."

In estimating oilers required for strict adherence to any given force employment schedule, the "oilers in use, peak day" is more accurate and meaningful. In estimating oiler requirements for evaluating tradeoffs among independent variables in the production function, the "average number of oilers in use, peak ten days" is no doubt superior. The user may choose either or both, as his purpose dictates.

III. PREPARATION OF INPUT DATA

The input data used in a simulation run are collected in up to 32 independent data decks, one for each case examined in the run. The data deck for a single case consists of eight subdecks. These are described in order below.

SUBDECK 1 -- CARRIER TASK GROUP ACTIVITY SCHEDULES AND UNREP LOCATIONS FOR NINETY DAYS

The input format for Subdeck 1 is given by card number 329. (See listing in Appendix.) Each of the ninety input cards in this subdeck is divided into 20 four-column fields, one for each of the twenty possible task groups in the schedule. If less than twenty CTGs are used, the remaining fields should be left blank.

Each four-column field assigned to a task group contains a one-digit code representing the activity of that field's CTG for the day in question. This activity code appears in the second column from the left; the code is as follows:

- 1 = strike day
- 2 = standby day
- 3 = unrep day
- 4 = transit day
- 5 = in port day

In addition to the information which must appear in the second column of an assigned field, the fourth column contains a single-digit "unrep location number" if, and only if, the activity code for that day is 3 (unrep day); if the code is anything other than 3, the fourth (unrep location) column must be left blank. The unrep location number should be an integer between one and eight inclusive.

If the simulation has been running successfully with, say, N CTGs in the system and the analyst wishes to delete certain CTGs and make additional runs with those remaining, a simple procedure exists. It

is not necessary to repunch Subdeck 1 to delete the unwanted CTGs. Instead, the composition of the CTGs to be deleted (Subdeck 3) should be revised so that they each have only one ship: a dummy ship with daily consumption rates of NSFO and JP-5 for all types of activities set at zero. In accordance with card 90 of the FORTRAN listing (see Appendix), no unreps will be scheduled for such CTGs.

A single blank card must appear at the end of this subdeck.

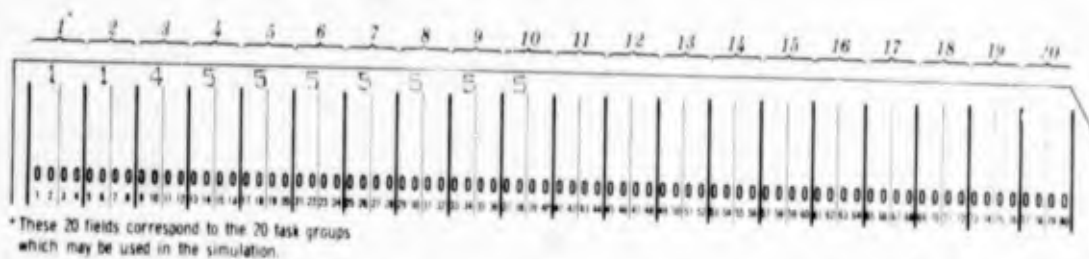


Fig. 3 -- Input format for Subdeck 1

SUBDECK 2 -- FUEL CONSUMPTIONS AND CAPACITIES FOR EACH CLASS OF SHIP

The input format for Subdeck 2 is given by card 390. The cards of this subdeck are divided into fields as shown in Fig. 4. Each card refers to one particular class ship. It contains the following:

- (a) Ship class number.
- (b) Four pairs of fields showing, for strike days, standby days, unrep days, and in-transit days, respectively, the consumption of NSFO and of JP-5 measured in thousands of barrels per day. (For escort ships the JP-5 consumption rate will of course be zero for all four types of activities.)
- (c) A pair of fields showing the ship's capacity for NSFO and JP-5, measured in thousands of barrels.

Subdeck 2 contains one card for each class ship in the fleet that will receive unrep support. In this subdeck the ship classes need not be numbered serially and the cards may appear in any order. The subdeck is followed by a blank card.

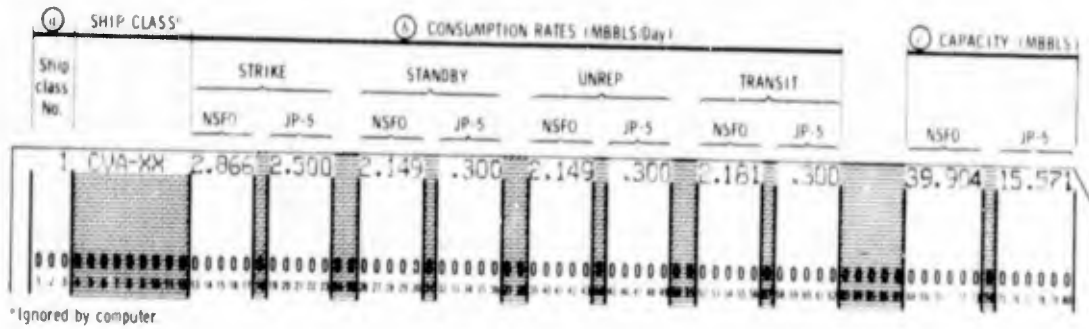


Fig. 4 -- Input format for Subdeck 2

SUBDECK 3 -- COMPOSITION OF THE CARRIER TASK GROUPS

The input format for Subdeck 3 is given by card 416. Cards are partitioned into fields as shown in Fig. 5. There is one card for each CTG; it shows the quantity of ships in the task group, by class. The CTGs must be numbered serially with no omissions, and the cards of this subdeck must appear in sequence.

This subdeck is followed by a single blank card.

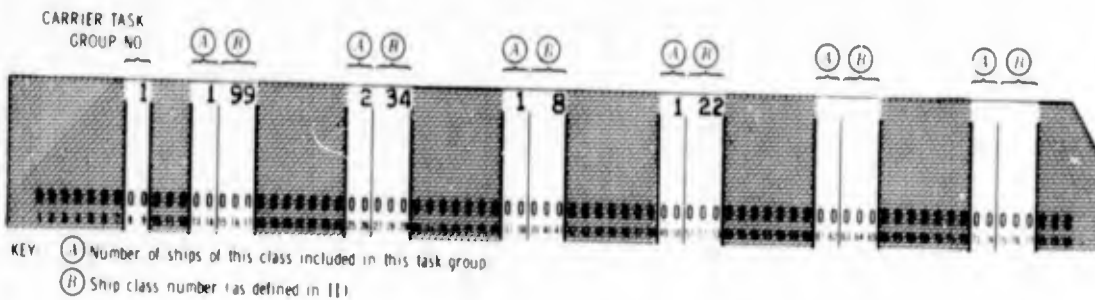


Fig. 5 -- Input format for Subdeck 3

SUBDECK 4 -- CHARACTERISTICS OF FLEET OILERS

The input format for Subdeck 4 is given by card 440. The cards are divided into fields as shown in Fig. 6. Each card contains the oiler's number (AOs are numbered serially from 1 through 40), its maximum sustained speed, its capacities of NSFO and JP-5, the NSFO needs of the oiler and its escorts while in the unrep area, and the daily fuel consumption rate of the unrep group while in transit.

The simulation bases its calculations on the oiler's net NSFO capacity. To get this capacity, it subtracts from the gross capacity two amounts: the (fixed) estimate of the amount the oiler and its escorts consume while in the unrep area, and the (variable) unrep group transit needs. The latter is obtained by multiplying the days in transit (computed when the oiler is assigned to an unrep location) by the unrep group's consumption rate per transit day.

Of course, when the model is used to simulate ammunition ship requirements, these last two entries represent ammunition consumed by the unrep group and should be zero.

When considering oiler movements where the unrep group is large and the support radii are long, it is apparent that the amount of NSFO the oiler is free to deliver to the CTG's may be significantly reduced. In such instances it may be helpful to use the last two data fields in this subdeck. If this option is taken, the user must not forget to include the ordinary fuel capacities of all ships in the unrep group when computing the oiler's gross capacity figure.

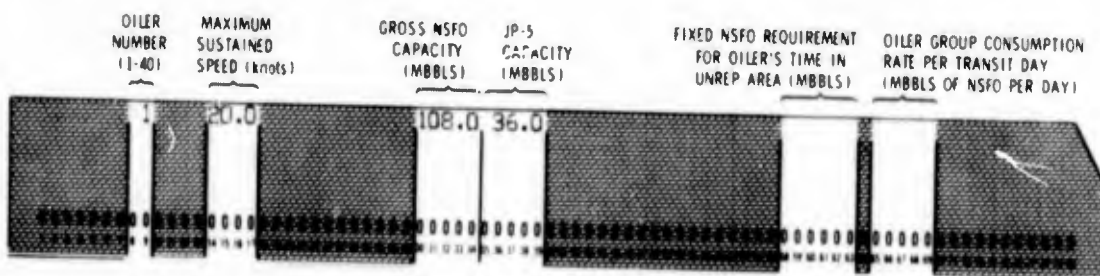


Fig. 6 -- Input format for Subdeck 4

It is preferable to avoid such complicated considerations in most simulations where a manual calculation can yield a usable estimate of the oiler's net deliverable capacity. In such cases the net figure is used in columns 30 through 34 and the final two data fields are left blank.

The system can introduce as many as forty oilers, as needed. The characteristics of the oilers, and the order in which it introduces them will be exactly as shown in this subdeck. If only N cards appear in this subdeck, where N is less than 40, the model automatically assigns the characteristics appearing on the Nth card to oilers N through 40. Thus, for example, if it is desired to run a simulation where all oilers are identical, only one card is needed for this subdeck. In this case N will be equal to one, and oilers 1 through 40 will be identical.

A blank card appears after this subdeck.

SUBDECK 5 -- AMOUNT OF FUEL ON BOARD CARRIER TASK GROUPS AT BEGINNING OF SIMULATION

The input format for Subdeck 5 is given by card 473. The cards are divided into fields as shown by Fig. 7.

This subdeck must contain one card for each CTG, showing for that group the fractions of full NSFO and JP-5 capacity that were on board at the beginning of the 90-day period. CTG's must be numbered sequentially with no omissions, and the cards must be in order.

A blank card appears at the end of this subdeck.

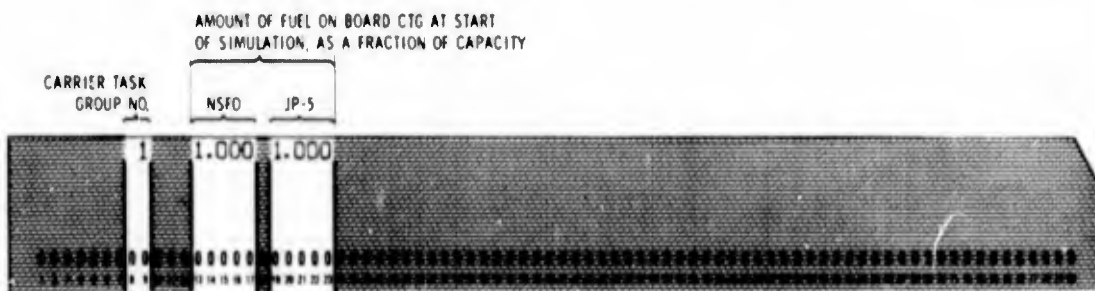


Fig. 7 -- Input format for Subdeck 5

SUBDECK 6 -- MISCELLANEOUS DATA, INCLUDING OUTPUT CONTROL

The input format for Subdeck 6 is given by card 494. The subdeck consists of a single card divided into five data fields, as shown in Fig. 8.

The first data field contains the oiler speed degradation factor which is multiplied by each oiler's maximum sustained speed (see Subdeck 5) to obtain its net rate of advance. If the user assumes a reduction in the rate of advance because of foul weather or defensive zig-zag maneuvers, the factor will be something less than 1.000.

The second data field, a single digit in column 50, indicates the oiler turnaround rule. The two choices are described in assumption (i) of the Introduction. A "1" indicates that an oiler is sent back to base when its amount on board is at or below the arbitrary "percentage AO drawdown level" specified in the next field (columns 53-56). The fourth field may be left blank when a "2" is used in column 50 to indicate that an oiler is returned to base when it appears to have a better chance of delivering more NSFO per day in the long run by returning rather than remaining on station. (See the Sec. V description of Subroutine DECISN.)

The fifth data field provides for a single digit to control the level of detail of the model's output. A blank, 0, or 1 in column 70 means the output for each case includes (a) all the input data, (b) summary of oiler utilization, (c) history of oilers by oiler number, (d) task group history, and (e) history of oilers by day. A "2" in column 70 deletes (e) from the above list. A "3" deletes (d) and (e). A "4" deletes (c), (d), and (e). Thus the higher the output control digit, the less detailed the output.

A blank card follows this subdeck.

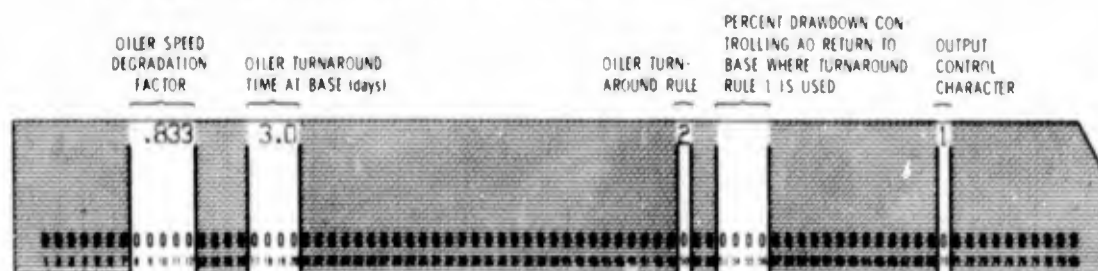


Fig. 8 -- Input format for Subdeck 6

SUBDECK 7 -- UNREP LOCATIONS AND THEIR DISTANCES FROM BASE OF SUPPORT

The input format for this subdeck is given by card 514. The cards are divided into two data fields, as shown in Fig. 9.

The unrep locations in this subdeck must be numbered serially with no omissions, and the cards must appear in sequence. The unrep locations referred to in Subdeck 1 must all appear in Subdeck 7. In addition, if there are any unused location numbers (i.e., location numbers between 1 and the highest in Subdeck 1, but not referred to in Subdeck 1), they also should appear in Subdeck 7 with the radius set at 0.

A blank card follows this subdeck.

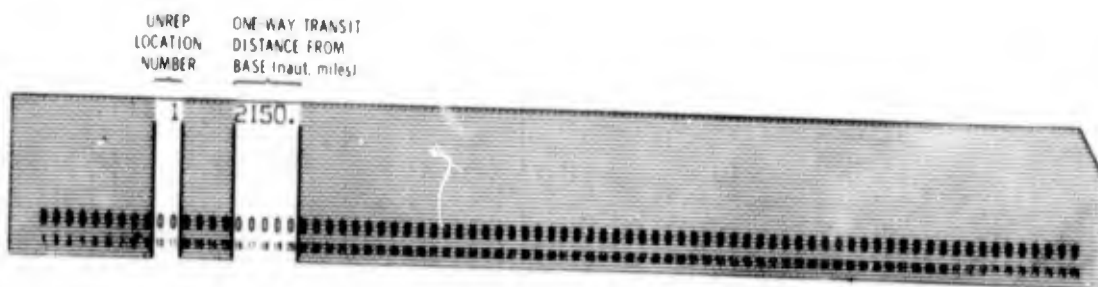


Fig. 9 -- Input format for Subdeck 7

SUBDECK 8 -- ADJUSTMENT FACTORS FOR CTG FUEL CONSUMPTION

The input format for this subdeck is given by card 534. The subdeck consists of a single card which contains adjustment factors for CTG consumption rates of NSFO and JP-5 on each of the four kinds of activity days. When the model computes CTG consumption on a certain day, it multiplies the consumption rates in the second subdeck by the factors on this card to get the adjusted consumption rates, which are used in the actual calculations of demand. By using these factors, the sensitivity of total oiler requirements to changes in fuel consumption rates may be easily examined without altering the data of Subdeck 2.

Two blank cards follow this subdeck since it is the last input data for the case. In addition, when this is the last of a series of cases in a single model run, a third blank is used to trigger the print-out of the summary analysis. (See Sec. IV.)

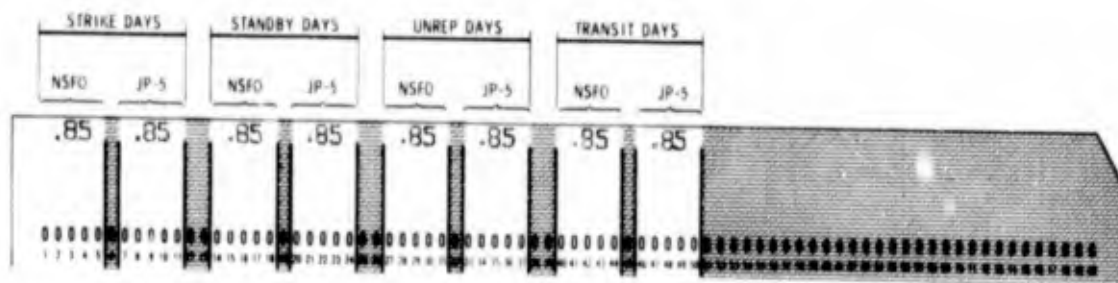


Fig. 10 -- Input format for Subdeck 8

IV. SAMPLE OUTPUT

The output available for each case the model examines can be divided into five parts: (1) input data printout, (2) carrier task group history, (3) daily oiler history, (4) history of oilers by oiler number, (5) summary of oiler utilization. If the analyst so desires, parts 2, 3, and 4 may be deleted to reduce the number of output pages. This is done by properly selecting the output control character in input Subdeck 6, as explained in Sec. III.

As the name implies, part 1 is merely a printout of the eight subdecks of input data under appropriate headings. Because these data are unaltered between read in and print out, and because they have been explained in Sec. III, this portion of the output will not be graphically illustrated as the balance of it will be.

Figure 11 contains portions of carrier task group history, part 2 of the output of a sample case. There were ten CTGs in the scenario, and this part of the output required 17 pages. The final columns show the percentages of fuel remaining on board the CTG immediately prior to the day's unrep.

Figure 12 reproduces portions of the next part of the output, history of oilers by day. Figure 13 contains parts of the history of oilers by oiler number. In the sample case a total of twelve oilers are introduced into the resupply pipeline over the 90 days, and each of these histories (parts 3 and 4) requires about 17 pages of printout. Headings are self-explanatory. Part 5 of the output, called the summary of oiler utilization, accompanies every case the model analyzes. It is illustrated by Fig. 14.

In addition to the five types of output which may accompany each case, the model prints out an analysis of oiler employment, all cases, as illustrated in Fig. 15. This analysis appears only once, at the conclusion of the series of cases examined in a single simulation run. The number of cases in a single run may range from one to thirty-two. This final "summary of cases" is a handy reference to the results of a run, especially if it contains more than a very few cases.

T A S K G R O U P H I S T O R Y

CLOSE OF DAY	TASK GROUP	NSFO INVENTORY MBRLS PERCENT	JP-5 INVENTORY MBRLS PERCENT	ACTIVITY TODAY	LOCATION AND DATE OF LAST UNREP	LOCATION AND DATE OF NEXT UNREP	PERCENT LAST DRAWDOWN NSFO
D+ 1	1	93.8	88.3	STRIKE	0 C+ 0	2 D+ 3	
D+ 1	2	93.7	88.1	STRIKE	0 D+ 0	2 D+ 4	
D+ 1	3	104.8	93.0	TRANSIT	0 D+ 0	2 D+ 5	
D+ 1	4	97.4	100.0	IN PORT	0 D+ 0	2 D+ 13	
D+ 1	5	111.4	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 1	6	69.7	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 1	7	58.0	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 1	8	72.6	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 1	9	72.6	100.0	IN PORT	0 D+ 0	4 D+ 6	
D+ 1	10	72.6	100.0	IN PORT	0 D+ 0	4 D+ 8	
D+ 2	1	81.3	76.5	STRIKE	0 D+ 0	2 D+ 3	
D+ 2	2	81.1	76.3	STRIKE	0 D+ 0	2 D+ 4	
D+ 2	3	96.9	85.9	TRANSIT	0 C+ 0	2 D+ 5	
D+ 2	4	97.4	100.0	IN PORT	0 D+ 0	2 D+ 13	
D+ 2	5	111.4	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 2	6	69.7	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 2	7	58.0	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 2	8	72.6	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 2	9	72.6	100.0	IN PORT	0 D+ 0	4 D+ 6	
D+ 2	10	72.6	100.0	IN PORT	0 D+ 0	4 D+ 8	
D+ 3	1	106.2	100.0	UNREP	2 D+ 3	2 D+ 7	
D+ 3	2	68.5	64.4	STRIKE	0 D+ 0	2 D+ 4	
D+ 3	3	84.5	75.0	STRIKE	0 D+ 0	2 D+ 5	
D+ 3	4	97.4	100.0	IN PORT	0 D+ 0	2 D+ 13	
D+ 3	5	111.4	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 3	6	69.7	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 3	7	58.0	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 3	8	72.6	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 3	9	67.0	92.3	TRANSIT	0 D+ 0	4 D+ 6	
D+ 3	10	67.0	92.3	TRANSIT	0 D+ 0	4 D+ 8	
D+ 3	1	42.9	100.0	UNREP	2 D+ 3	2 D+ 7	68.6
D+ 3	2	27.9	65.0	STRIKE	0 D+ 0	2 D+ 4	75.5
D+ 3	3	16.0	77.0	STRIKE	0 D+ 0	2 D+ 5	
D+ 3	4	20.8	100.0	IN PORT	0 D+ 0	2 D+ 13	
D+ 3	5	33.3	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 3	6	10.6	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 3	7	10.6	100.0	IN PORT	0 D+ 0	2 D+ 21	
D+ 3	8	10.6	100.0	IN PORT	0 D+ 0	2 D+ 14	
D+ 3	9	9.9	99.0	TRANSIT	0 D+ 0	4 D+ 6	
D+ 3	10	9.9	99.0	TRANSIT	0 D+ 0	4 D+ 8	
D+ 39	1	106.2	100.0	UNREP	2 D+ 39	2 D+ 87	56.9
D+ 39	2	68.5	64.4	STRIKE	2 D+ 36	2 D+ 40	63.8
D+ 39	3	88.0	78.1	STRIKE	2 D+ 37	2 D+ 41	
D+ 39	4	85.6	67.9	STRIKE	2 D+ 38	2 D+ 42	
D+ 39	5	111.4	100.0	UNREP	3 D+ 39	3 D+ 44	
D+ 39	6	46.0	65.9	STAND BY	2 D+ 35	2 D+ 41	56.2
D+ 39	7	38.5	66.4	STAND BY	2 D+ 35	2 D+ 41	68.9
D+ 39	8	67.3	92.7	STRIKE	2 D+ 38	2 D+ 42	
D+ 39	9	67.3	92.7	STRIKE	4 D+ 38	4 D+ 42	
D+ 39	10	56.6	78.0	STRIKE	4 D+ 36	4 D+ 40	

Fig. 11 -- Part 2 of sample output

D* 40	93.8	88.3	37.9	88.3	88.3	37.9	88.3	88.3	STRIKE	2	D* 39	2	D* 87	2	56.4	63.8
D* 40	106.3	100.0	42.9	100.0	100.0	42.9	100.0	100.0	UNREP	2	D* 40	2	D* 44	2		
D* 40	75.6	67.1	8.8	42.4	42.4	8.8	42.4	42.4	STRIKE	2	D* 37	2	D* 41	2		
D* 40	73.8	75.8	12.8	61.6	61.6	12.8	61.6	61.6	STRIKE	2	D* 38	2	D* 42	2		
D* 40	103.7	93.2	32.9	98.6	98.6	32.9	98.6	98.6	TRANSIT	3	D* 39	3	D* 44	3		
D* 40	40.0	57.4	9.1	85.8	85.8	9.1	85.8	85.8	STAND BY	2	D* 35	2	D* 41	2		
D* 40	33.6	57.9	9.1	85.8	85.8	9.1	85.8	85.8	STAND BY	2	D* 35	2	D* 41	2		
D* 40	62.0	85.4	9.4	96.0	96.0	9.4	96.0	96.0	STRIKE	2	D* 38	2	D* 42	2		
D* 40	62.0	85.4	9.4	96.0	96.0	9.4	96.0	96.0	STRIKE	4	D* 38	4	D* 42	4		
D* 40	72.6	100.0	10.0	100.0	100.0	10.0	100.0	100.0	UNREP	4	D* 40	4	D* 44	4	72.7	88.0
D* 41	81.3	76.5	32.9	76.7	76.7	32.9	76.7	76.7	STRIKE	2	D* 39	2	D* 87	2		
D* 41	93.7	88.1	37.9	88.3	88.3	37.9	88.3	88.3	STRIKE	2	D* 40	2	D* 44	2		
D* 41	112.7	100.0	20.8	100.0	100.0	20.8	100.0	100.0	UNREP	2	D* 41	2	D* 45	2	59.7	40.5
D* 41	62.0	63.7	8.8	42.4	42.4	8.8	42.4	42.4	STRIKE	2	D* 38	2	D* 42	2		
D* 41	96.1	86.3	32.4	97.3	97.3	32.4	97.3	97.3	TRANSIT	3	D* 39	3	D* 44	3		
D* 41	69.7	100.0	10.6	100.0	100.0	10.6	100.0	100.0	UNREP	2	D* 41	2	D* 45	2	48.9	83.0
D* 41	58.0	100.0	10.6	100.0	100.0	10.6	100.0	100.0	UNREP	2	D* 41	2	D* 45	2	49.5	83.0
D* 41	56.6	78.0	9.1	91.0	91.0	9.1	91.0	91.0	STRIKE	2	D* 38	2	D* 42	2		
D* 41	56.6	78.0	9.1	91.0	91.0	9.1	91.0	91.0	STRIKE	4	D* 38	4	D* 42	4		
D* 41	67.3	92.7	9.7	97.0	97.0	9.7	97.0	97.0	STRIKE	4	D* 40	4	D* 44	4		
D* 89	81.3	76.5	32.9	76.7	76.7	32.9	76.7	76.7	STRIKE	2	D* 87	2	D* 90	2		
D* 89	68.5	64.4	27.9	65.0	65.0	27.9	65.0	65.0	STRIKE	2	D* 86	2	D* 90	2		
D* 89	112.7	100.0	20.8	100.0	100.0	20.8	100.0	100.0	UNREP	2	D* 89	2	D* 90	2	59.7	40.5
D* 89	89.9	92.4	20.4	98.1	98.1	20.4	98.1	98.1	TRANSIT	2	D* 88	2	D* 90	2		
D* 89	111.4	100.0	33.3	100.0	100.0	33.3	100.0	100.0	IN PORT	3	D* 60	3	D* 90	3		
D* 89	69.7	100.0	10.6	100.0	100.0	10.6	100.0	100.0	IN PORT	2	D* 81	2	D* 90	2		
D* 89	58.0	100.0	10.6	100.0	100.0	10.6	100.0	100.0	IN PORT	2	D* 84	2	D* 90	2		
D* 89	56.6	78.0	9.1	91.0	91.0	9.1	91.0	91.0	STRIKE	2	D* 86	2	D* 90	2		
D* 89	56.6	78.0	9.1	91.0	91.0	9.1	91.0	91.0	STRIKE	4	D* 86	4	D* 90	4		
D* 89	67.3	92.7	9.7	97.0	97.0	9.7	97.0	97.0	STRIKE	4	D* 88	4	D* 90	4		
D* 90	106.7	100.0	42.9	100.0	100.0	42.9	100.0	100.0	UNREP	2	D* 90	2	D* 90	2	68.4	75.5
D* 90	106.3	100.0	42.9	100.0	100.0	42.9	100.0	100.0	UNREP	2	D* 90	2	D* 90	2	56.4	63.8
D* 90	100.4	89.0	16.8	80.8	80.8	16.8	80.8	80.8	STRIKE	2	D* 89	2	D* 90	2		
D* 90	82.5	84.7	20.0	96.7	96.7	20.0	96.7	96.7	TRANSIT	2	D* 88	2	D* 90	2		
D* 90	111.4	100.0	33.3	100.0	100.0	33.3	100.0	100.0	IN PORT	3	D* 60	3	D* 90	3		
D* 90	49.7	100.0	10.6	100.0	100.0	10.6	100.0	100.0	IN PORT	2	D* 81	2	D* 90	2		
D* 90	58.0	100.0	10.6	100.0	100.0	10.6	100.0	100.0	IN PORT	2	D* 84	2	D* 90	2		
D* 90	72.6	100.0	10.0	100.0	100.0	10.0	100.0	100.0	UNREP	2	D* 90	2	D* 90	2	72.7	88.0
D* 90	72.6	100.0	10.0	100.0	100.0	10.0	100.0	100.0	UNREP	2	D* 90	2	D* 90	2	72.7	88.0
D* 90	62.0	85.4	9.4	96.0	96.0	9.4	96.0	96.0	STRIKE	4	D* 88	4	D* 90	4		

Fig. 11 -- Continued

HISTORY OF OILERS BY DAY										
CLOSE OF DAY	OILER NUMBER	STATUS	NSFO ON BOARD		JP-5 ON BOARD		AMOUNT DEL. TODAY		CUMULATIVE TOTAL	
			MBRLS	PERCENT	MBRLS	PERCENT	MBRLS NSFO-MBRLS JPS	MBRLS NSFO-MBRLS JPS	MBRLS NSFO-MBRLS JPS	MBRLS NSFO-MBRLS JPS
1	1	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
1	2	RELOAD AT BASE	108.	100.0	36.	100.0				
2	1	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
2	2	RELOAD AT BASE	108.	100.0	36.	100.0				
2	3	RELOAD AT BASE	108.	100.0	36.	100.0				
3	1	UNREP AT LOCATION	75.	69.2	26.	70.8	33.	11.	33.	11.
3	2	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
3	3	RELOAD AT BASE	108.	100.0	36.	100.0				
3	4	RELOAD AT BASE	108.	100.0	36.	100.0				
4	1	UNREP AT LOCATION	28.	26.3	10.	27.8	46.	16.	80.	26.
4	2	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
4	3	RELOAD AT BASE	108.	100.0	36.	100.0				
4	4	RELOAD AT BASE	108.	100.0	36.	100.0				
5	1	UNREP AT LOCATION	0.	0.0	1.	2.2	28.	9.	108.	35.
5	2	UNREP AT LOCATION	87.	81.0	36.	100.0	21.	-0.	129.	35.
5	3	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
5	4	RELOAD AT BASE	108.	100.0	36.	100.0				
6	1	IN TRANSIT TO BASE	0.	0.0	1.	2.2				
6	2	STAND BY PART. FILLED AT LOC.	87.	81.0	36.	100.0				
6	3	UNREP AT LOCATION	88.	81.2	35.	97.8	70.	1.	149.	36.
6	4	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
7	1	IN TRANSIT TO BASE	0.	0.0	1.	2.2				
7	2	UNREP AT LOCATION	42.	38.6	21.	56.9	46.	16.	195.	52.
7	3	UNREP AT LOCATION	88.	81.2	35.	97.8				
7	4	STAND BY PART. FILLED AT LOC.	108.	100.0	36.	100.0				
7	5	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
7	7	RELOAD AT BASE	108.	100.0	36.	100.0				
.	.									
39	1	RELOAD AT BASE	108.	100.0	36.	100.0				
39	2	IN TRANSIT TO BASE	0.	0.0	3.	8.1				
39	3	LOITER AT BASE	108.	100.0	36.	100.0				
39	4	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
39	5	IN TRANSIT TO LOCATION	108.	100.0	36.	100.0				
39	6	STAND BY PART. FILLED AT LOC.	68.	63.3	34.	93.3				
39	7	RELOAD AT BASE	108.	100.0	36.	100.0				
39	8	LOITER AT BASE	108.	100.0	36.	100.0				
39	9	UNREP AT LOCATION	24.	22.2	19.	53.6	46.	16.	2454.	516.
39	10	UNREP AT LOCATION	59.	54.9	26.	71.2	49.	10.	2503.	527.
39	11	RELOAD AT BASE	108.	100.0	36.	100.0				

Fig. 12 -- Part 3 of sample output

HISTORY OF OILERS BY OILER NUMBER

OILER NUMBER	CLOSE OF DAY	STATUS	MSFO ON BOARD MOBLS PERCENT	JP-5 ON BOARD MOBLS PERCENT	AMOUNT DEL. TODAY MOBLS MSFO-MOBLS JPS	CUM. DEL. PER OILER MOBLS MSFO-MOBLS JPS
LOCATION OF OILER NO. 1 IS 2.						
1	1	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
1	2	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
1	3	UNREP AT LOCATION	75.	69.2	26.	70.8
1	4	UNREP AT LOCATION	28.	26.3	10.	33.
1	5	UNREP AT LOCATION	0.	0.0	1.	11.
1	6	IN TRANSIT TO BASE	0.	0.0	1.	16.
1	7	IN TRANSIT TO BASE	0.	0.0	1.	17.
1	8	RELOAD AT BASE	100.	100.0	1.	18.
1	9	RELOAD AT BASE	100.	100.0	1.	19.
1	10	RELOAD AT BASE	100.	100.0	1.	20.
1	11	IN TRANSIT TO LOCATION	100.	100.0	1.	21.
1	12	IN TRANSIT TO LOCATION	100.	100.0	1.	22.
1	13	UNREP AT LOCATION	101.	93.9	36.	100.0
1	14	UNREP AT LOCATION	38.	34.9	25.	119.
1	15	UNREP AT LOCATION	0.	0.0	10.	178.
1	16	IN TRANSIT TO BASE	0.	0.0	10.	216.
1	17	IN TRANSIT TO BASE	0.	0.0	10.	26.8
1	18	RELOAD AT BASE	100.	100.0	10.	26.8
1	19	RELOAD AT BASE	100.	100.0	36.	100.0
1	20	RELOAD AT BASE	100.	100.0	36.	100.0
1	21	LOITER AT BASE	100.	100.0	36.	100.0
1	22	LOITER AT BASE	100.	100.0	36.	100.0
1	23	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
1	24	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
1	25	UNREP AT LOCATION	62.	57.4	30.	82.5
1	26	UNREP AT LOCATION	17.	15.3	17.	48.1
1	27	UNREP AT LOCATION	0.	0.0	3.	9.3
1	28	IN TRANSIT TO BASE	0.	0.0	3.	9.3
1	29	IN TRANSIT TO BASE	0.	0.0	3.	9.3
1	30	RELOAD AT BASE	100.	100.0	36.	100.0
1	31	RELOAD AT BASE	100.	100.0	36.	100.0
1	32	RELOAD AT BASE	100.	100.0	36.	100.0
1	33	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
1	34	UNREP AT LOCATION	18.	16.9	20.	54.6
1	35	UNREP AT LOCATION	0.	0.0	4.	11.5
1	36	IN TRANSIT TO BASE	0.	0.0	4.	11.5
1	37	IN TRANSIT TO BASE	0.	0.0	4.	11.5
1	38	RELOAD AT BASE	100.	100.0	36.	100.0
1	39	RELOAD AT BASE	100.	100.0	36.	100.0
1	40	RELOAD AT BASE	100.	100.0	36.	100.0
1	41	RELOAD AT BASE	100.	100.0	36.	100.0
1	42	LOITER AT BASE	100.	100.0	36.	100.0
1	43	IN TRANSIT TO LOCATION	100.	100.0	36.	100.0
					90.	414.
					18.	432.
					6.	262.
					12.	307.
					14.	324.
					16.	111.
					16.	126.

Fig. 13 -- Part 4 of sample output

A N A L Y S I S O F O I L E R E M P L O Y M E N T A L L C A S E S

CASE NUMBER	OILERS ASSIGNED TO EACH LOCATION							TOTAL OILERS INTRODUCED INTO SYSTEM	AVERAGE OILERS IN USE PEAK 10 DAYS	OILERS IN USE PEAK DAY
	LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6	LOC 7			
1	0	7	3	2	0	0	0	12	9.2	10
2	0	8	4	0	0	0	0	12	9.6	10
3	8	0	1	0	0	0	0	9	7.5	8
4	0	9	4	0	0	0	0	13	10.9	11
5	8	0	1	0	0	0	0	9	8.0	8
6	0	5	2	2	0	0	0	9	8.2	9
7	5	0	1	2	0	0	0	8	7.2	8
8	0	10	3	3	0	0	0	16	14.1	15
9	10	0	1	3	0	0	0	14	12.2	13
10	0	5	2	2	0	0	0	9	8.2	9
11	5	0	1	2	0	0	0	8	7.2	8
12	0	7	3	3	0	0	0	13	10.4	12
13	6	0	1	3	0	0	0	10	8.5	9

Fig. 15 -- Summary analysis of all cases

V. A GENERAL DESCRIPTION OF HOW THE MODEL WORKS

The model is divided into a main routine and nine subroutines, as follows:

AO	main routine
READ	reads input data
MATRX3	initializes data matrices
CTG	prints CTG history after each day
HISTORY	prints outputs, including final summary
CONSP	updates inventory on board CTGs
UNREP	assesses demands associated with an unrep
FILL	satisfies demands of an unrep
FILLAO	return AOs to base for refill
DECISN	decides whether to return AO to base

This section should be read in conjunction with the glossary of symbols used in the model and with the listing that appears in the Appendix. Its purpose is to explain the routines and their relationships only to the extent that the comments appearing in the listing seem inadequate. The first eight subroutines are each described briefly. DECISN and the main routine merit more extended attention.

Subroutine READ (cards 304-583) reads and prints out for each case the necessary eight subdecks of data. After the model has analyzed each case and output the results, it calls READ and attempts to input data for the next case. If all cases have been examined, the first card encountered is a blank. This card, which is the third blank following Subdeck 8 of the final case, leads to CALL HISTORY (card 339) for the print-out of the analysis of oiler employment -- all cases.

Subroutine MATRX3 (cards 584-711) establishes the initial values for certain variables used throughout the case analysis. The first portion, through card 665, uses the input data to calculate and store for later use the fuel capacities and consumption rates for carrier task groups in the system. The next portion initializes the CTG matrices which contain fuel inventories, activity status, date and location of last unrep as well as next unrep, and percentage last drawdown for the first day. (See DRWDWN(I) in Glossary for definition of percentage.) The last portion initializes oiler status, inventory, and locations.

Subroutine CTG (cards 712-768) prints the carrier task group history (see Fig. 11). In order to conserve storage in core, this subroutine is called at the close of each day to print out that day's contribution to CTG history. As described earlier, this portion of the output may be suppressed by properly selecting the output control character in Subdeck 6 of the input data.

Subroutine HISTORY (cards 769-1091) prints all output resulting from the simulation except for the input data (done in READ) and the CTG history (done in CTG). When HISTORY is called with the index KSCR1 set at zero, the first part of the subroutine (cards 801-1059) prints out the results of the case just analyzed. These results are illustrated in Figs. 12-14. When all cases have been analyzed, the index KSCR1 is set at one (see card 338) and the second part of HISTORY (cards 1060-1091) prints out the analysis of oiler employment -- all cases, shown in Fig. 15.

Subroutine CONSMP (cards 1092-1167) is called once for each carrier task group each day. It updates the amounts of NSFO and JP-5 on board the CTG by deducting the day's consumptions from the inventories at the close of the proceeding day.

Subroutine UNREP (cards 1168-1218) is called immediately prior to each unrep. It assesses the demand associated with that particular unrep, and updates certain other data relating to CTG history, such as the date and location of the last (i.e., current) unrep and the next one, and the percentages of the current drawdowns.

Subroutine FILL (cards 1219-1271) satisfies the demands of a particular unrep to the maximum extent possible, subject to limitations imposed by the amounts aboard the AO prior to the unrep. It updates the NSFO and JP-5 demands remaining after the unrep, the amounts aboard the CTG and AO, and the AO activity status for the unrep day.

Subroutine FILLAO (cards 1272-1346) is called during or after an unrep, when it is determined that an oiler should be sent back to base. It returns the oiler to base, refills it, and returns it to the unrep location from which it came.

Subroutine DECISN (cards 1347-1566) is called every time an oiler completes an unrep and has NSFO remaining on board. It determines

whether to retain the AO on station or return it to base for a refill. The logic of this subroutine is more complicated than any of the others. Figure 16, in conjunction with the annotated listing, illustrates that logic.

Upon entering DECISN a major demand cumulator is established and an artificial day index, KDDAY, is established to permit the search for future pending unreps at this location. KDDAY is initially set equal to today, NDAY. (NDAY, the master day index, is unaffected by the use of this artificial index.) We then enter Loop 1 (cards 1377-1404). Loop 1 determines how much NSFO, if any, is yet to be delivered at this location on KDDAY. As we leave this loop and go to FORTRAN statement 1020, this amount is called DAYDEM.

Before proceeding further, a word of explanation is in order concerning the three demand cumulators used in this subroutine. At the close of a certain day, KDDAY (where $KDDAY \geq NDAY$, the day of the decision), TOTDEM is the total amount of fuel which will be delivered between (a) the just-completed unrep on NDAY, and (b) the close of the day, KDDAY. Thus, if $NDAY > KDDAY$, TOTDEM may be comprised of addends representing unreps over several days. DAYDEM, however, is a cumulative demand index of the same type that spans only a single day, KDDAY. Unlike TOTDEM and DAYDEM, ARTDEM (CTG) is indexed by task group, i.e., has as many values as there are task groups in the system. ARTDEM (CTG) is equal to the difference between the NSFO capacity of the task group in question and its actual inventory at the close of KDDAY. This set of demand cumulators tallies how much would be needed if an unrep were to take place at some time in the future, say on KDDAY; it is needed only if KDDAY is sometime after the decision date ($KDDAY > NDAY$). Thus its use does not begin unless and until we enter Loop 2.

After the first pass through Loop 1 (when $KDDAY = NDAY$), we want to know whether there are any other unreps scheduled for this location today. If so, we obviously want to retain the oiler on station, for negligible delay is involved in such retention. If this is not the first pass ($KDDAY > NDAY$), we go to the primary analysis to evaluate the consequences of a delay of $KDDAY - NDAY$ days. Suppose this is the first pass through Loop 1 and there are no more unreps scheduled

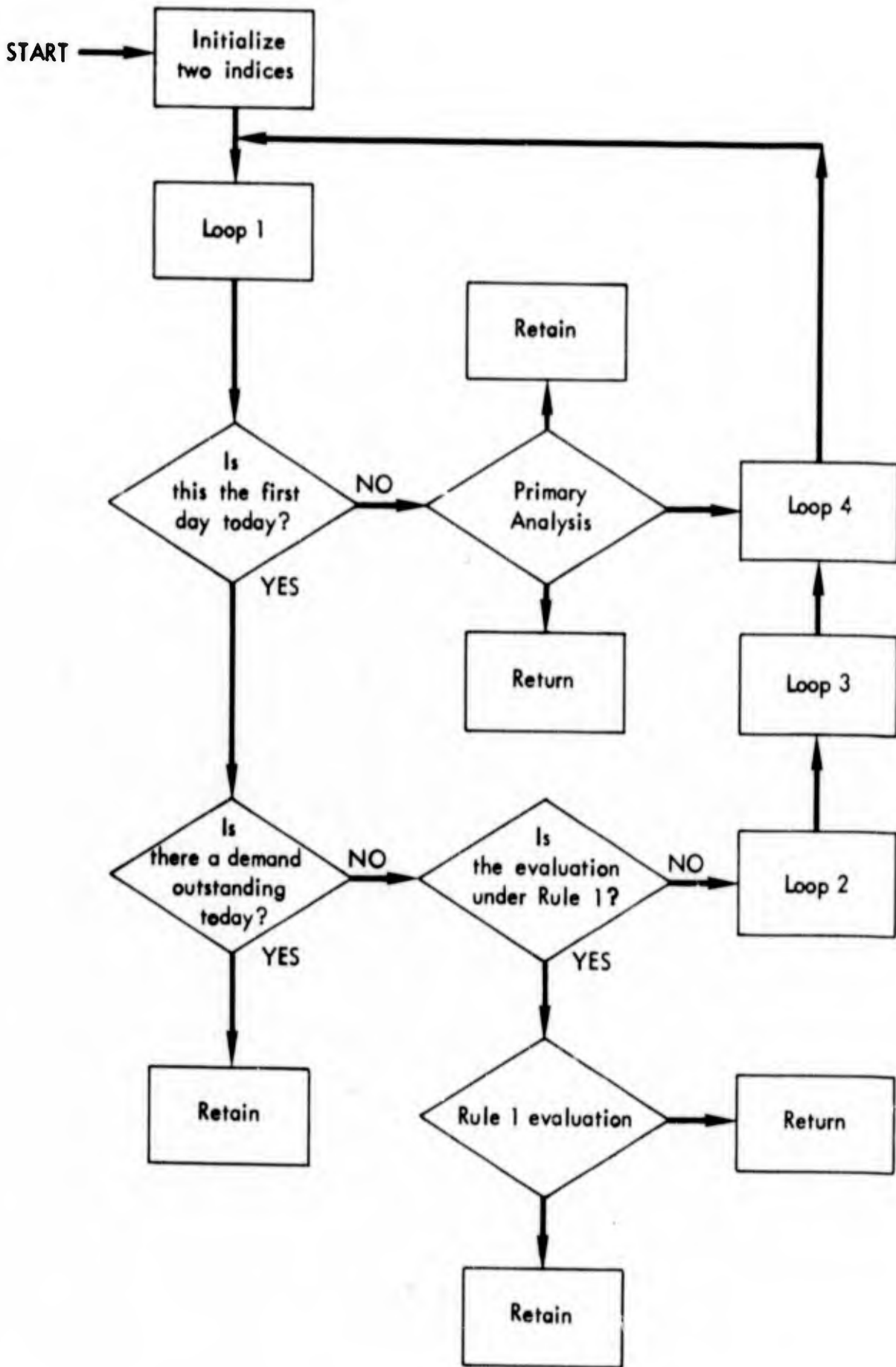


Fig. 16 -- Flowchart of subroutine DECISN

at this location today. Arriving at the middle diamond in the center of Fig. 16, we look at whether the retain/return decision is being made on the basis of Rule 1, an arbitrary percentage drawdown for the oiler, or Rule 2, based on maximizing delivery productivity. (Rule 2 tends to yield lower support requirements, and is preferred. See assumption 1 of Sec. I.) If this is a Rule 1 simulation, control is transferred to cards 1431-1465 and the decision is made in a straightforward manner.

If the simulation is based on Rule 2, we pass through Loops 2 and 3 to prepare for more detailed evaluations. Cards 1521 through 1549 constitute Loop 2. This loop establishes the potential demand matrix, ARTDEM (CTG), and begins initializing this matrix by adding to it the consumptions on NDAY of each CTG not yet examined by the main routine.

Next we enter Loop 3 (cards 1550-1564). This loop completes the initialization of the potential demand matrix by adding to the results of Loop 2 the net unfilled demands through NDAY. Loops 2 and 3 may be used, at most, once per pass through the subroutine. Their function is to set up ARTDEM for (a) augmenting (by Loop 4), (b) use (by Loop 1), and (c) evaluation (by primary analysis) as KDDAY, the artificial day index, is incremented one day at a time to simulate progressively longer looks into the future beyond NDAY.

As we leave Loop 3, we know two things. First, there are no more unreps scheduled at this location today, NDAY. Second, ARTDEM (CTG) contains the net unfilled NSFO demands of the task groups through the close of NDAY.

We now enter Loop 4 (cards 1496-1520), which updates the running potential demand matrix, ARTDEM (CTG), for each task group. The potential demands are increased on KDDAY by the CTGs' respective consumption rates for that day. As we enter Loop 4 for the first time, KDDAY has already been incremented (card 1526) so that $KDDAY = NDAY + 1$.

Next, control is passed to Loop 1 again so that TOTDEM can be updated through the close of KDDAY. After this the Primary Analysis examines the consequences of retaining the oiler until KDDAY; on first pass this involves a one-day retention.

The Primary Analysis (cards 1466-1495) is the heart of the Rule 2 evaluation. When we look at unreps scheduled one or more days ahead

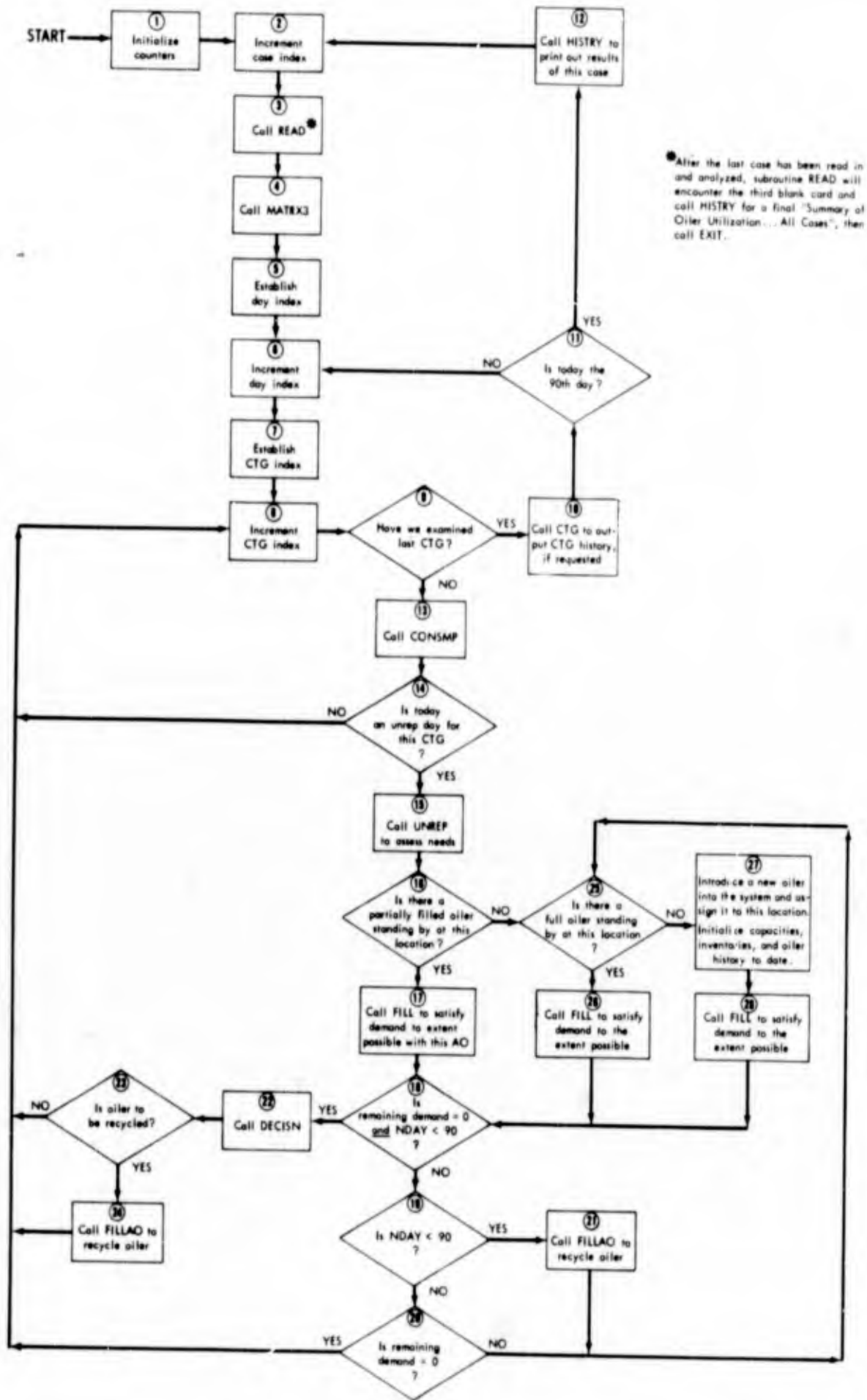
(beyond NDAY), this analysis returns or retains the AO on the basis of which course yields the highest productivity, measured in estimated barrels of NSFO delivered per day.

On the first pass through the Primary Analysis, the oiler's round-trip cycle time to this location is computed and stored under the name NCYCLE (cards 1472-1475). This quantity includes transit time in both directions and normal base turnaround time. The Primary Analysis computes four values on which to make its decision. A is the amount of NSFO that the oiler can deliver if it remains in the unrep area through KDDAY. Obviously, it is the lesser of total demand and amount on board (cards 1480-1483). B is the number of days' wait involved if the oiler is retained on station until KDDAY. C is the oiler's net NSFO capacity. D is the oiler's round-trip cycle at this location. Cards 1487-1488 represent an attempt to include in that cycle time an allowance for the oiler's normal on-station time. (The 1.3 in the denominator is an empirically determined factor which seemed to yield minimum unrep ship requirements over a large number of cases examined.)

The ratio A/B represents the average number of MBBLs per day that could be delivered if the oiler loiters in the unrep area for KDDAY-NDAY days. The comparable productivity figure if the oiler is returned to base for a refill is presumed to be C/D. If the former is greater than the latter on the first pass through the Primary Analysis, the oiler is retained on station outright. If not, KDDAY is incremented by one, an additional pass is made through Loop 4 and Loop 1, and the Primary Analysis tries to determine whether the TOTDEM for a two-day wait is large enough to justify the oiler's retention. If not, the model continues to cycle through Loop 4, Loop 1, and the Primary Analysis, looking progressively farther ahead as KDDAY is incremented on each pass through (card 1490). This process is repeated until the oiler is retained on station or until KDDAY-NDAY exceeds NCYCLE, in which case the oiler is returned to base for a refill (cards 1476-1478).

Figure 11 is the flow chart of the main routine; the boxes in that diagram are matched with the cards in the listing below. This will improve the reader's understanding of the flow chart by enabling him to locate the necessary comment statements in the listing.

Box	Cards	Box	Cards	Box	Cards	Box	Cards
1	19-24	8	46	15	83-91	22	135-139
2	25-26	9	47-48	16	92-104	23	140-144
3	27-30	10	49-58	17	105-110	24	145-147
4	31-37	11	59-60	18	111-124	25	148-204
5	38-40	12	61-65	19	125	26	205-209
6	41-42	13	66-76	20	126-128	27	210-296
7	43-45	14	77-82	21	129-134	28	297-300



After the last case has been read in and analyzed, subroutine READ will encounter the third blank card and call HISTRY for a final "Summary of Oiler Utilization... All Cases", then call EXIT.

Fig. 17 -- Flowchart of the main routine
(The numbers refer to Table 1)

Appendix

FORTRAN IV LISTING OF MODEL

```

SIBFTC AO
COMMON
1   BNSFO(60),   BBLSJ(20),   BBLSN(20),   BJP5(60),   0001
2   CNSFU(60),   BOARDJ(40,90), BOARDN(40,90), CJP5(60),   0002
3   DEMNDN(20), CTGCP1(20), CTGCP2(20), DEMNDJ(20),   0003
4   GRPUSE(40), DIST(20), DRWDWN(20), DRWDNJ(20),   0004
5   LO(40),     LASTLO(20), LASTUN(20), LGROUP(20),   0005
6   MGROUP(20), MSTATS(40,90), NACTVY(90,20), MCLASS(60),   0006
7   NCODE(20),  NEXTLO(20), NEXTUN(20), NCLASS(20,6),   0007
8   NWAY(40),   OILNSF(40), OILJP5(40), NOILRS(40),   0008
9   PRCNTJ(20), PRCNTN(20), RATE1B(20), RATE2B(20),   0009
COMMON
1   RATE2T(20), RATE1S(20), RATE2S(20), RATE1T(20),   0010
2   SNSFU(60),  TJP5(60),   TNSFO(60),   SJP5(60),   0011
3   UNSFO(60),  VELMAX(40), PJP5(60),   UJP5(60),   0012
4   PNSFO(60),  ZJP5(20),   ZNETN(40),   ZNSFO(20)  0013
DIMENSION ARTDEM(20) 0014
C 0015
C INITIALIZE SWITCH---LATER, WHEN ALL CASES HAVE BEEN EXAMINED, THIS 0016
C SWITCH WILL BE SET TO 1 AND A SUMMARY OF ALL CASES WILL BE MADE 0017
C KSCRI=0 0018
C 0019
C ESTABLISH AND INCREMENT A CASE INDEX 0020
C Kсандy=0 0021
C 1 Kсандy =Kсандy+1 0022
C 0023
C READ AND PRINT OUT INPUT DATA 0024
C CALL READ (Kсандy,NGROUP,NC,NLOC,DWEATH,TBASE,RULE, 0025
C IPCENT,JOKER,S1,S2,B1,B2,U1,U2,T1,T2,KSCRI) 0026
C 0027
C 0028
C 0029
C 0030
C 0031
C 0032
C 0033
C 0034
C 0035
C 0036
C 0037
C 0038
C 0039
C 500 NDAY=0 0040
C 501 NDAY=NDAY+1 0041
C 0042
C 0043
C 0044
C 0045
C 502 KTG=KTG+1 0046
C IF (KTG.EQ.NGROUP+1) GO TO 505 0047
C GO TO 510 0048
C 0049
C 0050
C 0051
C 0052
C 0053
C 505 IF (JOKER.GE.3) GO TO 5901 0054

```

```
C 0055
C SUBROUTINE CTG PRINTS THIS DAY'S CONTRIBUTION TO CARRIER TASK GROUP 0056
C HISTORY 0057
C CALL CTG (NGROUP,NDAY,KTG,KSANDY) 0058
5901 IF (NDAY.LT.90) GO TO 501 0059
C 0060
C IF WE HAVE COMPLETED CONSIDERATION OF THE NINETIFTH DAY, CALL HIS- 0061
C TORY TO PRINT OUT THE DESIRED OUTPUT FOR THIS CASE 0062
C CALL HISTRY (KSCRI,KSANDY,JOKER) 0063
C GO TO 1 0064
C 0065
C THE FIRST STEP IN CONSIDERING EACH CTG FOR A PARTICULAR DAY IS TO 0066
C CALL CONSPM TO UPDATE THE INVENTORIES ON BOARD. THUS WE REDUCE 0067
C THE PREVIOUS DAY'S CLOSING INVENTORY BY THE AMOUNT CONSUMED TODAY 0068
C 510 CALL CONSPM (NDAY,KTG,NCHECK) 0069
C 0070
C THE FOLLOWING TWO STATEMENTS CHECK IF THERE IS AN ERROR (NCHECK=1) 0071
C IN THE ASSIGNMENT OF ACTIVITY CODE DISCOVERED IN THE SUBROUTINE 0072
C CONSPM. 0073
C IF (NCHECK .NE. 1) GO TO 1709 0074
C GO TO 1 0075
C 0076
C DETERMINE WHETHER (A) THIS IS AN UNREP DAY FOR THIS CTG, REQUIRING 0077
C FURTHER CALCULATIONS, OR (B) THIS IS NOT AN UNREP DAY FOR THIS CTG 0078
C SO WE CAN PROCEED TO CONSIDERATION OF THE NEXT CTG 0079
C 1709 IF (NCODE(KTG) .EQ. 3) GO TO 536 0080
C GO TO 502 0081
C 0082
C CALL UNREP (A) TO UPDATE DATE AND LOCATION OF LAST AND NEXT UNREP 0083
C FOR THIS CTG, AND (B) TO COMPUTE DEMAND TO BE MET AND DRAWDOWN 0084
C PERCENTAGES 0085
C 536 CALL UNREP (NPLACE,NDAY,KTG) 0086
C 0087
C IF THE DEMANDS ARE ZERO, THAT IS, IF THIS IS A DUMMY CTG WITH ZERO 0088
C CONSUMPTION RATES, DO NOT PERFORM AN UNREP. 0089
C IF (DEMNDN(KTG).EQ.0..AND.DEMNDJ(KTG).EQ.0.) GO TO 502 0090
C 0091
C SEARCH FOR A PARTIALLY FILLED OILER STANDING BY AT THE LOCATION OF 0092
C THIS UNREP. (AT MOST ONE CAN EXIST.) 0093
C 600 L=0 0094
C 601 L=L+1 0095
C IF (L.EQ.41) GO TO 700 0096
C IF (LD(L).EQ.NPLACE) GO TO 9006 0097
C GO TO 601 0098
C 9006 IF ((MSTATS(L,NDAY).EQ.4).AND.(MSTATS(L,NDAY+1).EQ.3)) GO TO 607 0099
C IF ((NDAY.EQ.90).AND.(MSTATS(L,90).EQ.4).AND.(BOARDN(L,90).GT.0.)) 0100
C GO TO 607 0101
C IF (MSTATS(L,NDAY).EQ.3) GO TO 607 0102
C GO TO 601 0103
C 0104
C UPON FINDING A PARTIALLY FILLED OILER STANDING BY AT THIS LOCATION 0105
C CALL SUBROUTINE FILL TO (A) FILL THE DEMAND TO THE EXTENT POSSIBLE 0106
C WITH THIS AO, (B) UPDATE DEMAND REMAINING FOR THIS UNREP, AMOUNT 0107
C ON BOARD CTG, AMOUNT ON BOARD AO, AND OILER STATUS FOR TODAY 0108
C 607 CALL FILL (L,NDAY,KTG) 0109
```

```
C
C WE LOOK AT NDAY AND THE REMAINING NSFO DEMAND TO DECIDE WHAT TO DO 0110
C NEXT. THERE ARE FOUR POSSIBILITIES. THEY ARE LISTED BELOW, ALONG 0111
C WITH THE ACTION WE WOULD LIKE TO TAKE UNDER EACH. 0112
C (1) DEMAND .EQ. 0, NDAY .LT. 90, (2) DEMAND .EQ. 0, NDAY .EQ. 90, 0113
C (3) DEMAND .GT. 0, NDAY .LT. 90, (4) DEMAND .GT. 0, NDAY .EQ. 90. 0114
C IN EVENT 1 WE CALL DECISN TO RETAIN OR REFILL THE AD, THEN WE 0115
C CONSIDER THE NEXT CTG. IN EVENT 2 WE IGNORE DECISN (SINCE THE AD'S 0116
C FATE AFTER DAY 90 IS A MOOT POINT), WE SIMPLY PROCEED TO CONSIDERA- 0117
C TION OF THE NEXT CTG. IN EVENT 3 WE CALL FILLAD TO REFILL THE 0118
C EMPTY OILER, THEN SEARCH FOR A FULL AD TO COMPLETE THE UNREP. IN 0119
C EVENT 4 WE IGNORE DECISN (SAME REASON AS IN 2) AND SEARCH FOR A 0120
C FULL AD TO COMPLETE THE UNREP. FTM STMS 1668 THROUGH 1669 ASSESS 0121
C THE SITUATION AND TAKE APPROPRIATE ACTION. 0122
C 1668 IF((DEMNDN(KTG) .EQ. 0.) .AND. (NDAY .LT. 90)) GO TO 631 0123
C IF (NDAY .LT. 90) GO TO 1667 0124
C 1666 IF (DEMNDN(KTG) .EQ. 0.) GO TO 502 0125
C GO TO 700 0126
C 0127
C IF DEMAND FOR NSFO WAS NOT FULLY MET THIS AD MUST BE EMPTY, SO 0128
C CALL FILLAD TO SEND IT BACK TO BASE, REFILL IT, AND RETURN IT TO 0129
C THIS LOCATION 0130
C 1667 CALL FILLAD (L,NDAY,TBASE) 0131
C GO TO 700 0132
C 0133
C IF DEMAND FOR NSFO WAS FULLY MET, THE AD PROBABLY HAS SOME NSFO 0134
C REMAINING ON BOARD. CALL SUBROUTINE DECISN TO DETERMINE WHETHER 0135
C AD SHOULD BE RETAINED ON STATION OR RETURNED TO BASE FOR REFILL 0136
C 631 CALL DECISN (NDAY,NGROUP,NPLACE,L,CHECK,TBASE,RULE,PCENT,KTG) 0137
C 0138
C IF SUBROUTINE DECISN HAS RETAINED OILER ON STATION (SIGNIFIED BY 0139
C CHECK=1.) WE PROCEED TO CONSIDERATION OF THE NEXT CTG. IF NOT, 0140
C CALL FILLAD TO SEND AD TO BASE, REFILL IT, AND RETURN IT TO THIS 0141
C LOCATION. 0142
C IF (CHECK.EQ.1.) GO TO 502 0143
C CALL FILLAD (L,NDAY,TBASE) 0144
C 1669 GO TO 502 0145
C 0146
C IF SEARCH FOR A PARTIALLY FILLED AD STANDING BY AT THIS LOCATION 0147
C DID NOT FIND ONE (OR IF THE ONE FOUND COULD NOT FULLY MEET DEMAND), 0148
C PROCEED TO SEARCH FOR (COMPLETELY) FULL OILERS STANDING BY AT THIS 0149
C LOCATION (SIGNIFIED BY STATUS = 6). IF ONLY ONE EXISTS WE USE IT. 0150
C IF MORE THAN ONE EXISTS WE USE THE ONE WHICH HAS BEEN STANDING BY 0151
C AT THIS LOCATION FOR THE LEAST AMOUNT OF TIME. IF NONE EXISTS, WE 0152
C GO TO FORTRAN STATEMENT 900 AND INTRODUCE ANOTHER AD INTO SYSTEM. 0153
C 0154
C 700 KDAY=NDAY 0155
C COUNT=0. 0156
C 701 L=0 0157
C 702 L=L+1 0158
C IF (L.EQ.41) GO TO 718 0159
C IF (LO(L).EQ.NPLACE) GO TO 705 0160
C GO TO 702 0161
C 705 IF (MSTATS(L,KDAY).EQ.6) GO TO 707 0162
C GO TO 702 0163
```

C		0164
C	CHECK STATUS FOR OILER ON PREVIOUS DAY TO SEE IF IN TRANSIT	0165
	707 IF (MSTATS(L,KDAY-1).EQ.2) GO TO 708	0166
	709 COUNT=L.	0167
	IF (L.EQ.40) GO TO 716	0168
	GO TO 702	0169
	716 KDAY=KDAY-1	0170
	GO TO 701	0171
	718 IF (COUNT.EQ.1.) GO TO 716	0172
	GO TO 900	0173
C		0174
C	WE REACH FIN STATEMENT 708 WHEN (AND IF) WE HAVE SELECTED THE	0175
C	MOST RECENTLY ARRIVED FULL AD LOITERING AT THE LOCATION OF THIS	0176
C	UNREP. BEGINNING HERE AND RUNNING THROUGH FIN STATEMENT 6671, WE	0177
C	RESCHEDULE THE SURPLUS PRE-DELIVERY LOITER TIME (IF ANY), SO THAT	0178
C	IT OCCURS AT BASE RATHER THAN AT UNREP LOCATION	0179
	708 IF (MSTATS(L,NDAY-1).EQ.2) GO TO 6672	0180
	710 LTRNST=0	0181
	LLOITR=0	0182
	KOUNX=NDAY	0183
	6666 IF(MSTATS(L,KOUNX-1).EQ.6)GO TO 6667	0184
	IF(MSTATS(L,KOUNX-1).EQ.2)GO TO 6668	0185
	GO TO 6669	0186
	6667 LLOITR=LLOITR+1	0187
	KOUNX=KOUNX-1	0188
	GO TO 6666	0189
	6668 LTRNST=LTRNST+1	0190
	KOUNX=KOUNX-1	0191
	GO TO 6666	0192
	6669 IF(LLOITR.EQ.0)GO TO 6672	0193
	KOUNX1=NDAY-LLOITR-LTRNST	0194
	KOUNX2=NDAY-LTRNST-1	0195
	KOUNX3=NDAY-LTRNST	0196
	KOUNX4=NDAY-1	0197
	DO 6670 KON=KOUNX1,KOUNX2	0198
	MSTATS(L,KON)=6	0199
	6670 CONTINUE	0200
	DO 6671 KON=KOUNX3,KOUNX4	0201
	MSTATS(L,KON)=2	0202
	6671 CONTINUE	0203
C		0204
C	NEXT WE CALL SUBROUTINE FILL TO REPLENISH THE CTG WITH THE CARGO	0205
C	ABOARD THE FULL OILER WE LOCATED AS PER ABOVE.	0206
	6672 CALL FILL (L,NDAY,KTG)	0207
	800 GO TO 1668	0208
C		0209
C	IF NO PARTIALLY OR WHOLLY FILLED OILERS WERE FOUND LOITERING AT	0210
C	THE LOCATION OF THIS UNREP (OR IF THOSE FOUND WERE INADEQUATE	0211
C	TO COMPLETE THE UNREP), WE INTRODUCE A NEW OILER INTO THE SYSTEM	0212
	900 L=0	0213
	901 L=L+1	0214
	IF (L.EQ.41) GO TO 905	0215
C		0216
C	SEARCH FOR FIRST UNASSIGNED OILER	0217
	IF (LO(L) .EQ. 0) GO TO 910	0218
	GO TO 901	0219
	906 FORMAT (34HMORE THAN FORTY OILERS ARE NEEDED)	0220
	905 WRITE (6,906)	0221

C		0222
C	IF ALL FORTY OILERS ARE ALREADY IN THE SYSTEM, OUR DEMANDS ARE EX-	0223
C	CEEDING THE SIMULATIONS CAPABILITIES. PRINT ABOVE MESSAGE AND GO	0224
C	TO NEXT CASE	0225
	GO TO 1	0226
C		0227
C	ASSUMING WE HAVE FOUND AN UNASSIGNED OILER, INTRODUCE IT INTO THE	0228
C	SYSTEM.	0229
C	ASSIGN IT TO THIS LOCATION, SET STATUS EQUAL TO APPROPRIATE CODE	0230
C	FOR TODAY (UNREP) AND PREVIOUS DAYS (AT BASE, TRANSIT TO LOCATION)	0231
C	THIS CARRIES US THROUGH FTM STATEMENT 7005.	0232
	910 MSTATS(L,NDAY)=4	0233
	NEX=NDAY+1	0234
	DO 913 I=NEX,90	0235
	MSTATS(L,I)=3	0236
	913 CONTINUE	0237
	LO(L)=NPLACE	0238
C		0239
C	CALCULATE ONE WAY TRANSIT TIME AND NET NSFO CAPACITY AND RECORD	0240
C	OILERS HISTORY UP TO THIS DAY	0241
	K=0	0242
	915 K=K+1	0243
	IF (K .EQ. NLOC+1) GO TO 1689	0244
	1690 IF (NPLACE.EQ.LOC(K)) GO TO 925	0245
	GO TO 915	0246
	1688 FORMAT (47H YOU HAVE NOT PROVIDED RADII FOR THIS LOCATION.)	0247
	1689 WRITE (6,1688)	0248
	GO TO 1	0249
	925 TIME =DIST(K)/ (VELMAX(L)*DWEATH*24.)	0250
	ZNETN(L)=OILNSF(L)-(XNEEDS(L)+(GRPUSE(L)*2.*TIME))	0251
	NWAY(L)=(TIME+.5)	0252
C		0253
C	FILL ASSIGNED OILER TO CAPACITY	0254
	DO 926 N=NDAY,90	0255
	BOARDN(L,N)=ZNETN(L)	0256
	BOARDJ(L,N)=OILJP5(L)	0257
	926 CONTINUE	0258
C		0259
C	RECORD HISTORY OF NEWLY INTRODUCED AO. FIRST, ESTABLISH STATUS AND	0260
C	INVENTORIES DURING TIME IN TRANSIT TO LOCATION.	0261
	LAST5=NDAY-1	0262
	LAST4 = NDAY-NWAY(L)	0263
	IF (LAST4.LE.0) GO TO 7002	0264
	DO 930 I=LAST4,LAST5	0265
	MSTATS(L,I)=2	0266
	BOARDN(L,I)=ZNETN(L)	0267
	BOARDJ(L,I)=OILJP5(L)	0268
	930 CONTINUE	0269
	GO TO 931	0270
	7002 IF (LAST5.LE.0) GO TO 1001	0271
	DO 7003 I=1,LAST5	0272
	MSTATS(L,I)=2	0273
	BOARDN(L,I)=ZNETN(L)	0274
	BOARDJ(L,I)=OILJP5(L)	0275
	7003 CONTINUE	0276
	GO TO 1001	0277

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C
C NEXT, ESTABLISH STATUS AND INVENTORIES DURING TIME AT BASE 0278
931 LAST3=LAST4-1 0279
  NBASE = TBASE + .5 0280
  LAS=LAST3-NBASE+1 0281
  IF (LAS.LE.0) GO TO 7004 0282
  DO 935 I=LAS, LAST3 0283
  MSTATS(L, I)=1 0284
  BOARDN(L, I) = ZNETN(L) 0285
  BOARDJ(L, I) = OILJP5(L) 0286
935 CONTINUE 0287
  GO TO 1001 0288
7004 IF (LAST3.LE.0) GO TO 1001 0289
  DO 7005 I=1, LAST3 0290
  MSTATS(L, I)=1 0291
  BOARDN(L, I)=ZNETN(L) 0292
  BOARDJ(L, I)=OILJP5(L) 0293
7005 CONTINUE 0294
C 0295
C HAVING INTRODUCED A NEW OILER INTO THE SYSTEM WE NOW CALL SUBROU- 0296
C TIME FILL TO UNREP THE CTG 0297
C 1001 CALL FILL (L, NDAY, KTG) 0298
  GO TO 1668 0299
  END 0300
C 0301
C 0302
C $IBFTC READ 0303
SUBROUTINE READ (KSANDY, NGROUP, NC, NLOC, DWEATH, TBASE, 0304
IRULE, PCENT, JOKER, S1, S2, B1, B2, U1, U2, T1, T2, KSCR1) 0305
C 0306
C THIS SUBROUTINE READS AND PRINTS OUT INPUT DATA 0307
COMMON 0308
1 BNSFO(60), BBLSJ(20), BBLSN(20), BJP5(60), 0309
2 CNSFO(60), BOARDJ(40,90), BOARDN(40,90), CJP5(60), 0310
3 DEMNDN(20), CTGCP1(20), CTGCP2(20), DEMNDJ(20), 0311
4 GRPUSE(40), DIST(20), DRWDWN(20), DRWDNJ(20), 0312
5 LO(40), LASTLO(20), LASTUN(20), LGROUP(20), 0313
6 MGROUP(20), LOC(20), LOCATN(90,20), MCLASS(60), 0314
7 NCODE(20), MSTATS(40,90), NACTVY(90,20), NCLASS(20,6), 0315
8 NWAY(40), NEXTLO(20), NEXTUN(20), NOILRS(40), 0316
9 PRCNTJ(20), OILNSF(40), OILJP5(40), QTY(20,6), 0317
COMMON 0318
1 RATE1S(20), RATE1B(20), RATE2B(20), RATE1T(20), 0319
2 RATE2T(20), RATE1U(20), RATE2U(20), SJP5(60), 0320
3 SNSFO(60), TJP5(60), TNSFO(60), UJP5(60), 0321
4 UNSFO(60), VELMAX(40), PJP5(60), XNEEDS(40), 0322
PNSFO(60), ZJP5(20), ZNETN(40), ZNSFO(20) 0323
C 0324
C READ AND PRINT OUT SUBDECK 1...CTG ACTIVITY SCHEDULES AND UNREP 0325
C LOCATIONS FOR 90 DAYS 0326
DO 2 NDAY = 1, 90 0327
READ (5,6)(NACTVY(NDAY, KGROUP), LOCATN(NDAY, KGROUP), KGROUP=1, 20) 0328
6 FORMAT (20(1X, I1, I2)) 0329
IF (NACTVY(1,1).GT.0) GO TO 2 0330

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```
C
C WE ENCOUNTER THE FOLLOWING TWO FTN STMS UPON COMPLETING THE ANALY- 0331
C SIS OF THE LAST CASE. WHEN WE ATTEMPT TO READ SUBDECK ONE FOR 0332
C ANOTHER CASE WE ENCOUNTER THE THIRD BLANK CARD DENOTING THE END OF 0333
C THE SERIES OF CASES (NACTVY(1,1) = 0). THEREUPON WE SET KSCRI=1 AND 0334
C CALL HISTRY FOR A FINAL SUMMARY ENTITLED...ANALYSIS OF OILER 0335
C EMPLOYMENT--ALL CASES...THEN CALL EXIT 0336
C KSCRI=1 0337
C CALL HISTRY (KSCRI,KSANDY,JOKER) 0338
C CALL EXIT 0339
2 CONTINUE 0340
C 0341
C THE NEXT READ INSTRUCTION CONFIRMS THAT THERE IS A BLANK AFTER 0342
C SUBDECK 1. 0343
C READ (5,3) CK1 0344
C IF (CK1.EQ. .0) GO TO 5 0345
C WRITE (6,4) 0346
C CALL EXIT 0347
3 FORMAT (F10.1) 0348
4 FORMAT (46H ERROR IN SET UP OF SCHEDULE OF CTG OPERATIONS) 0349
C 0350
C FTN STMS 5 THRU 10 COUNT THE ACTUAL NUMBER OF CTG.S IN THE SYSTEM 0351
C AND CALL THAT NUMBER NGROUP. 0352
C 5 DO 8 KGROUP = 1,20 0353
C IF (NACTVY(1,KGROUP)+LOCATN(1,KGROUP).EQ.0) GO TO 9 0354
C 8 CONTINUE 0355
C KGROUP=21 0356
C 9 KGROUP = KGROUP-1 0357
C 10 NGROUP = KGROUP 0358
C 0359
C WRITE THIS SCHEDULE 0360
C 11 FORMAT (77H1 0361
C 1 INPUT DATA FOR CASE ,12) 0362
C 12 FORMAT (47H-SCHEDULE OF OPERATIONS FOR CARRIER TASK GROUPS) 0363
C 14 FORMAT (119HOACTIVITY STATUS OF TASK GROUP-- 1=STRIKE 2=STA 0364
C 1ND BY 3=UNDERWAY REPLENISHMENT 4=TRANSIT 5=IN PORT ) 0365
C 20 FORMAT (39HO CARRIER TASK GROUP NO.) 0366
C 15 FORMAT (131HO 0367
C 1 8 9 10 11 12 13 14 15 16 17 18 0368
C 2 19 20) 0369
C WRITE (6,11)KSANDY 0370
C WRITE (6,12) 0371
C WRITE (6,14) 0372
C WRITE (6,20) 0373
C WRITE (6,15) 0374
C WRITE(6,1985) 0375
1985 FORMAT(1H ) 0376
DO 17 NDAY=1,90 0377
16 FORMAT (12H DAY=,12,1X,12,19(4X,12)) 0378
17 WRITE (6,16) NDAY, (NACTVY(NDAY,K),K=1,NGROUP) 0379
18 FORMAT (46HOLOCATION OF CARRIER TASK GROUPS ON UNREP DAYS) 0380
WRITE (6,18) 0381
DO 19 NDAY=1,90 0382
19 WRITE (6,16) NDAY,(LOCATN(NDAY,K),K=1,NGROUP) 0383
0384
```


C		0491
C	READ AND PRINT OUT SUBDECK 6...MISCELLANEOUS DATA, INCLUDING OUTPUT	0492
C	CONTROL	0493
63	FORMAT (7X,F5.3,4X,F4.1,29X,F1.0,2X,F4.2,13X,11)	0494
	READ (5,63) DWEATH,TBASE,RULE,PCENT,JOKER	0495
	READ (5,34) NTEST1	0496
	IF (NTEST1.EQ.0) GO TO 62	0497
65	FORMAT (40H YOU ARE MISSING A BLANK AFTER SUBDECK 6)	0498
	WRITE (6,65)	0499
	CALL EXIT	0500
C		0501
C	WRITE MISCELLANEOUS DATA	0502
67	FORMAT(120H-OILER SPEED DEGRADATION FACTOR, TURNAROUND TIME AT BAS	0503
	IE, RULE FOR RETURN, PERCENT DRAWDOWN UNDER RULE 1, OUTPUT CONTROL)	0504
69	FORMAT (11H 12X,F5.3,24X,F4.1,17X,F2.0,22X,F3.2,21X,11)	0505
62	WRITE (6,67)	0506
	WRITE (6,69) DWEATH,TBASE,RULE,PCENT,JOKER	0507
	WRITE (6,789)	0508
C		0509
C	READ AND PRINT OUT SUBDECK 7...UNREP LOCATIONS AND THEIR DISTANCES	0510
C	FROM THE BASE OF SUPPORT	0511
70	K=0	0512
71	K=K+1	0513
73	FORMAT (9X,12,4X,F5.0)	0514
	READ (5,73) LOC(K), DIST(K)	0515
	IF (LOC(K).EQ.0) GO TO 75	0516
	GO TO 71	0517
75	NLOC=K-1	0518
C		0519
C	WRITE UNDERWAY REPLENISHMENT LOCATIONS AND THEIR DISTANCES FROM	0520
C	BASE	0521
77	FORMAT (73H-UNDERWAY REPLENISHMENT LOCATIONS AND THEIR DISTANCES F	0522
	FROM BASE (N.MILES))	0523
78	FORMAT (22HOUNREP.LOC. DISTANCE)	0524
	WRITE (6,77)	0525
	WRITE (6,78)	0526
	DO 79 K=1,NLOC	0527
80	FORMAT (11H 7X,12,6X,F5.0)	0528
79	WRITE (6,80) LOC(K), DIST(K)	0529
	WRITE (6,789)	0530
C		0531
C	READ AND PRINT OUT SUBDECK 8...ADJUSTMENT FACTORS FOR CTG FUEL	0532
C	CONSUMPTION	0533
81	FORMAT (4(F5.3,1X,F5.4,2X))	0534
	READ (5,81) S1, S2, B1, B2, U1, U2, T1, T2	0535
	READ (5,83) CHECK1, CHECK2	0536
83	FORMAT (F5.4,1X,F5.4)	0537
	IF (CHECK1+CHECK2.EQ.0.) GO TO 86	0538
85	FORMAT (61H ERROR IN SET UP OF ADJUSTMENT FACTORS FOR CARRIER TASK	0539
	1 GROUP)	0540
	WRITE (6,85)	0541
	CALL EXIT	0542

C
C WRITE ADJUSTMENT FACTORS FOR C.T.G. FUEL CONSUMPTION 0543
87 FORMAT (47H-ADJUSTMENT FACTORS FOR C.T.G. FUEL CONSUMPTION) 0544
86 WRITE (6,87) 0545
88 FORMAT (69H0 STRIKE STAND BY UNREP 0546
1 TRANSIT) 0547
WRITE (6,88) 0548
100 FORMAT (75H NSFO JP-5 NSFO JP-5 NSFO JP-5 0549
1 NSFO JP-5) 0550
WRITE (6,100) 0551
89 FORMAT (1H 4(5X,F5.3,3X,F5.3)) 0552
WRITE (6,89) S1,S2,B1,B2,U1,U2,T1,T2 0553
0554
C 0555
C THE BALANCE OF THIS SUBROUTINE CONFIRMS THAT THERE IS A SECOND 0556
C BLANK AT THE END OF THE LAST (EIGHTH) SUBDECK OF THIS CASE 0557
C READ (5,92) NOIL 0558
92 FORMAT (110) 0559
IF (NOIL.EQ.0) GO TO 5900 0560
91 FORMAT (79H YOU FORGOT TO PUT A SECOND BLANK AT THE END OF THE EIG 0561
1HTH SUBDECK OF THIS CASE) 0562
WRITE (6,91) 0563
CALL EXIT 0564
C DETERMINE WHETHER CTG HISTORY IS TO BE INCLUDED IN OUTPUT 0565
5900 IF (JOKER .GE.3) GO TO 9879 0566
C 0567
C PRINT OUT TITLES FOR CARRIER TASK GROUP HISTORY 0568
2001 FORMAT (63H1 TASK GROUP HIS 0569
1 T O R Y) 0570
2002 FORMAT (132H- CLOSE OF TASK NSFO INVENTORY JP-5 INVEN 0571
1TORY ACTIVITY LOCATION AND DATE LOCATION AND DATE PERCENT L 0572
2AST DRAWDOWN) 0573
2003 FORMAT (132H DAY GROUP MBBLS PERCENT MBBLS PE 0574
1RCENT TODAY OF LAST UNREP OF NEXT UNREP NSFO 0575
2 JP-5) 0576
2000 WRITE (6,2001) 0577
WRITE (6,2002) 0578
WRITE (6,2003) 0579
9879 RETURN 0580
END 0581
C 0582
C 0583

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$IRFTC MATRX3
SUBROUTINE MATRX3 (NGROUP,S1,S2,B1,B2,U1,U2,T1,T2,NC)
C
C THE FIRST PORTION OF THIS SUBROUTINE, THROUGH FTN STM 126, USES
C INPUT DATA TO CALCULATE AND STORE FOR LATER USE THE FUEL CAPACITIES
C AND CONSUMPTION RATES FOR CARRIER TASK GROUPS IN SYSTEM.
C THE NEXT PORTION INITIALIZES CTG MATRIX WHICH CONTAINS FUEL
C INVENTORIES, ACTIVITY STATUS, DATE AND LOCATION OF LAST UNREP AS
C WELL AS NEXT UNREP, AND PERCENT OF LAST DRAWDOWN FOR THE FIRST DAY.
C THE LAST PORTION INITIALIZES MATRICES CONTAINING THE CURRENT
C STATUS OF OILERS, THEIR NET INVENTORIES, AND UNREP LOCATIONS.
COMMON
1 BNSFO(60), BOARDJ(40,90), BBLSN(20), BJP5(60),
2 CNSFO(60), CTGCP1(20), BOARDN(40,90), CJP5(60),
3 DEMNDN(20), DIST(20), CTGCP2(20), DEMNDJ(20),
4 GRPUSE(40), LASTLO(20), DRWDWN(20), DRWDNJ(20),
5 LO(40), LOC(20), LASTUN(20), LGROUP(20),
6 MGROUP(20), MSTATS(40,90), NACTVY(90,20), MCLASS(60),
7 NCODE(20), NEXTLO(20), NEXTUN(20), NCLASS(20,6),
8 NWAY(40), OILNSF(40), OILJP5(40), NOILRS(40),
9 PRCNTJ(20), PRCNTN(20), RATE1B(20), RATE2B(20),
COMMON
1 RATE2T(20), RATE1U(20), RATE2U(20), RATE1T(20),
2 SNSFO(60), TJP5(60), TNSFO(60), SJP5(60),
3 UNSFO(60), VELMAX(40), PJP5(60), UJP5(60),
4 PNSFO(60), ZJP5(20), ZNETN(40), ZNSFO(20)
C
C CALCULATE CAPACITIES AND DAILY CONSUMPTION RATES OF TASK GROUPS IN
C MBLS OF NSFO AND JP-5
C CLEAR VECTORS FOR CAPACITIES AND RATES
100 DO 110 J=1,NGROUP
RATE1S(J)=0.
RATE2S(J)=0.
RATE1R(J)=0.
RATE2B(J)=0.
RATE1U(J)=0.
RATE2U(J)=0.
RATE1T(J)=0.
RATE2T(J)=0.
CTGCP1(J)=0.
CTGCP2(J)=0.
110 CONTINUE
DO 126 J=1,NGROUP
DO 125 K=1,6
IF (NCLASS(J,K).EQ.0) GO TO 125
L=1
C
C MATCH CLASS NUMBER OF CARRIER TASK GROUP WITH LIST OF CLASSES TO
C GET RESPECTIVE RATES OF CONSUMPTION
115 IF (NCLASS(J,K).EQ.MCLASS(L)) GO TO 120
L=L+1
IF (L.EQ.NC+1) GO TO 130
GO TO 115
131 FORMAT (55H A MATCHING CLASS IS MISSING FOR CLASS NUMBER IN C.T.G.
1)
130 WRITE (6,131)
CALL EXIT
C
C MULTIPLY QTY. OF SHIPS TIMES THE ITEM IN THE CLASS THAT IT MATCHES
120 CAPN=QTY(J,K)*CNSFO(L)
CAPJ=QTY(J,K)*CJP5(L)
RATES1=QTY(J,K)*SNSFO(L)*S1
RATES2=QTY(J,K)*SJP5(L)*S2

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	RATEB1=QTY(J,K)*BNSFO(L)*B1	0647
	RATEP2=QTY(J,K)*RJP5(L)*R2	0648
	RATEU1=QTY(J,K)*UNSF0(L)*U1	0649
	RATEU2=QTY(J,K)*UJP5(L)*U2	0650
	RATET1=QTY(J,K)*TNSFO(L)*T1	0651
	RATET2=QTY(J,K)*TJP5(L)*T2	0652
	RATE1S(J)=RATES1+RATE1S(J)	0653
	RATE2S(J)=RATES2+RATE2S(J)	0654
	RATE1P(J)=RATEB1+RATE1B(J)	0655
	RATE2P(J)=RATEB2+RATE2B(J)	0656
	RATE1U(J)=RATEU1+RATE1U(J)	0657
	RATE2U(J)=RATEU2+RATE2U(J)	0658
	RATE1T(J)=RATET1+RATE1T(J)	0659
	RATE2T(J)=RATET2+RATE2T(J)	0660
	CTGCP1(J)=CTGCP1(J)+CAPN	0661
	CTGCP2(J)=CTGCP2(J)+CAPJ	0662
125	CONTINUE	0663
126	CONTINUE	0664
C		0665
C	INITIALIZE C.T.G. MATRIX WHICH CONTAINS FUEL INVENTORIES, ACTIVITY	0666
C	STATUS, DATE AND LOCATION OF LAST UNREP AS WELL AS NEXT UNREP, AND	0667
C	PERCENT OF LAST DRAWDOWN FOR THE FIRST DAY	0668
	DO 299 J=1,NGROUP	0669
	NCODE(J)=NACTVY(1,J)	0670
	LASTLO(J)=0	0671
	LASTUN(J)=0	0672
	DRWDWN(J)=0.	0673
	DRWDNJ(J)=0.	0674
	BBLSN(J)=CTGCP1(J)*ZNSFO(J)	0675
	RBLSJ(J)=CTGCP2(J)*ZJP5(J)	0676
	PRCNTN(J)=ZNSFO(J)	0677
	PRCNTJ(J)=ZJP5(J)	0678
C		0679
C	SEARCH FOR DATE AND LOCATION OF NEXT UNREP	0680
	DO 280 L=1,90	0681
	IF (NACTVY(L,J).EQ.3) GO TO 290	0682
280	CONTINUE	0683
	NEXTLO(J)=0	0684
	NEXTUN(J)=0	0685
	GO TO 299	0686
290	NEXTLO(J)=LOCATN(L,J)	0687
	NEXTUN(J)=L	0688
299	CONTINUE	0689
C		0690
C	INITIALIZE MATRIX CONTAINING CURRENT STATUS OF OILERS AND THEIR	0691
C	NET NSFO AND JP-5 INVENTORIES	0692
C	SET OILER STATUS EQUAL TO ZERO FOR ALL 90 DAYS AND SET INVENTORY	0693
C	EQUAL TO ZERO	0694
129	DO 301 K=1,40	0695
	DO 300 N=1,90	0696
	MSTATS(K,N)=0	0697
	BOARDJ(K,N)=0.	0698
	BOARDN(K,N)=0.	0699
300	CONTINUE	0700
301	CONTINUE	0701
C		0702
C	FOR EACH OILER SET INITIAL LOCATION EQUAL TO ZERO, INDICATING THAT	0703
C	IT HAS NOT YET BEEN INTRODUCED INTO THE SYSTEM AND ASSIGNED TO AN	0704
C	UNREP LOCATION	0705
	DO 305 M=1,40	0706
305	LO(M)=0	0707
	RETURN	0708
	END	0709

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C
C
$IBFTC CTG
SUBROUTINE CTG (NGROUP,NDAY,KTG,KSANDY)
C
C IF THE OUTPUT CONTROL CHARACTER INDICATES THAT CTG HISTORY BY DAY
C IS TO BE INCLUDED AMONG THE OUTPUT, THIS SUBROUTINE WILL BE CALLED
C AT THE CLOSE OF EACH OF THE NINETY DAYS TO PRINT THAT DAY'S CON-
C TRIBUTION TO CTG HISTORY. IF THIS PORTION OF THE OUTPUT IS TO BE
C INCLUDED, THE HEADING WILL HAVE BEEN PRINTED BY SUBR. READ .
COMMON
1      BLSJ(20),      BLSN(20),      RJP5(60),
2      RNSFO(60),    BOARDJ(40,90), BOARDN(40,90),    CJP5(60),
3      CNSFO(60),    CTGCP1(20),   CTGCP2(20),   DEMNDJ(20),
4      DEMNDN(20),   DIST(20),     DRWDWN(20),   DRWDNJ(20),
5      GRPUSE(40),   LASTLO(20),   LASTUN(20),   LGROUP(20),
6      LO(40),       LOC(20),      LOCATN(90,20), MCLASS(60),
7      MGROUP(20),  MSTATS(40,90), NACTVY(90,20), NCLASS(20,6),
8      NCODE(20),   MEXTLO(20),  NEXTUN(20),  NOILRS(40),
9      NWAY(40),    OILNSF(40),  OILJP5(40),  QTY(20,6),
10     PRCNTJ(20),  PRCNTN(20),  RATE1B(20),  RATE2B(20),
COMMON
1      RATE2T(20),  RATE1U(20),  RATE2S(20),  RATE1T(20),
2      SNSFO(60),  TJP5(60),   TNSFO(60),   UJP5(60),
3      UNSFO(60),  VELMAX(40), PJP5(60),    XNEEDS(40),
4      PNSFO(60),  ZJP5(20),   ZNETN(40),   ZNSFO(20)
2004 FORMAT (1H0)
WRITE (6,2004)
2006 DO 2020 J=1,NGROUP
CENTN=PRCNTN(J)*100.
CENTJ=PRCNTJ(J)*100.
PERCTN=DRWDWN(J)*100.
PERCTJ=DRWDNJ(J)*100.
2011 FORMAT (1H ,2X,2HD+,13,7X,12,7X,F6.1,3X,F5.1,6X,F6.1,3X,F5.1,3X,
16HSTRIKE,4X,5X,12,3X,2HD+,13,5X,5X,12,3X,2HD+,13)
2013 FORMAT (1H ,2X,2HD+,13,7X,12,7X,F6.1,3X,F5.1,6X,F6.1,3X,F5.1,2X,
18HSTAND BY,3X,5X,12,3X,2HD+,13,5X,5X,12,3X,2HD+,13)
2015 FORMAT (1H ,2X,2HD+,13,7X,12,7X,F6.1,3X,F5.1,6X,F6.1,3X,F5.1,4X,
15HUNREP,4X,5X,12,3X,2HD+,13,5X,5X,12,3X,2HD+,13,5X,3X,F5.1,3X,
2F5.1)
2017 FORMAT (1H ,2X,2HD+,13,7X,12,7X,F6.1,3X,F5.1,6X,F6.1,3X,F5.1,3X,
17HTRANSIT,3X,5X,12,3X,2HD+,13,5X,5X,12,3X,2HD+,13)
2019 FORMAT (1H ,2X,2HD+,13,7X,12,7X,F6.1,3X,F5.1,6X,F6.1,3X,F5.1,3X,
17HIN PORT,3X,5X,12,3X,2HD+,13,5X,5X,12,3X,2HD+,13)
IF (NACTVY(NDAY,J).EQ.1) WRITE(6,2011) NDAY,J,BLSN(J),CENTN,
1BBLSJ(J),CENTJ, LASTLO(J), LASTUN(J), NEXTLO(J), NEXTUN(J)
IF (NACTVY(NDAY,J).EQ.2) WRITE (6,2013) NDAY,J,BLSN(J),CENTN,
1BBLSJ(J),CENTJ, LASTLO(J), LASTUN(J), NEXTLO(J), NEXTUN(J)
IF (NACTVY(NDAY,J).EQ.3) WRITE (6,2015) NDAY,J,BLSN(J),CENTN,
1BBLSJ(J),CENTJ, LASTLO(J), LASTUN(J), NEXTLO(J), NEXTUN(J), PERCTN,
2PERCTJ
IF (NACTVY(NDAY,J).EQ.4) WRITE (6,2017) NDAY,J,BLSN(J),CENTN,
1BBLSJ(J),CENTJ, LASTLO(J), LASTUN(J), NEXTLO(J), NEXTUN(J)
IF (NACTVY(NDAY,J).EQ.5) WRITE (6,2019) NDAY,J,BLSN(J),CENTN,
1BBLSJ(J),CENTJ, LASTLO(J), LASTUN(J), NEXTLO(J), NEXTUN(J)
2020 CONTINUE
RETURN
END
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6IBFTC HISTRY
SUBROUTINE HISTRY (KSCR1,KSANDY,JOKER)

THIS SUBROUTINE PRINTS ALL OF THE OUTPUT RESULTING FROM THE SIMULATION, WITH THE EXCEPTION OF CARRIER TASK GROUP HISTORY, WHICH IS PRINTED BY SUBROUTINE CTG. WHEN HISTRY IS CALLED THE OUTPUT PRODUCED BY IT WILL BE EITHER (A) RESULTS OF A SINGLE CASE, OR (B) SUMMARY ANALYSIS OF ALL CASES

COMMON

1	BNSFO(60),	BOARDJ(40,90),	BOARDN(40,90),	CJP5(60),
2	CNSFO(60),	CTGCP1(20),	CTGCP2(20),	DEMNDJ(20),
3	DEMNDN(20),	DIST(20),	DRWDWN(20),	DRWDNJ(20),
4	GRPUSE(40),	LASTLO(20),	LASTUN(20),	LGROUP(20),
5	LO(40),	LOC(20),	LOCATN(90,20),	MCLASS(60),
6	MGROUP(20),	MSTATS(40,90),	NACTVY(90,20),	NCLASS(20,6),
7	NCODE(20),	NEXTLO(20),	NEXTUN(20),	NOILRS(40),
8	NWAY(40),	OILNSF(40),	OILJP5(40),	QTY(20,6),
9	PRCNTJ(20),	PRCNTN(20),	RATE1B(20),	RATE2B(20)

COMMON

1	RATE2T(20),	RATE1S(20),	RATE2S(20),	RATE1T(20),
2	SNSFO(60),	TJP5(60),	TNSFO(60),	SJP5(60),
3	UNSF0(60),	VELMAX(40),	PJP5(60),	UJP5(60),
4	PNSFO(60),	ZJP5(20),	ZNETN(40),	ZNSFO(20)

DIMENSION INUSE8(90),KLOC7(32),KLOC8(32)
DIMENSION KLOC1(32),KLOC2(32),KLOC3(32),KLOC4(32),KLOC5(32),
IKLOC6(32),KTOTAL(32),PEAK10(32),KOUNT3(32)

FIRST WE DETERMINE WHETHER THIS IS A CALL TO PRINT RESULTS OF A SINGLE CASE (SIGNIFIED BY KSCR1=0), OR A CALL TO PRINT A SUMMARY ANALYSIS OF ALL CASES (KSCR1=1).
IF (KSCR1.EQ.1) GO TO 1981

FOR A SINGLE CASE ANALYSIS WE FIRST REASSIGN ANY SURPLUS AD PRE-DELIVERY LOTTER TIME FROM THE UNREP LOCATION TO THE BASE
DO 4567 KON=1,40
IF((MSTATS(KON,90).LE.5).AND.(MSTATS(KON,90).GT.2))GO TO 4567
NUTTY=90

4568 IF(MSTATS(KON,NUTTY).EQ.6)GO TO 4520
IF (MSTATS(KON,NUTTY).EQ.2) GO TO 4569
GO TO 4567

4569 MSTATS(KON,NUTTY)=6
4520 NUTTY=NUTTY-1
GO TO 4568
4567 CONTINUE

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C IF THE OUTPUT CONTROL CHARACTER REQUESTS IT (JOKER=0 OR 1), WE 0814
C PRINT OUT HISTORY OF OILERS BY DAY 0815
IF (JOKER .GE.2) GO TO 9875 0816
2030 FORMAT (81H1 H I S T O R Y O 0817
IF O I L F R S B Y D A Y) 0818
2031 FORMAT (129HOCLOSE OF OILER STATUS 0819
INSFO ON BOARD JP-5 ON BOARD AMOUNT DEL. TODAY CUMULAT 0820
2IVE TOTAL) 0821
2032 FORMAT (132H DAY NUMBER MB 0822
1BLS PERCENT MBBLS PERCENT MBBLS NSFO-MBBLS JPS MBBLS NS 0823
2FO-MBBLS JP5) 0824
2033 FORMAT (1H0) 0825
WRITE (6,2030) 0826
WRITE (6,2031) 0827
WRITE (6,2032) 0828
WRITE (6,2033) 0829
ACUMN=0. 0830
ACUMJ=0. 0831
DO 2056 K=1,90 0832
2035 WRITE (6,2034) 0833
2034 FORMAT (1H ) 0834
DO 2055 J=1,40 0835
OBOARD=BOARDJ(J,K)/OILJP5(J)*100. 0836
ONBORD=BOARDN(J,K)/ZNETN(J)*100. 0837
IF (MSTATS(J,K).EQ.0) GO TO 2055 0838
IF (MSTATS(J,K).EQ.1) GO TO 2037 0839
IF (MSTATS(J,K).EQ.2) GO TO 2039 0840
IF (MSTATS(J,K).EQ.3) GO TO 2041 0841
IF (MSTATS(J,K).EQ.4) GO TO 2043 0842
IF (MSTATS(J,K).EQ.5) GO TO 2045 0843
IF (MSTATS(J,K).EQ.6) GO TO 2049 0844
2036 FORMAT (1H 5X,12,7X,12,10X,14HRELOAD AT BASE,13X,F6.0,3X,F5.1,6X,F 0845
16.0,3X,F5.1) 0846
2037 WRITE (6,2036) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD 0847
GO TO 2055 0848
2038 FORMAT (1H 5X,12,7X,12,10X,22HIN TRANSIT TO LOCATION,5X,F6.0,3X, 0849
1F5.1,6X,F6.0,3X,F5.1) 0850
2039 WRITE (6,2038) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD 0851
GO TO 2055 0852
2040 FORMAT (1H 5X,12,7X,12,5X,29HSTAND BY PART. FILLED AT LOC.,3X, 0853
1F6.0,3X,F5.1,6X,F6.0,3X,F5.1) 0854
2041 WRITE (6,2040) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD 0855
GO TO 2055 0856
2043 TOTN=BOARDN(J,K-1)-BOARDN(J,K) 0857
TOTJ=BOARDJ(J,K-1)-BOARDJ(J,K) 0858
ACUMN=ACUMN+TOTN 0859
ACUMJ=ACUMJ+TOTJ 0860
2042 FORMAT (1H 5X,12,7X,12,10X,17HUNREP AT LOCATION,10X,F6.0,3X,F5.1, 0861
16X,F6.0,3X,F5.1,F6.0,3X,F6.0,5X,F6.0,3X,F6.0) 0862
WRITE (6,2042) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD, 0863
1TOTN,TOTJ,ACUMN,ACUMJ 0864
GO TO 2055 0865
2044 FORMAT (1H 5X,12,7X,12,10X,18HIN TRANSIT TO BASE,9X,F6.0,3X,F5.1, 0866
16X,F6.0,3X,F5.1) 0867
2045 WRITE (6,2044) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD 0868
GO TO 2055 0869
2046 FORMAT (1H 5X,12,7X,12,5X,30H LOITER AT BASE ,2X, 0870
1F6.0,3X,F5.1,6X,F6.0,3X,F5.1) 0871
2049 WRITE (6,2046) K,NOILRS(J),BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD 0872
2055 CONTINUE 0873
2056 CONTINUE 0874

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C
C IF THE OUTPUT CONTROL CHARACTER REQUESTS IT (JOKER .LE. 3), WE PRINT
C OUT HISTORY OF OILERS BY OILER NUMBER.
9875 IF (JOKER.GE.4) GO TO 1965
WRITE (6,2060)
WRITE (6,2061)
WRITE (6,2062)
WRITE (6,2063)
2060 FORMAT (94H1
OILERS BY OILER NUMBER/HO)
2061 FORMAT (131HO OILFR CLOSE OF STATUS
INSFO ON BOARD JP-5 ON BOARD AMOUNT DEL. TODAY CUM. DEL.
2 PER OILER)
2062 FORMAT (132H NUMBER DAY MB
IBLS PERCENT MBBL5 PERCENT MBBL5 NSFO-MBBL5 JP5 MBBL5 NS
2FO-MBBL5 JP5)
DO 2086 J=1,40
ACUMN=0.
ACUMJ=0.
2064 FORMAT (23HLOCATION OF OILER NO. ,I2,4H IS ,I2,1H.)
WRITE (6,2064) J, LO(J)
DO 2085 K=1,90
OBOARD=BOARDJ(J,K)/OILJP5(J)*100.
ONBORD=BOARDN(J,K)/ZNETN(J)*100.
IF (MSTATS(J,K).EQ.0) GO TO 2085
IF (MSTATS(J,K).EQ.1) GO TO 2067
IF (MSTATS(J,K).EQ.2) GO TO 2069
IF (MSTATS(J,K).EQ.3) GO TO 2071
IF (MSTATS(J,K).EQ.4) GO TO 2073
IF (MSTATS(J,K).EQ.5) GO TO 2075
IF (MSTATS(J,K).EQ.6) GO TO 2077
2068 FORMAT (1H 5X, I2, 7X, I2, 10X, 14HRELOAD AT BASE, 13X, F6.0, 3X, F5.1, 6X, F
16.0, 3X, F5.1)
2067 WRITE (6,2068) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD
GO TO 2085
2070 FORMAT (1H 5X, I2, 7X, I2, 10X, 22HIN TRANSIT TO LOCATION, 5X, F6.0, 3X,
1F5.1, 6X, F6.0, 3X, F5.1)
2069 WRITE (6,2070) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD
GO TO 2085
2072 FORMAT (1H 5X, I2, 7X, I2, 8X, 29HSTAND BY PART. FILLED AT LOC., F6.0,
13X, F5.1, 6X, F6.0, 3X, F5.1)
2071 WRITE (6,2072) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD
GO TO 2085
2073 TOTN=BOARDN(J,K-1)-BOARDN(J,K)
TOTJ=BOARDJ(J,K-1)-BOARDJ(J,K)
ACUMN=ACUMN+TOTN
ACUMJ=ACUMJ+TOTJ
2074 FORMAT (1H 5X, I2, 7X, I2, 10X, 17HUNREP AT LOCATION, 10X, F6.0, 3X, F5.1,
16X, F6.0, 3X, F5.1, F6.0, 3X, F6.0, 5X, F6.0, 3X, F6.0)
WRITE (6,2074) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD,
1TOTN,TOTJ,ACUMN,ACUMJ
GO TO 2085
2076 FORMAT (1H 5X, I2, 7X, I2, 10X, 18HIN TRANSIT TO BASE, 9X, F6.0, 3X, F5.1,
16X, F6.0, 3X, F5.1)
2075 WRITE (6,2076) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD
GO TO 2085
2078 FORMAT (1H 5X, I2, 7X, I2, 7X, 30H LOITER AT BASE ,F6.0,
13X, F5.1, 6X, F6.0, 3X, F5.1)
2077 WRITE (6,2078) NOILRS(J),K,BOARDN(J,K),ONBORD,BOARDJ(J,K),OBOARD
2085 CONTINUE
2086 CONTINUE

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4865	KOUNT3(KSANDY)=INUSER(N)	0991
9865	CONTINUE	0992
	GO TO 9869	0993
9868	COUNT8=COUNT8/10.	0994
	WRITE(6,2033)	0995
	WRITE(6,9870) COUNT8	0996
9870	FORMAT(52HOAVERAGE NUMBER OF OILERS IN USE FOR PEAK TEN DAYS= ,	0997
	1F4.1)	0998
	WRITE (6,780)	0999
780	FORMAT (1H0)	1000
	WRITE(6,777)	1001
	WRITE (6,778)	1002
777	FORMAT (132HOOILER ACTIVITY STATUS CODE - 0=NOT IN SYSTEM 1=A	1003
	1T BASE 2=IN TRANSIT TO LOCATION 3=STANDBY PARTIALLY FILLED	1004
	2 AT LOCATION)	1005
778	FORMAT (112H0	1006
	1P 5=INTRANSIT TO BASE 6=PREDELIVERY LOITER AT BASE) 4=UNRE	1007
C		1008
C	FTN STMS 1640 THROUGH 1641 COMPUTE AND STORE VALUES NEEDED FOR THE	1009
C	FINAL..ANALYSIS OF OILER EMPLOYMENT--ALL CASES..	1010
1640	LTOTAL=0	1011
	LOC1=0	1012
	LOC2=0	1013
	LOC3=0	1014
	LOC4=0	1015
	LOC5=0	1016
	LOC6=0	1017
	LOC7=0	1018
	LOC8=0	1019
	DO 1973 KOST=1,40	1020
	IF (LO(KOST).EQ.0) GO TO 1973	1021
	IF(LO(KOST).EQ.1)GO TO 1967	1022
	IF(LO(KOST).EQ.2)GO TO 1968	1023
	IF(LO(KOST).EQ.3)GO TO 1969	1024
	IF(LO(KOST).EQ.4)GO TO 1970	1025
	IF(LO(KOST).EQ.5)GO TO 1971	1026
	IF(LO(KOST).EQ.6)GO TO 1972	1027
	IF(LO(KOST).EQ.7)GO TO 5005	1028
	IF(LO(KOST).GE.8)GO TO 5006	1029
	GO TO 1966	1030
1967	LOC1=LOC1+1	1031
	GO TO 1966	1032
1968	LOC2=LOC2+1	1033
	GO TO 1966	1034
1969	LOC3=LOC3+1	1035
	GO TO 1966	1036
1970	LOC4=LOC4+1	1037
	GO TO 1966	1038
1971	LOC5=LOC5+1	1039
	GO TO 1966	1040
1972	LOC6=LOC6+1	1041
	GO TO 1966	1042
5005	LOC7=LOC7+1	1043
	GO TO 1966	1044
5006	LOC8=LOC8+1	1045
1966	LTOTAL=LTOTAL+1	1046

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1973 CONTINUE
KLOC1(KSANDY)=LOC1
KLOC2(KSANDY)=LOC2
KLOC3(KSANDY)=LOC3
KLOC4(KSANDY)=LOC4
KLOC5(KSANDY)=LOC5
KLOC6(KSANDY)=LOC6
KLOC7(KSANDY)=LOC7
KLOC8(KSANDY)=LOC8
KTOTAL(KSANDY)=L TOTAL
PEAK10(KSANDY)=COUNT8
1641 GO TO 1980
C
C FTN STMS 1981 THROUGH 1982 ARE ENCOUNTERED ONCE, AFTER ALL CASES
C HAVE BEEN EVALUATED. THEY PRINT OUT ..ANALYSIS OF OILER
C EMPLOYMENT--ALL CASES..
1981 WRITE(6,1984)
1984 FORMAT(1H1)
WRITE(6,1987)
WRITE(6,2033)
WRITE(6,5000)
WRITE(6,5001)
WRITE(6,5002)
1987 FORMAT(102H
IR F M P L O Y M E N T ..... A N A L Y S I S O F O I L E
5000 FORMAT(125H CASE OILERS ASSIGNED TO EACH LOCA
ITION TOTAL OILERS AVERAGE OILERS OILERS I
2N USE)
5001 FORMAT(122H NUMBER LOC 1 LOC 2 LOC 3 LOC 4 LOC 5 LO
IC 6 LOC 7 LOC 7+ INTRODUCED IN USE PEAK D
2AY)
5002 FORMAT(108H
1 INTO SYSTEM PEAK 10 DAYS)
WRITE(6,2033)
KSANDY=KSANDY-1
DO 1982 INDX=1,KSANDY
WRITE(6,1983)INDX,KLOC1(INDX),KLOC2(INDX),KLOC3(INDX),KLOC4(INDX)
1,KLOC5(INDX),KLOC6(INDX),KLOC7(INDX),KLOC8(INDX),KTOTAL(INDX),PEAK
210(INDX),KOUNT3(INDX)
1983 FORMAT(2H ,14,110,718,115,F17.1,115)
1982 CONTINUE
1980 RETURN
END

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IBFTC CONSUMP
 SUBROUTINE CONSUMP (NDAY,KTG,NCHECK)

THIS SUBROUTINE IS CALLED ONCE FOR EACH CARRIER TASK GROUP EACH DAY
 ITS PURPOSE IS TO UPDATE THE AMOUNTS OF NSFO AND JP-5 ON BOARD THE
 CTG BY DEDUCTING TODAYS CONSUMPTIONS FROM THE INVENTORY AT THE
 CLOSE OF YESTERDAY

COMMON BRLSJ(20), BBLSN(20), BJP5(60),
 1 RNSFO(60), BOARDN(40,90), BOARDN(40,90), CJP5(60),
 2 CNSFO(60), CTGCP1(20), CTGCP2(20), DEMNDJ(20),
 3 DEMNDN(20), DIST(20), DRWDWN(20), DRWDNJ(20),
 4 GRPUSE(40), LASTLO(20), LASTUN(20), LGROUP(20),
 5 LO(40), LOC(20), LOCATN(90,20), MCLASS(60),
 6 MGROUP(20), MSTATS(40,90), NACTVY(90,20), NCLASS(20,6),
 7 NCODE(20), NEXTLO(20), NEXTUN(20), NOILRS(40),
 8 NWAY(40), OILNSF(40), OILJP5(40), QTY(20,6),
 9 PRCNTJ(20), PRCNTN(20), RATE1B(20), RATE2B(20)
 COMMON RATE1S(20), RATE2S(20), RATE1T(20),
 1 RATE2T(20), RATE1U(20), RATE2U(20), SJP5(60),
 2 SNSFO(60), TJP5(60), TNSFO(60), UJP5(60),
 3 UNSFO(60), VELMAX(40), PJP5(60), XNEEDS(40),
 4 PNSFO(60), ZJP5(20), ZNETN(40), ZNSFO(20)

NCHECK WILL BE SET EQUAL TO 1 IF THERE IS AN ERROR CAUSED BY THE
 ASSIGNMENT OF AN ILLEGAL ACTIVITY CODE. IT IS INITIALIZED IN THE
 FOLLOWING STATEMENT.
 NCHECK = 0

UPDATE A DAYS ACTIVITY MATRIX
 NCODE(KTG)=NACTVY(NDAY,KTG)

NEXT IDENTIFY THIS CTG ACTIVITY FOR TODAY
 IF (NCODE(KTG).EQ.1) GO TO 512
 IF (NCODE(KTG).EQ.2) GO TO 513
 IF (NCODE(KTG).EQ.3) GO TO 514
 IF (NCODE(KTG).EQ.4) GO TO 515
 IF (NCODE(KTG).EQ.5) GO TO 517
 WRITE (6,1687)

1687 FORMAT (127H THE CTG ACTIVITY CODES ARE LIMITED TO INTEGERS FROM 1
 1 TO 5, INCLUSIVE. YOUR INPUT DATA (SUBDECK 1) VIOLATES THIS RESTRICTION.)
 NCHECK = 1
 GO TO 518

THEN UPDATE CTG FUEL INVENTORY BY SUBTRACTING THE APPROPRIATE
 CONSUMPTIONS

512 BBLSJ(KTG)=BBLSJ(KTG)-RATE2S(KTG)
 BBLSN(KTG)=BBLSN(KTG)-RATE1S(KTG)
 GO TO 516

513 BBLSJ(KTG)=BBLSJ(KTG)-RATE2B(KTG)
 BBLSN(KTG)=BBLSN(KTG)-RATE1B(KTG)
 GO TO 516

514 BBLSJ(KTG)=BBLSJ(KTG)-RATE2U(KTG)
 BBLSN(KTG)=BBLSN(KTG)-RATE1U(KTG)
 GO TO 516

515 BBLSJ(KTG)=BBLSJ(KTG)-RATE2T(KTG)
 BBLSN(KTG)=BBLSN(KTG)-RATE1T(KTG)

C		1149
C	CALCULATE AMOUNT ON BOARD CTG AS A PERCENT OF CAPACITY	1150
516	IF(BBLSJ(KTG).GT.0.) GO TO 3222	1151
	BBLSJ(KTG) = 0.	1152
3222	IF(BPLSN(KTG).GT.0.) GO TO 3223	1153
	BPLSN(KTG) = 0.	1154
3223	PRCNTJ(KTG) = BBLSJ(KTG)/CTGCP2(KTG)	1155
	PRCNTN(KTG)=BPLSN(KTG)/CTGCP1(KTG)	1156
	GO TO 518	1157
C		1158
C	SET INVENTORY EQUAL TO FULL CAPACITY IF CTG IS IN PORT	1159
517	BBLSJ(KTG)=CTGCP2(KTG)	1160
	BPLSN(KTG)=CTGCP1(KTG)	1161
	PRCNTJ(KTG)=1.00	1162
	PRCNTN(KTG)=1.00	1163
518	RETURN	1164
	FND	1165

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C
C
C 1166
C 1167
C 1168
C 1169
C 1170
C 1171
C 1172
C 1173
COMMON
      BBL SJ(20),      BBL SN(20),      B JP5(60),
1  HNSFO(60),  BUARDJ(40,90),  BOARDN(40,90),  C JP5(60),
2  UNSFO(60),  CTGCP1(20),    CTGCP2(20),    DEMNDJ(20),
3  DEMNDN(20),  DIST(20),     DRWDWN(20),    DRWDNJ(20),
4  GRPUSF(40),  LASTLO(20),   LASTUN(20),   LGROUP(20),
5  LO(40),     LOC(20),      LOCATN(90,20), MCLASS(60),
6  MGROUP(20), MSTATS(40,90), NACTVY(90,20), NCLASS(20,6),
7  NCODE(20),  NEXTLO(20),   NEXTUN(20),   NOILRS(40),
8  NWAY(40),   OILNSF(40),  OILJP5(40),   QTY(20,6),
9  PRCNTJ(20), PRCNTN(20),   RATE1B(20),   RATE2B(20)
COMMON
      RATE1S(20),  RATE2S(20),  RATE1T(20),
1  RATE2T(20),  RATE1U(20),  RATE2U(20),  SJP5(60),
2  SNSFO(60),  TJP5(60),   TNSFO(60),   UJP5(60),
3  UNSFO(60),  VELMAX(40), PJP5(60),   XNEEDS(40),
4  PNSFO(60),  ZJP5(20),   ZNETN(40),   ZNSFO(20)
C 1189
C 1190
C 1191
C 1192
C 1193
C 1194
C 1195
C 1196
C 1197
C 1198
C 1199
C 1200
C 1201
C 1202
C 1203
C 1204
C 1205
C 1206
C 1207
C 1208
C 1209
C 1210
C 1211
C 1212
C 1213
C 1214
C 1215
C 1216
      UPDATE THE FOLLOWING CTG DATA ..DATE AND LOCATION OF LAST UNREP,
      DATE AND LOCATION OF NEXT UNREP, PERCENT OF LAST DRAWDOWN
      LASTUN(KTG)=NDAY
      LASTLO(KTG)=LOCATN(NDAY,KTG)
      M=NDAY
535 M=M+1
      IF (M.EQ.91) GO TO 537
      IF (NACTVY(M,KTG).EQ.3) GO TO 540
      GO TO 535
537 NEXTUN(KTG)=0
      NEXTLO(KTG)=0
      GO TO 550
540 NEXTUN(KTG)=M
      NEXTLO(KTG)=LOCATN(M,KTG)
C
C 1205
C 1206
C 1207
C 1208
C 1209
C 1210
C 1211
C 1212
C 1213
C 1214
C 1215
C 1216
      CALCULATE DEMAND FOR THIS CARRIER TASK GROUP
550 DEMNDN(KTG)=CTGCP1(KTG)-BBL SN(KTG)
      DEMNDJ(KTG)=CTGCP2(KTG)-BBL SJ(KTG)
C
C
      CALCULATE PERCENT LAST DRAWDOWN
      DRWDWN(KTG)=1.00-(DEMNDN(KTG)/CTGCP1(KTG))
      DRWDNJ(KTG)=1.00-(DEMNDJ(KTG)/CTGCP2(KTG))
C
C
      SET LOCATION INDEX EQUAL TO LOCATION OF THIS CTG
      NPLACE=LASTLO(KTG)
      RETURN
      END

```

```

C
C
$IBFTC FILL 1217
SUBROUTINE FILL (L,NDAY,KTG) 1218
C 1219
C 1220
C THE PURPOSE OF THIS SUBROUTINE IS TO SATISFY THE DEMANDS OF A 1221
C PARTICULAR UNREP TO THE MAXIMUM EXTENT POSSIBLE, SUBJECT TO 1222
C LIMITATIONS IMPOSED BY THE AMOUNTS ABOARD THE AO PRIOR TO 1223
C THE UNREP. IT UPDATES THE NSFO AND JP-5 DEMANDS REMAINING, THE 1224
C AMOUNTS ABOARD THE CTG AND AO, AND THE AO ACTIVITY STATUS FOR THE 1225
C UNREP DAY (NDAY). 1226
COMMON 1227
1 BNSFO(60), BBLSJ(20), BBLSN(20), BJP5(60), 1228
2 CNSFO(60), BOARDJ(40,90), BOARDN(40,90), CJP5(60), 1229
3 DEMNDN(20), CTGCP1(20), CTGCP2(20), DEMNDJ(20), 1230
4 GRPUSE(40), DIST(20), DRWDWN(20), DRWDNJ(20), 1231
5 LO(40), LASTLO(20), LASTUN(20), LGROUP(20), 1232
6 MGROUP(20), MSTATS(40,90), NACTVY(90,20), MCLASS(60), 1233
7 NCODE(20), NEXTLO(20), NEXTUN(20), NCLASS(20,6), 1234
8 NWAY(40), OILNSF(40), OILJP5(40), NOILKS(40), 1235
9 PRCNTJ(20), PRCNTN(20), RATE1B(20), RATE2B(20), 1236
COMMON 1237
1 RATE2T(20), RATE1U(20), RATE2S(20), RATE1T(20), 1238
2 SNSFO(60), TJP5(60), TNSFO(60), SJP5(60), 1239
3 UNSFO(60), VELMAX(40), PJP5(60), UJP5(60), 1240
4 PNSFO(60), ZJP5(20), ZNETN(40), ZNSFO(20) 1241
IF (DEMNDN(KTG).LE.BOARDN(L,NDAY)) GO TO 615 1242
DEMNDN(KTG)=DEMNDN(KTG)-BOARDN(L,NDAY) 1243
BBLSN(KTG)=BBLSN(KTG)+BOARDN(L,NDAY) 1244
PRCNTN(KTG)=BBLSN(KTG)/CTGCP1(KTG) 1245
DO 609 J=NDAY,90 1246
609 BOARDN(L,J)=0. 1247
610 IF (DEMNDJ(KTG).LE.BOARDJ(L,NDAY)) GO TO 618 1248
DEMNDJ(KTG)=DEMNDJ(KTG)-BOARDJ(L,NDAY) 1249
BBLSJ(KTG)=BBLSJ(KTG)+BOARDJ(L,NDAY) 1250
PRCNTJ(KTG)=BBLSJ(KTG)/CTGCP2(KTG) 1251
DO 611 J=NDAY,90 1252
611 BOARDJ(L,J)=0. 1253
GO TO 620 1254
615 DO 616 J=NDAY,90 1255
616 BOARDN(L,J)=BOARDN(L,J)-DEMNDN(KTG) 1256
BBLSN(KTG)=CTGCP1(KTG) 1257
PRCNTN(KTG)=1.000 1258
DEMNDN(KTG)=0. 1259
GO TO 610 1260
618 DO 619 J=NDAY,90 1261
619 BOARDJ(L,J)=BOARDJ(L,J)-DEMNDJ(KTG) 1262
PRCNTJ(KTG)=1.000 1263
BBLSJ(KTG)=CTGCP2(KTG) 1264
DEMNDJ(KTG)=0. 1265
620 MSTATS(L,NDAY)=4 1266
RETURN 1267
END 1268
1269

```

```

C
C
C 1270
C 1271
C 1272
C 1273
C 1274
C 1275
C 1276
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C 1327
C 1328

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*TRFTC FILLAD
SUBROUTINE FILLAD (L,NDAY,TBASE)
THE PURPOSE OF THIS SUBROUTINE IS TO SEND AN OILER BACK TO BASE,
REFILL IT, AND RETURN IT TO THE UNREP LOCATION FROM WHICH IT CAME
COMMON BBSLJ(20), BBSLN(20), BJP5(60),
1 BNSFO(60), BOARDJ(40,90), BOARDN(40,90), CJP5(60),
2 CNSFO(60), CTGCP1(20), CTGCP2(20), DEMNDJ(20),
3 DEMNDN(20), DIST(20), DRDOWN(20), DRWONJ(20),
4 GRPUSE(40), LASTLO(20), LASTUN(20), LGROUP(20),
5 LO(40), LOC(20), LOCATN(90,20), MCLA(60),
6 MGROUP(20), MSTATS(40,90), NACTVY(90,20), NCLASS(20,6),
7 NCODE(20), NEXTLO(20), NEXTUN(20), NOILRS(40),
8 NWAY(40), OILNSF(40), OILJP5(40), QTY(20,6),
9 PRCNTJ(20), PRCNTN(20), RATE1B(20), RATE2B(20),
COMMON RATE1S(20), RATE2S(20), RATE1T(20),
1 RATE2T(20), RATE1U(20), RATE2U(20), SJP5(60),
2 SNSFO(60), TJP5(60), TNSFO(60), UJP5(60),
3 UNSFO(60), VELMAX(40), PJP5(60), XNEEDS(40),
4 PNSFO(60), ZJP5(20), ZNETN(40), ZNSFO(20)

FTN STMS 1650 THROUGH 622 ESTABLISH PROPER VALUE OF AO ACTIVITY
CODE (MSTATS(L,I)=5) DURING THE OILERS RETURN TO BASE.
1650 NTRIP=NWAY(L)
IF (NTRIP.LT.1) NTRIP=1
DO 622 K=1,NTRIP
I=NDAY + K
MSTATS(L,I)=5
IF (NDAY+K.EQ.90) GO TO 628
622 CONTINUE

FTN STMS 1651 THROUGH 623 ESTABLISH THE PROPER AO ACTIVITY CODE
(1=AT BASE) AND AO INVENTORIES (FULL) WHILE THE OILER IS AT BASE
1651 NBASE=TBASE +.5
IF (NBASE.LT.1) NBASE=1
NEXT1=NTRIP+1
NEXT2=NEXT1+NBASE - 1
DO 623 K=NEXT1,NEXT2
I=NDAY + K
MSTATS(L,I)=1
BOARDN(L,I)=ZNETN(L)
BOARDJ(L,I)=OILJP5(L)
IF (NDAY+K.EQ.90) GO TO 628
623 CONTINUE

FTN STMS 1652 THROUGH 624 ESTABLISH THE PROPER AO ACTIVITY CODE
(2=ENROUTE TO LOCATION) AND INVENTORIES (FULL) DURING THE OILERS
RETURN VOYAGE TO THE UNREP LOCATION.
1652 NEXT3=NEXT2+1
NEXT4=NEXT3+NTRIP-1
DO 624 K=NEXT3,NEXT4
I=NDAY + K
MSTATS(L,I)=2
BOARDN(L,I)=ZNETN(L)
BOARDJ(L,I)=OILJP5(L)
IF (NDAY+K.EQ.90) GO TO 628
624 CONTINUE

C		1329
C	FTN STMS 1653 THROUGH 625 SET OILER INVENTORIES (FULL) AND RETAIN	1330
C	THE AD IN STATUS 6 (PREDELIVERY LOITER AT UNREP LOCATION) FROM THE	1331
C	DAY THE AD ARRIVES BACK AT THE LOCATION THROUGH THE NINETIETH DAY	1332
	1653 NEXT5=NEXT4+1	1333
	LAST = 90 - NDAY	1334
	IF (LAST.LT.NEXT5) GO TO 628	1335
	DO 625 K=NEXT5, LAST	1336
	I=NDAY + K	1337
	BOARDN(L,I)=ZNETN(L)	1338
	BOARDJ(L,I)=OILJP5(L)	1339
	MSTATS(L,I)=6	1340
	IF (I.EQ.90) GO TO 628	1341
	625 CONTINUE	1342
	628 RETURN	1343
	END	1344
C		1345
C		1346

```

SUBFC DECISN                                1347
SUBROUTINE DECISN (NDAY,NGROUP,NPLACE,L,CHECK,THASE,RULE, 1348
 1PCENT,KTG)                                1349
C                                             1350
C EVERY TIME AN OILER COMPLETES ANY UNREP AND HAS NSFO REMAINING ON 1351
C BOARD, THIS SUBROUTINE IS CALLED TO DETERMINE WHETHER TO RETAIN THE 1352
C AO ON STATION OR RETURN IT TO BASE FOR RE-FILL. 1353
COMMON                                     1354
1   BNSFO(60),   BRLSJ(20),   BBLSN(20),   BJP5(60),   1355
2   CNSFO(60),   BOARDJ(40,90),   BOARDN(40,90),   CJP5(60),   1356
3   DEMNDN(20),   CTGCP1(20),   CTGCP2(20),   DEMNDJ(20),   1357
4   GRPUSE(40),   DIST(20),   DRWDWN(20),   DRWDNJ(20),   1358
5   LI(40),   LASTLO(20),   LASTUN(20),   LGROUP(20),   1359
6   MGROUP(20),   LOC(20),   LOCATN(90,20),   MCLASS(60),   1360
7   MSTATS(40,90),   NACTVY(90,20),   NCLASS(20,6),   1361
8   NCODE(20),   NEXTLO(20),   NEXTUN(20),   NOILRS(40),   1362
9   NWAY(40),   OILNSF(40),   OILJP5(40),   QTY(20,6),   1363
COMMON                                     1364
1   PRCNTJ(20),   PRCNTN(20),   RATE1R(20),   RATE2B(20),   1365
2   RATE2T(20),   RATE1S(20),   RATE2S(20),   RATE1T(20),   1366
3   RATE1U(20),   RATE2U(20),   SJP5(60),   1367
4   SNSFO(60),   TJPS(60),   TNSFO(60),   UJP5(60),   1368
5   UNSFO(60),   VELMAX(40),   PJP5(60),   XNEEDS(40),   1369
6   PNSFO(60),   ZJPS(20),   ZNETN(40),   ZNSFO(20) 1370
DIMENSION ARTDEM(20)                       1371
C                                             1372
C ESTABLISH A TOTAL DEMAND CUMULATOR 1373
TOTDEM=0.                                  1374
C                                             1375
C SET AN ARTIFICIAL DAY INDEX EQUAL TO TODAY 1376
KDDAY=NDAY                                 1377
C                                             1378
C FTN STMS 1000 THROUGH 1600 CONSTITUTE LOOP 1. THE PURPOSE OF 1379
C LOOP 1 IS TO DETERMINE HOW MUCH NSFO, IF ANY, IS YET TO BE 1380
C DELIVERED AT THIS LOCATION ON KDDAY. AS WE LEAVE THIS LOOP AND GO 1381
C TO FTN STM 1020, THIS AMOUNT IS CALLED DAYDEM 1382
1000 DAYDEM=0.                              1383
C                                             1384
C ESTABLISH AND INCREMENT A CTG INDEX 1385
NKTG=0                                     1386
1005 NKTG=NKTG+1                            1387
C                                             1388
C WE EXIT FROM LOOP 1 VIA THE NEXT STM AFTER EXAMINING ALL CTG.S 1389
IF (NKTG.EQ.NGROUP+1) GO TO 1020           1390
IF (NACTVY(KDDAY,NKTG).EQ.3) GO TO 1008    1391
GO TO 1005                                  1392
1008 IF (LOCATN(KDDAY,NKTG).EQ.NPLACE) GO TO 1010 1393
ARTDEM(NKTG)=0.                            1394
GO TO 1005                                  1395
1010 IF (KDDAY.EQ.NDAY) GO TO 1011          1396
X=ARTDEM(NKTG)                              1397
GO TO 1016                                  1398
1011 IF (NKTG.LE.KTG) GO TO 1015           1399
X=CTGCP1(NKTG)-BBLSN(NKTG)+RATE1U(NKTG)   1400
GO TO 1016                                  1401
1015 X=0.                                    1402
1016 ARTDEM(NKTG)=0.                        1403
1012 DAYDEM=DAYDEM+X
1600 GO TO 1005

```


C		1460
C	THE NEXT STATEMENT SERVES TO RETURN THE OILER TO BASE FOR A REFILL.	1461
C	IT TRIGGERS CALL FILLAO IN THE MAIN ROUTINE.	1462
	1608 CHECK=0.	1463
	1609 GO TO 1099	1464
C		1465
C	FTN STMS 1601 THROUGH 1602 CONSTITUTE THE PRIMARY ANALYSIS. IT IS	1466
C	THE HEART OF THE RULE 2 EVALUATION. WHEN WE LOOK AT UNREPS	1467
C	SCHEDULED ONE OR MORE DAYS INTO THE FUTURE (BEYOND NDAY), THIS	1468
C	ANALYSIS RETURNS OR RETAINS THE AO ON THE BASIS OF WHICH COURSE	1469
C	YIELDS THE HIGHEST PRODUCTIVITY, MEASURED IN ESTIMATED BARRELS OF	1470
C	NSFO DELIVERED PER DAY.	1471
	1601 IF (KDDAY.GE.NDAY+2) GO TO 5050	1472
	FUN=NWAY(L)	1473
	CYCLE=(2.*FUN)+TBASE	1474
	NCYCLE=CYCLE+.5	1475
	5050 IF (KDDAY-NDAY.LE.NCYCLE) GO TO 1025	1476
	1024 CHECK=0.	1477
	GO TO 1099	1478
	1025 TOTDEM=TOTDEM+DAYDEM	1479
	IF (BOARDN(L,NDAY).LE.TOTDEM) GO TO 1027	1480
	A=TOTDEM	1481
	GO TO 1028	1482
	1027 A=BOARDN(L,NDAY)	1483
	1028 H=KDDAY-NDAY	1484
	C=ZNETN(L)	1485
	D=NCYCLE	1486
	IF (TOTDEM.EQ.0.) GO TO 1023	1487
	D=D+((C*B)/(1.3*TOTDEM))	1488
	1023 IF (A/B.GT.C/D) GO TO 1091	1489
	KDDAY=KDDAY+1	1490
	IF (MDDAY.EQ.91) GO TO 1026	1491
	GO TO 1030	1492
	1026 IF (TOTDEM.LE.0.) GO TO 1024	1493
	1602 GO TO 1091	1494
C		1495
C	FTN STMS 1030 THRU 1603 CONSTITUTE LOOP 4. THE FUNCTION OF THIS	1496
C	LOOP IS TO UPDATE THE RUNNING POTENTIAL DEMAND MATRIX,	1497
C	ARTDEM (NDEXTG), FOR EACH TASK GROUP. THE POTENTIAL DEMANDS ARE	1498
C	INCREASED ON KDDAY BY THE CTG.'S RESPECTIVE CONSUMPTION RATES FOR	1499
C	THAT DAY.	1500
	1030 NDEXTG=0	1501
	1035 NDEXTG=NDEXTG+1	1502
	IF (NDEXTG.EQ.NGROUP+1) GO TO 1000	1503
	IF (NACTVY(KDDAY,NDEXTG).EQ.1) GO TO 1037	1504
	IF (NACTVY(KDDAY,NDEXTG).EQ.2) GO TO 1039	1505
	IF (NACTVY(KDDAY,NDEXTG).EQ.3) GO TO 1041	1506
	IF (NACTVY(KDDAY,NDEXTG).EQ.4) GO TO 1043	1507
	GO TO 1045	1508
	1037 CONSMN=RATE1S(NDEXTG)	1509
	GO TO 1046	1510
	1039 CONSMN=RATE1B(NDEXTG)	1511
	GO TO 1046	1512
	1041 CONSMN=RATE1U(NDEXTG)	1513
	GO TO 1046	1514
	1043 CONSMN=RATE1T(NDEXTG)	1515
	GO TO 1046	1516
	1045 CONSMN=0.	1517
	1046 ARTDEM(NDEXTG)=ARTDEM(NDEXTG)+CONSMN	1518
	1603 GO TO 1035	1519

C		1520
C	FTN STMS 1604 THROUGH 1605 CONSTITUTE LOOP 2. THE FUNCTION OF THIS	1521
C	LOOP IS TO ESTABLISH THE POTENTIAL DEMAND MATRIX, ARTDEM (NDEXTG),	1522
C	AND TO BEGIN THE INITIALIZATION OF THIS MATRIX BY ADDING TO IT THE	1523
C	CONSUMPTIONS ON NDAY OF EACH CTG NOT YET EXAMINED BY THE MAIN	1524
C	ROUTINE.	1525
1604	KDDAY=KDDAY+1	1526
	IF (KDDAY.EQ.91) GO TO 1026	1527
	DO 3005 K=1,NGROUP	1528
3005	ARTDEM(K)=0.	1529
	NDEXTG=KTG+1	1530
3008	IF (NDEXTG.GT.NGROUP) GO TO 3050	1531
	IF (NACTVY(NDAY,NDEXTG).EQ.1) GO TO 3010	1532
	IF (NACTVY(NDAY,NDEXTG).EQ.2) GO TO 3015	1533
	IF (NACTVY(NDAY,NDEXTG).EQ.3) GO TO 3020	1534
	IF (NACTVY(NDAY,NDEXTG).EQ.4) GO TO 3025	1535
	GO TO 3030	1536
3010	CONSUM=RATE1S(NDEXTG)	1537
	GO TO 3031	1538
3015	CONSUM=RATE1B(NDEXTG)	1539
	GO TO 3031	1540
3020	CONSUM=RATE1U(NDEXTG)	1541
	GO TO 3031	1542
3025	CONSUM=RATE1T(NDEXTG)	1543
	GO TO 3031	1544
3030	CONSUM=0.	1545
3031	ARTDEM(NDEXTG)=CONSUM	1546
	NDEXTG=NDEXTG+1	1547
1605	GO TO 3008	1548
C		1549
C	FTN STMS 3050 THROUGH 1606 CONSTITUTE LOOP 3. THIS LOOP COMPLETES	1550
C	THE INITIALIZATION OF THE POTENTIAL DEMAND MATRIX BY ADDING TO THE	1551
C	RESULTS OF LOOP 2 THE NET UNFILLED DEMANDS THRU NDAY. LOOPS 2 AND 3	1552
C	MAY BE USED AT MOST ONCE PER PASS THROUGH THE SUBROUTINE. THEIR	1553
C	FUNCTION IS TO SET UP ARTDEM FOR (A) AUGMENTING (BY LOOP 4),	1554
C	(B) USE (BY LOOP 1), AND (C) EVALUATION (BY PRIMARY ANALYSIS) AS	1555
C	KDDAY, THE ARTIFICIAL DAY INDEX, IS INCREMENTED ONE DAY AT A TIME	1556
C	TO SIMULATE PROGRESSIVELY LONGER LOOKS INTO THE FUTURE BEYOND NDAY	1557
3050	NDEXTG=0	1558
3060	NDEXTG=NDEXTG+1	1559
	IF (NDEXTG.EQ.NGROUP+1) GO TO 1030	1560
	DNET=CTGCP1(NDEXTG)-BBLSN(NDEXTG)	1561
	IF (NDEXTG.EQ.KTG) DNET=0.	1562
	ARTDEM(NDEXTG)=ARTDEM(NDEXTG)+DNET	1563
1606	GO TO 3060	1564
1099	RETURN	1565
	END	1566

DOCUMENT CONTROL DATA

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10. ABSTRACT <p>A listing and description of the FORTRAN IV simulation program for resupply at sea. This model was the principal analytical tool used in preparing RM-5155-ISA. Each simulation run accommodates as many as 32 cases wherein the activities of up to 20 carrier task groups (CTGs) are examined for 90 days. The CTGs are resupplied with oil or ammunition by underway replenishment (unrep) ships cycling between base and up to eight unrep locations. The task groups operate according to an input schedule that is always met, and the program determines the number of logistics ships needed to meet requirements. Daily printouts record the location, activity, receipts or issues, and inventory of each task group and each unrep ship, and at the end of the 90-day simulation runs a final summary printout is made. Unlike most computer simulations, this model has no built-in stochastic features; input data decks can be randomized, if desired. The main routine and nine subroutines have extensive internal documentation and commentary.</p>		11. KEY WORDS Computer simulation Navy Ships Logistics Ordnance Fuels Tactical warfare	