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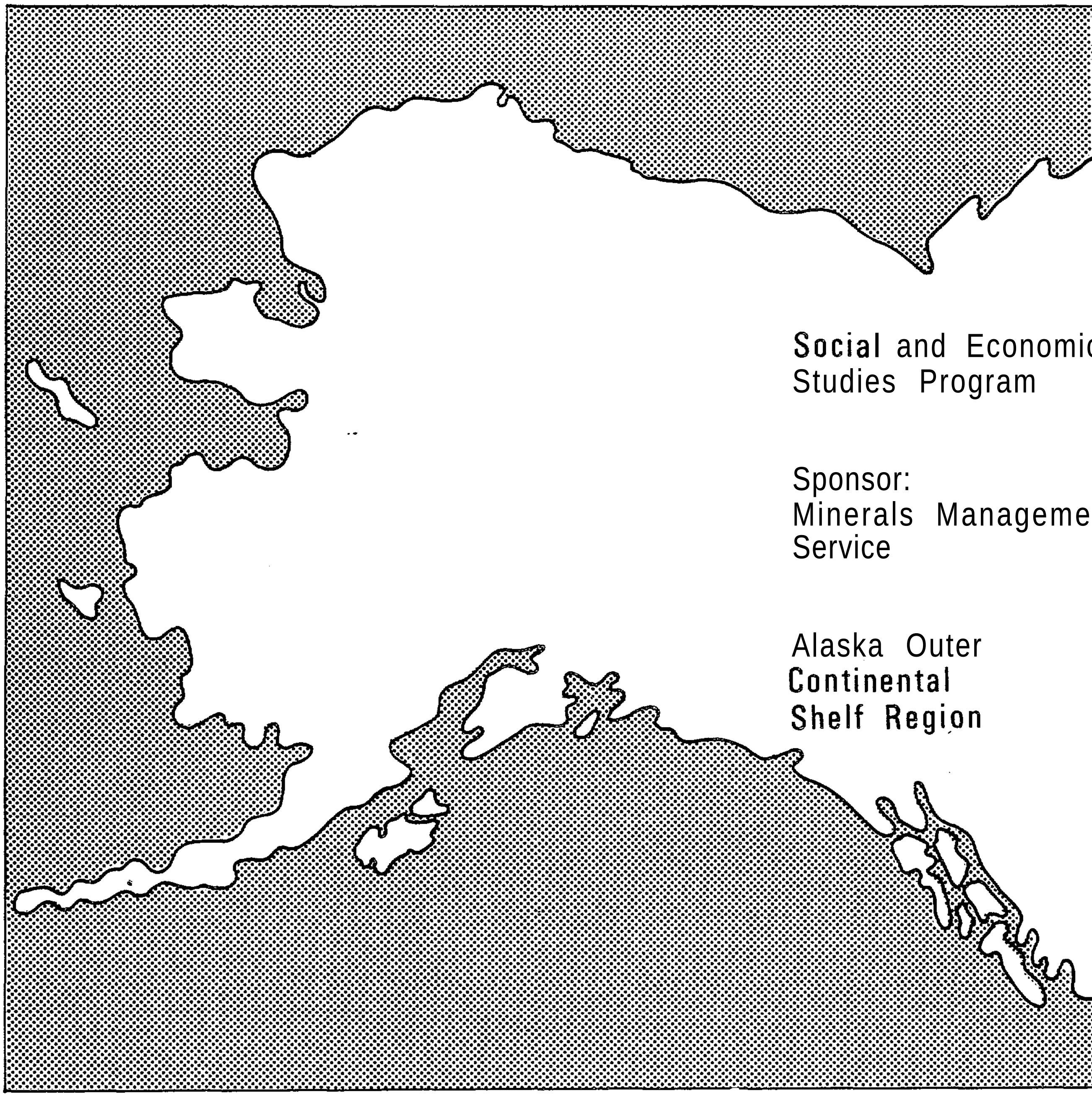

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North Aleutian Basin Transportation Methodology

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SOCIAL AND ECONOMIC STUDIES PROGRAM
ALASKA OCS REGION

NORTH ALEUTIAN BASIN TRANSPORTATION METHODOLOGY

Prepared for

MINERALS MANAGEMENT SERVICE.
ALASKA OUTER CONTINENTAL SHELF REGION
Anchorage, Alaska

Prepared By

ERE SYSTEMS, LTD.
Arlington, Virginia

November 1984

NOTICE

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Social and Economic Studies Program
Alaska OCS Region

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ABSTRACT

NORTH ALEUTIAN BASIN TRANSPORTATION METHODOLOGY

The principal objective of this report is to develop for the Minerals Management Service (MMS), Alaska Outer Continental Shelf (OCS) Region, a methodology to evaluate potential changes in transportation services affected by possible development of the North Aleutian Basin. The need for this methodology is driven by a proposed April 1985 lease sale in this offshore basin. In preparing for this sale, MMS is evaluating the effects of this potential development on social and economic activities in the surrounding area. Due to the remote character of this area, marine and air transportation services are an important economic activity potentially affected by the logistical requirements of the petroleum industry. The methodology consists of a set of forecasting and analysis procedures with associated assumptions bout expected future events or activities, plus recommended standards for certain predetermined conditions.

The methodology seeks to define and evaluate, for each transportation mode, the incremental difference between conditions likely to occur without the North Aleutian lease sale and conditions likely to occur with the lease sale. The differences between these two sets of conditions for some horizon year are presumed to be indicators of the affects of the lease offering. In an application of this methodology, these indicators are further evaluated to determine the nature of expected changes.

In developing each set of conditions, the methodology seeks to establish a basis for economic change in the Aleutian Islands. Although the

economy is evaluated in detail by other contractors, several assumptions are made about future economic development in the Aleutians, including expected petroleum development activities. The resultant economic description provides the basis for procedures to forecast and evaluate future transportation demands. In subsequent steps, explained in detail in the text, these demands are converted to operational characteristics (aircraft or marine vessel activities). In the application of this methodology, these operational characteristics would be compared to the operational capacity of existing and future facilities (information developed in previous studies), in order to determine possible deficiencies.

The North Aleutian lease sale presents a unique set of circumstances with regard to this methodology because three other offshore lease sales have been held in the geographically proximate area. The three prior sales were held in the Norton Basin during November 1982; in the St. George Basin during February 1983; and in the Navarin Basin during April 1984. The methodology must consider the influence of these prior sales on future conditions without the North Aleutian sale.

The suggested methodology is largely based on information available through existing secondary and some primary sources. Over time, the sources will grow out of date and be replaced by newer, hopefully better, information. As the quality of the data changes, so to the methodology. The consequence of this relationship is that the methodology may have a time value similar to that of the data supporting it. The time value of this supporting data should be kept in mind when this document is subsequently used.

I

INTRODUCTION

The principal objective of this report is to develop for the Minerals Management Service (MMS) a methodology to forecast and evaluate future changes in marine and air transportation services potentially affected by development of the North Aleutian Basin. The methodology consists of a set of procedures with associated assumptions about expected future events or activities and recommended standards for certain predetermined conditions. The MMS intends to use this methodology to evaluate transportation demands generated from a proposed April 1985 offshore lease offering in the North Aleutian Basin. The methodology is expected to be applied by various MMS staff, whose formal education, for the most part, is in areas other than transportation planning. Thus, a second objective of this report is to make the methodology as clearly understood and widely usable as possible.

It should be noted that certain assumptions used in this document are based on incomplete knowledge of expected economic and petroleum development activities. In the context of the Social and Economic Studies Program, economic data is typically contained in documents produced by other contractors or by MMS itself, while petroleum development data is produced solely by MMS. Certain aspects of the methodology also deal with cumulative conditions imposed by prior lease sales. Information about prior sales is typically stipulated by MMS, either directly or by incorporation of related assumptions and other data in the Man in the Arctic Program (MAP) Econometric Model, run by a Social and Economic Studies Program contractor. At the time this report was prepared, neither the economic data nor proposed petroleum development information was complete. Nonetheless, certain assumptions were made to replace this missing information. As knowledge of these activities improves, the various assumptions need to be reviewed and changed, as necessary.

One final point needs to be made in Introducing this document. The methods suggested and employed herein are for the most part based on information available through existing secondary and some primary sources. Over time, the sources grow out of date and the data are no longer applicable, being replaced by newer, hopefully better, information. As the quality of the data changes, so to the methodology. The consequence of this relationship is that the methodology may have a time value similar to that of the data supporting it. The time value of this supporting data should be kept in mind when this document is subsequently used.

OVERVIEW OF THE METHODOLOGY

The methodology seeks to define and evaluate, for each transportation mode, the incremental difference between conditions likely to occur without the specific lease offering (hereinafter referred to as the Base Case) and conditions likely to occur with the specific lease offering (hereinafter referred to as the OCS Case). Forecast conditions include numerical estimates of transportation demand requirements and supply capacity. The numerical differences between Base Case and OCS Case conditions for some horizon year are presumed to be indicators of the affects of the lease offering. In the application of this methodology, these indicators are further evaluated to determine if the expected change has a positive or negative effect on use of the transportation system by today's societies.

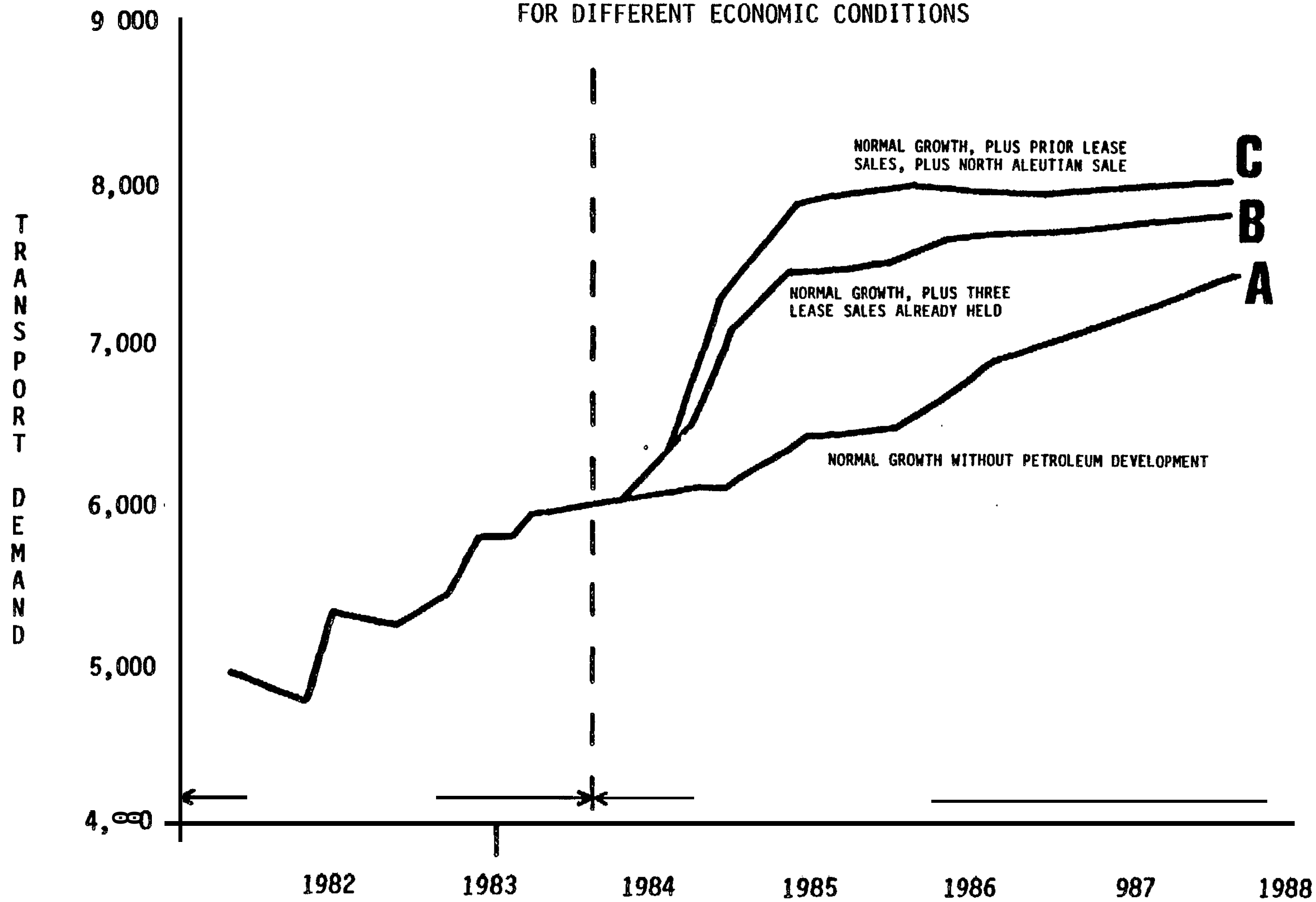
The portion of the methodology presented in this report deals with development of the Base Case and OCS Case conditions and their numerical representation. In developing each case, the methodology seeks to establish a basis for economic change and, from this base, forecast relevant transportation demands. In turn, the transportation demands are converted to operational characteristics (aircraft or marine vessel activities). Transportation capacity and expected changes in transportation supply are assessed separately. Transportation capacity and supply information relevant to the North Aleutian Basin can be found in the following Social and Economic Studies Program reports: Technical Report 52 (Peat, Marwick, Mitchell & Co. and J. Lindsay & Assoc., 1980); Technical Report 58 (Peat., Marwick, Mitchell & Co. and ERE Systems, Ltd., 1981); Technical Report 66 (ERE Systems, Ltd., 1982); and Technical Report 84 (Louis Berger and Associates, Inc., 1983). In the final step, a comparative analysis between demand and supply is made to determine whether 'the existing facilities and services can continue to function at acceptable levels.

The North Aleutian lease offering presents a unique set of circumstances with regard to this methodology because three other offshore lease sales have been held in the geographically proximate area prior to the North Aleutian lease offering. The situation can best be visualized in Figure 1, which shows variations in transportation demand over time for various conditions. The bottom line (curve "A") represents both a historic demand curve and a set of future demand conditions that might exist if there was no OCS development in the region. That is, changes in economic conditions, and therefore, transportation demand, would be due to factors other then oil and gas development. In the Aleutian region, commercial fishing, and particularly fishing for underutilized species, could provide the impetus for such non-OCS economic growth.

The middle curve in Figure 1, curve "B", represents a set of conditions that might exist when economic activities related to the three prior

FIGURE 1

I LUSTRATED VARIATIONS IN TRANSPORTATION DEMANDS
FOR DIFFERENT ECONOMIC CONDITIONS



SOURCE: ERE Systems, Ltd.

lease offerings are added to conditions represented by curve "A". Soon after each lease sale, petroleum development activity begins and the added transportation demands rise and fall in response to these new economic stimulants. The vertical difference between the bottom curve "A" and the middle curve "B" is the increase in transportation demand due to the three lease offerings.

The top curve in Figure 1, curve "C", represents conditions that might exist if, in addition to the three earlier lease offerings, a fourth lease sale was held at a later date. In the context of this analysis, the fourth sale is the North Aleutian Basin. As a result of this additional lease offering, there is an incremental increase in economic activity and, as shown by the vertical difference between the curves "B" and "C", there is also an incremental increase in transportation demand. The methodology described in this document seeks to develop the middle and top forecast curves for each transportation mode in order to measure the incremental change in transportation demand due to only the latest lease offering. By converting the various economic and petroleum development demands into operational characteristics, the effects on cargo handling capabilities, facility capacity, and quality of service can be evaluated.

One of the most important external components to this methodology is the economy and its related demographic characteristics, both of which drive transportation demand. The economy is external to this methodology only because the economic analyses and forecasts are conducted by other contractors. Normally, the economy would be considered an integral part of a transportation demand study. In the context of this methodology, changes to the local and regional economy are of primary interest, since local community and region-serving transportation facilities are most directly affected by OCS activities. To adequately assess the affects of OCS transportation demands, the economic aspects of proposed OCS development must be translated into local and regional economic changes. In developing the OCS Case forecast, these OCS imposed economic changes must be juxtapositioned with economic changes expected to occur normally.

Within the general organization of this report, these economic factors are presented first, to the extent they are known or can be assumed. In succession after the economic discussion are presented each of the other components of. the methodology, organized by transportation mode. Only the marine and aviation transportation systems are addressed since these are the only regional systems in the North Aleutian Basin. The specific formulas used to develop transportation demands and to convert demands to operational requirements are discussed for each mode.

POPULATION. EMPLOYMENT AND THE ECONOMY

Economic conditions are a major factor in determining demand levels for any transportation mode. In air transportation, for example, higher levels of air passenger travel demands can be correlated with a rise in household or personal income. Similarly, when businesses are operating in a rising economic cycle, business travel demands and goods shipments also rise. This section explores development of the economic information that drives changes in transportation demand.

Among a variety of methods, transportation demand can be defined in terms of per capita consumption rates (e.g. air trips or marine tonnage per capita), or in terms of commercial or industrial growth expectations (e.g. a doubling of commercial fishing operations can be assumed to double existing transportation demands, all other factors being equal). In the context of this methodology, the focus of the economic analysis is twofold: 1) to find within historic economic data and historic transportation demand information, the per capita or growth linkages between economic conditions and transportation demand; and 2) to identify forecast population and commercial or industrial growth trends to which the historic per capita or growth relationships can be applied to derive future transportation demand. The historic per capita or growth linkages are typically developed as part of the research related to defining existing transportation facilities and services (see relevant portions of the various Technical Reports cited earlier).

For the purpose of preparing this methodology, it is assumed MMS will be deriving population, employment, and economic data from either local community studies or through the MAP econometric model. This latter model is operated by the University of Alaska, Institute for Social and Economic Research (ISER) . The model can provide forecasts of expected economic conditions in the State as a whole and in its various major subregions, and has the capability to feed economic data to a separate community level model. In conduction with MMS, ISER has developed a detailed set of assumptions about how major economic trends and construction projects of statewide significance (such as oil and gas facilities) will be incorporated into the model. These various . assumptions are incorporated herein by reference (see University of Alaska, Institute for Social and Economic Research, 1981). Researchers using the methodology in this report should check for consistency. between the assumptions made-herein and those employed in producing the latest output from the MAP model.

In the MAP model, two economic scenarios are developed to represent growth in the economy: one scenario excludes activities expected from the proposed lease offering (i.e. conditions without the offering or "base case"); the second includes these activities (i.e. conditions with the offering or "OCS case"). The Base Case economic scenario normally includes all relevant statewide and regional economic changes that are reasonably expected to occur in the future. For example, construction of the Northwest Gas Pipeline or the Susitna Dam. Development of the commercial fishing industry in the southern Bering Sea and the cumulative effects of the three preceding offshore lease offerings are of particular regional interest to the economic Base Case for the North Aleutian Basin lease sale.

COMMERCIAL FISHING

In the past, there has been considerable debate about the magnitude of the fishing activities that might evolve as a result of exploitation of underutilized fish species (groundfish). In prior studies conducted for the State and for the Social and Economic Studies Program, fishing has been identified as the major part of the present and future economy of the region (see Earl R. Combs, Inc, 1981; and Terry, J.M., Stoles, R.G. & Larson, D.M., 1980). One of the major problems in forecasting the Base Case is accurately measuring the expected direction of the groundfishing industry, Previous forecasts have covered a broad range of expectations. Of considerable importance to this methodology are the assumptions about how the fishing industry will attract employment. Specifically, assumptions pertaining to the magnitude of transient fishing industry employment and assumptions about the rate of change from transient to locally based fishing employment can be expected to influence air transportation demands directly and marine transportation demands indirectly.

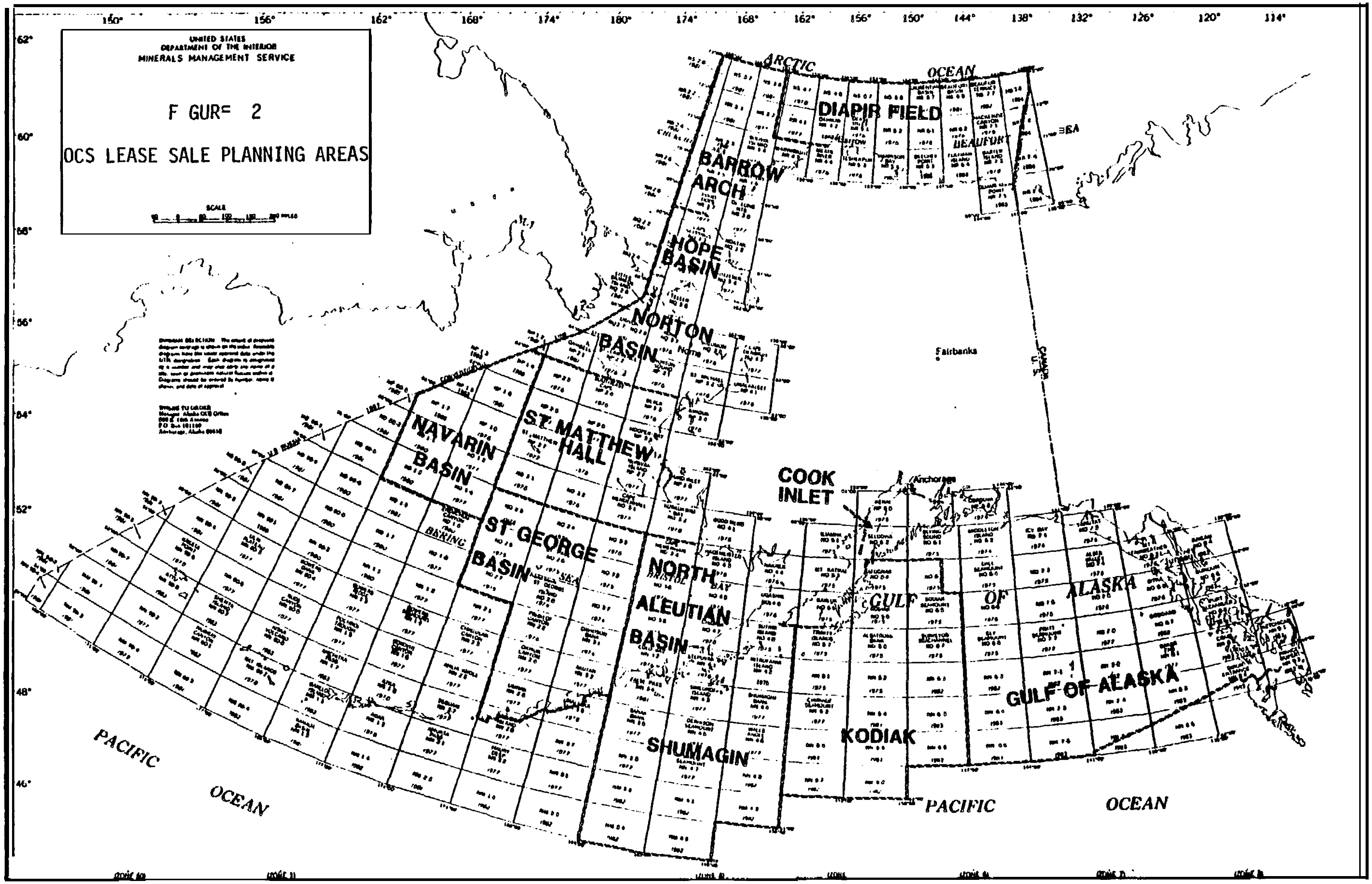
Prior studies have assumed that a large percentage of groundfish industry employment will initially come from other parts of Alaska and from outside Alaska (Terry, J.M., Stoles, R.G., & Larson, D.M., 1980). Presently, most traditional species workers are transient and tend to stay for most of the fishing season. However, the seasons last only several months: Salmon set gillnets - 2 months; Salmon drift gillnets and purse seines - 3 months; and crab - 7 months (Earl R. Combs, Inc, 1981). In contrast, the groundfishing industry has no season, per se. If the groundfish workers are transient, based on some periodic rotation to their normal homes, this implies an increased demand on aviation services. As the industry grows and the workforce transitions to a higher percentage of local employment due to in-migration, workers travel less, but many may bring families, thereby increasing demands on both air and marine transportation services-in a different way.

PETROLEUM DEVELOPMENT - BASE CASE

Another economic issue is the affect of cumulative prior lease offerings. These also have specific relevance to this methodology and are discussed in the following paragraphs. The North Aleutian Lease Sale is the fourth in a succession of four offshore basins offered for lease in the Bering Sea. Within the Base Case economic scenario, the three lease offerings that preceed the North Aleutian offering are assumed to stimulate the population and economy of the region at the same time fishing activities are accelerating. Within the framework of this methodology the assumed cumulative characteristics of these prior OCS offerings become a part of the Base Case transportation demand forecast.

The three prior lease offerings are in the Norton Basin, St. George Basin, and Navarin Basin. See Figure 2 for locations. The Norton Basin lease sale was held during November 1982; the St. George lease sale was held in February 1983; and the Navarin Basin lease sale was held in April 1984. The number of possible combinations of events from these three prior sales is impossible to forecast within the framework of this methodology. Consequently, some surrogate condition(s) must be assumed for each lease area in order to provide a representative interpretation of these events. Assuming a high level of activity for the prior sales would submerge the North Aleutian impacts, while assuming a low level of activitiy would make the North Aleutian events to be of greater significance then may be warranted.

It is assumed that, at a minimum, exploration activities will occur in each of these lease offering areas. Since a marine support base has already been developed at Unalaska/Dutch Harbor (Tremont, J., 1983), it



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OCS LEASE SALE PLANNING AREAS

is assumed this base will be used to directly support the marine transportation demands for the St. George Basin. If a small marine support base is established on St. Matthew Island to serve Navarin Basin exploration, Unalaska/Dutch Harbor will likely serve as the principal staging area (Louis Berger & Associates, Inc., 1983). Existing facilities at Nome are assumed to directly support the marine transportation demands related to the Norton Basin, with some indirect support provided at Unalaska/Dutch Harbor.

With regard to aviation support during exploration activities, the airport at Cold Bay is expected to serve as the principal- staging facility. Although Unalaska/Dutch Harbor provides a better coordinated location, the airport runway has not been lengthened, and may not be without massive state aid (Dames & Moore, 1980b). However, the runway on St. George Island recently has been lengthened by 1,000 feet. (Tremont, J., 1983), and offers alternative or emergency aviation access to the St. George Basin and Navarin Basin offshore areas. A gravel airstrip on St. Matthew Island, which was assumed in conjunction with the support base in the Navarin Basin studies, (see Louis Berger & Associates, Inc., 19839, could provide more direct air support in the Navarin Basin, eliminating the need to use the St. George runway except in emergencies. However, a runway on St. Matthew Island might do considerable environmental damage and, as a result, become such a political or judicial issue that it is never constructed. In summary, exploration related air transportation support to offshore locations in the St. George and Navarin Basins is expected to be centered at Cold Bay, with alternative support to the St. George Basin provided at St. George Island and alternative support to the Navarin Basin provided at St. Matthew Island.

- All exploration related air support to the Norton Basin is expected to be handled through Nome with no secondary support from Aleutian bases.

In Technical Report 80, Dames & Moore assumed it unlikely that three, much less then four, of the basins would reach the development stage (Dames &Moore and Harrison, G. S., 1982). The probability of such development occuring concurrently was considered more remote. However, for purposes of presenting this methodology we have assumed each of these three basins are developed in accordance with the somewhat concurrent schedule suggested in Table 2-1 of Technical Report 80.

One of the primary facilities supporting the transportation of petroleum products from all four lease sale areas is a Very Large Crude Carrier (VLCC) terminal located in the Aleutians and hereinafter referred to as the Aleutian Transshipment Terminal. The general concept is that shuttle tankers or pipelines would bring the crude petroleum products from the lease sale areas to the terminal and VLCC ships would move the products to market (see several versions of this concept: Dames & Moore, 1980a; Dames & Moore and Harrison, G.S., 1982). The location of this terminal has not been determined, although two sites have potential for the harbor, airport, and infrastructure requirements: Unalaska Bay (Unalaska/Dutch Harbor) and Cold Bay/Morzhovoi Bay. Due to poor airport facilities and potential harbor congestion, Unalaska/Dutch Harbor is somewhat less favorable than Cold Bay/Morzhovoi Bay (Dames & Moore and Harrison, G.S., 1982).

During the development stage, it is assumed a small marine support base is developed on St. Matthew Island to serve rigs and platforms in the Navarin Basin (Louis Berger & Associates, Inc., 1983). Primary marine support for this forward base would come from Unalaska/Dutch Harbor, or a new base at Morzhovoi Bay operated in conjunction with the Aleutian Transshipment Terminal. Subsequently, during the production stage, Navarin Basin resources are moved by shuttle tankers operating between a loading terminal on St. Matthew Island and the Aleutian Transshipment Terminal (Dames & Moore and Harrison, G.S., 1982). In the St. George Basin, a pipeline is assumed to bring crude oil products from the lease area to the Aleutian Transshipment Terminal. In the Norton Basin, ice strengthened shuttle tankers operating from offshore loading platforms in Norton Sound are assumed to move products to the Aleutian Transshipment Terminal (Dames & Moore and Harrison, G.S., 1982).

PETROLEUM DEVELOPMENT - OCS CASE

In the OCS Case, as defined earlier, the activities of the North Aleutian Lease Sale are added to those described above for the Base Case. The timing of North Aleutian exploration activities generally coincides with the beginning of the development stage in the Norton Basin, and mid point of exploration in the St. George and Navarin Basins. The scenarios used by Dames & Moore in Technical Report 80 (Dames & Moore and Harrison, G.S., 1982) assume that a petroleum discovery has been made in the St. George and Navarin basins and that continuing exploration activities are focused on delineation of the fields. Before a decision is made to develop either the St. George or Navarin Basins, the scenario for the North Aleutian area assumes a discovery is made there too. Thus, before any major development decisions are made, the knowledge about the likely size of the respective finds is assumed to be known. The approximate timeframe to reach this point is late 1987 or early 1988.

With respect to marine support operations, one of the more difficult questions is likely to be the continued use of Unalaska/Dutch Harbor as the principal marine support base. In the Navarin Basin analysis, the combination of the Navarin and St. George development activities at Unalaska/Dutch Harbor were forecast to most likely exceed the present capacity of the port by 1992 (Louis Berger & Associates, Inc., 1983).

Due to fluctuating OCS demands, this condition would last only about three or four years but resurface by 2000. Improved operational procedures with regard to the handling of refined petroleum products would improve the situation, but may not be feasible without cooperation from the various dock owners. The possible addition of North Aleutian exploration activities in 1986 raises cargo throughput levels, but is not expected to seriously effect port capacity. However, the addition of North Aleutian development activities, even with the operational improvements, may or may not exceed capacity.

For purposes of begining the analysis, it will be assumed that North Aleutian marine activities during the exploration stage are located at Unalaska/Dutch Harbor. During the development stage, however, marine activities are shifted to a location nearby the Aleutian Transshipment Terminal. This support base is assumed to be supplied directly from the Lower 48, as well as through Unalaska/Dutch Harbor. The base also is assumed to serve as an auxillary base for the St. George Basin when operations at Unalaska/Dutch Harbor can no longer be efficiently conducted - specifically, between 1992 and 1995, and after 2000 (Louis Berger and Associates, Inc., 1983). In the application of this methodology, this hypothesis and its timing must be examined through sensitivity testing, particularly in light of the assumtion that all four lease areas will be developed. Subsequent applications of the methodology might well begin with different assumptions regarding other lease sales activities vis-a-vis North Aleutian activities.

No major improvements to existing aviation facilities are assumed - specifically at Unalaska/Dutch Harbor. Consequently, aviation support to the St. George and Navarin Basins is assumed to follow the same pattern as described earlier with primary staging occuring at Cold Bay. The new support base at Morzhovoi Bay (Aleutian Transshipment Terminal) will require a new airfield. Primary staging, however, is assumed to continue at Cold Bay.

Assumptions associated with the fishing issue and those related to prior lease offerings are economic factors and, as such, constitute inputs to ISER's MAP Model. For this reason they fall outside this methodology. However, the assumptions made for the MAP Model also become important inputs to this methodology, as noted in the discussion above. Other important outputs of the MAP modeling effort are the various population forecasts produced by the model itself. Of particular interest in this transportation study are forecasts for the Municipality of Anchorage, the Wade Hampton Census Division, and Census Divisions encompassing the following areas or regional centers: Aleutian Islands, North Slope Borough, Bethel, and Nome. The specific use of these various forecasts is explained further in later sections of this methodology. It is assumed that ISER, through its use of the MAP model, will develop Base Case and OCS Case population forecasts for these Census Areas. In the absence of regional population data from the MAP model, some proportional adjustment can be made to available 1980 Census data, or future population estimates can be extrapolated from historic trends and net natural increase (birth/death) statistics. Such information is available from the Alaska Department of Health and Social Services, Bureau of Vital Records.

II

MARINE TRANSPORTATION

This chapter presents the individual factors needed to define the marine transportation portion of the Base and OCS Cases, which were described generally in Chapter I, and illustrated earlier by curves "B" and "C" in Figure 1. With respect to the Base Case, marine transportation demands include those of the present economy, as extended into the future, plus those generated by OCS development in the Norton, Navarin, and St. George lease sales areas. OCS Case transportation demands add those generated by OCS development in the North Aleutian sale area.

In the Bering Sea region, marine transportation currently serves as the primary distribution system for consumer goods and industrial equipment, as well as a market oriented transportation system for the fishing industry. The marine transportation system is expected to continue to serve such demands throughout the forecast period. With the advent of OCS development, marine transportation services expand adding the movement of OCS related supplies and equipment into and within the various lease areas, and, if recoverable oil and/or gas resources are found, also adding the movement of crude products to market.

Since the methodology is to be applied by persons who are without formal training in transportation planning, the approach has been simplified. With respect to marine transportation, a basic premise of the methodology is that two factors can be used to measure impacts at a particular port: 1) the ratio between local tonnage demand and port tonnage handling capacity; and 2) local vessel activity, The changes in the tonnage demand/capacity ratio are used to evaluate cargo handling facilities and services, while changes in vessel activity are used to evaluate the adequacy of berthing space and port traffic problems. Together, both factors contribute to an evaluation of a port's capability to handle future marine transportation demands.

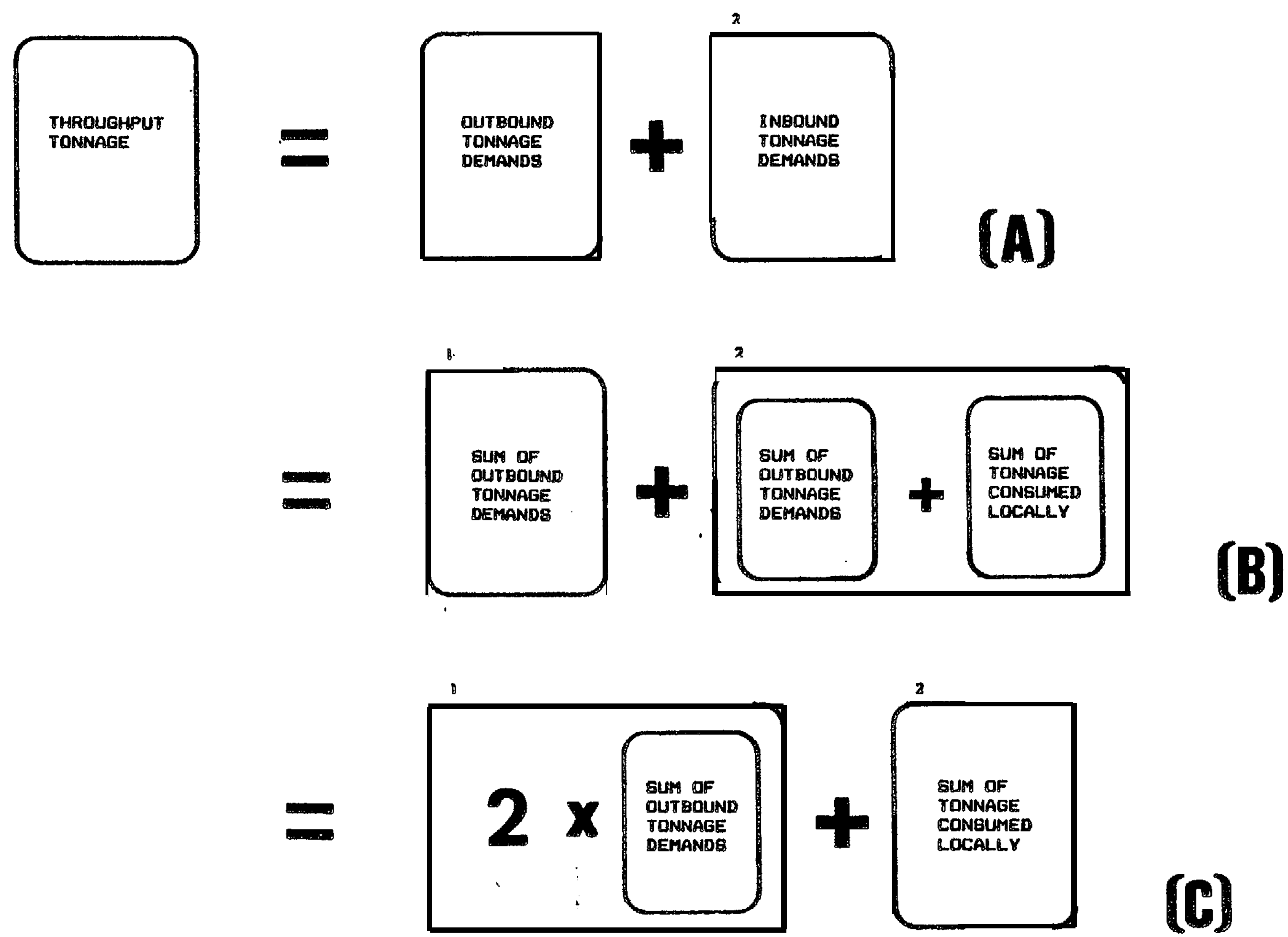
Estimates of existing handling capacity for ports in the Aleutian region have been made in prior Social and Economic Studies Program reports (see Technical Report 52 - Peat, Marwick, Mitchell & Co. and J. Lindsay & Assoc. , 1980; Technical Report. 58 - Peat, Marwick, Mitchell & Co. and ERE Systems, Ltd., 1981; Technical Report 66 - ERE Systems, Ltd., 1982; and Technical Report 84 - Louis Berger and Assoc., 1983) and other documents (see Alaska Consultants, Inc. and PRC-Harris, Inc., 1981). Consequently, the focus of this discussion is on calculating the numerator portion of the demand/capacity ratio and determining the number of vessel trips with and without the proposed North Aleutian lease offering. In the discussion that follows, the determination of tonnage demands and vessel trips are presented in separate sections and each port is treated individually. Since OCS activities can be expected to be focused at one or several ports, the methodology addresses the key ports of Unalaska/Dutch Harbor, Cold Bay, St. George Island, and St. Matthew Island. This information is organized so that the Base Case and OCS Case formulas are separately developed.

Marine Tonnage Demands

Marine tonnage demand is typically measured as "Throughput Tonnage", which is defined as the sum of all cargo movements into and out of a port.. A representation of this definition of throughput tonnage is illustrated in version [Al of the general formula in Figure 3. For accounting purposes, inbound and outbound tonnage demands can be divided into any number of categories, the number depending on the functions of the port or the kinds of cargo moved through the port. For example, Unalaska/Dutch Harbor is a major transshipment port for petroleum products, producing high liquid bulk volumes both inbound and outbound; while Cold Bay, which receives large quantities of various aviation fuels due to the community's aviation function, produces only high inbound liquid bulk volumes. The ability to represent various categories in the formulas, however, is more likely to be based on the ability to identify relevant data for each type cargo movement. It is assumed, for the categories discussed in this analysis that detailed data about historic tonnage movements can be obtained from the publication, "Waterborne Commerce of the United States" (see U.S. Army,

FIGURE 3

GENERAL ORMU FOR THROUGHPUT MARINE TONNAGE



SOURCE: ERE SYSTEMS, LTD.

Corps of Engineers, annual).

In communities such as Unalaska/Dutch Harbor or Nome, significant volume of cargo to surrounding regional villages, version [A] of the general formula in Figure 3 must be modified. In a transshipment port, inbound tonnage must be calculated from separate estimates of outbound transshipped tonnage and inbound tonnage destined only for the port itself but not transshipped (referred to as "locally consumed"). This allows separate assessments of the economic factors that influence the transshipment service area and those that influence the port community itself. Substituting this relationship for inbound tonnage in version [A] of the formula in Figure 3, produces version [B], and after transposing terms gives the relationship in version [C].

BASE CASE

The Base Case tonnage forecast provides the basis for subsequent comparative analysis. A Base Case forecast must be prepared for each of the principal ports likely to be affected by an increase in OCS development activities. In the Aleutian region, the ports that must be included are: Unalaska/Dutch Harbor, Cold Bay, St. George Island, and St. Matthew Island. The circumstances at each port and the appropriate formula for determining tonnage demands are discussed in the following subsections.

Unalaska/Dutch Harbor

Generally, Unalaska/Dutch Harbor is expected to continue its principal transshipment function. Thus the port is expected to continue to handle all petroleum products redistributed to western and northwestern Alaska, as well as southwest Alaska, whether for OCS or non-OCS development purposes. The port is also expected to be the major collection point in southwest Alaska for the shipment of fish products to foreign and Lower 48 ports.

The general formula for throughput tonnage at Unalaska/Dutch Harbor is given in Figure 3, formula version [C], presented earlier. Due to the complexity of functions and activities at Unalaska/Dutch Harbor, those portions of the formula pertaining to outbound and inbound tonnage demands must be greatly expanded and, in this analysts, separate formulas are used to represent each. These separate formulas are simply expanded subsets of the general formula in Figure 3 and may be ' substituted in that formula.

Outbound Tonnage. Several versions of the formula for Base Case outbound marine tonnage at Unalaska/Dutch Harbor are given in Figure 4. Version [A] shows in a simple fashion the three principal components: outbound tonnage attributable to demands made by villages in the transshipment service area; outbound tonnage generated locally (primarily fish products); and outbound tonnage generated by offshore

FIGURE 4

FORMULA FOR BASE CASE OUTBOUND MARINE TONNAGE
AT UNALASKA/DUTCH HARBOR

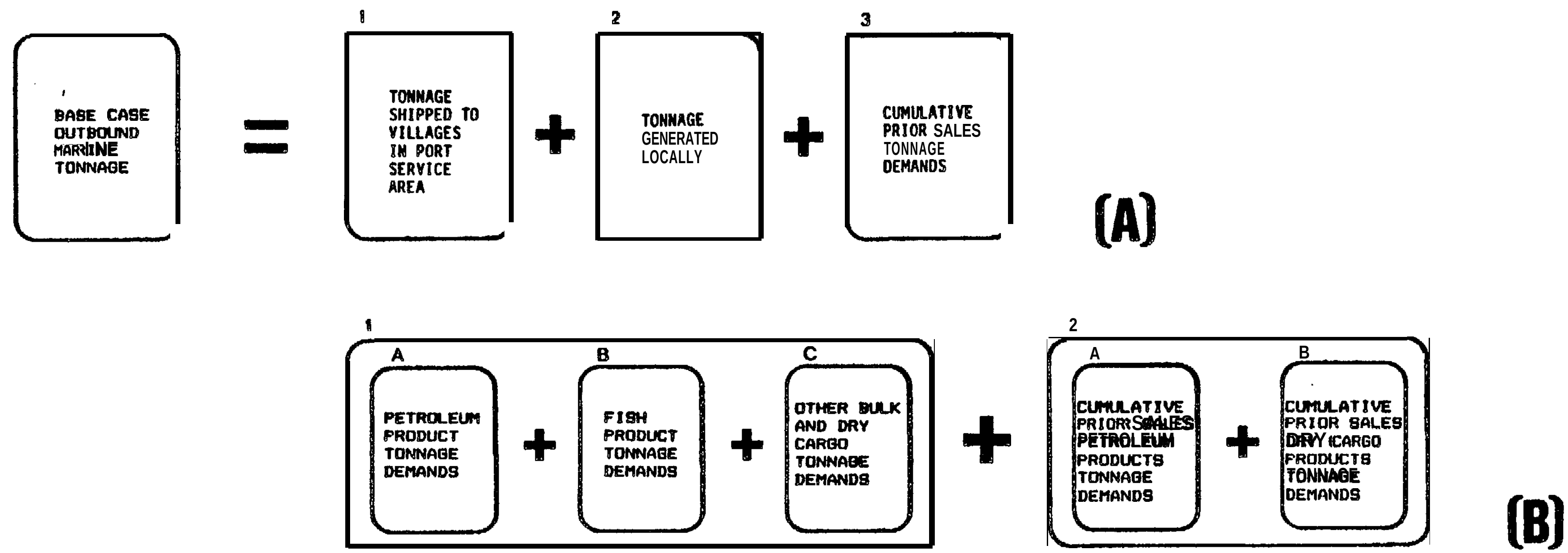
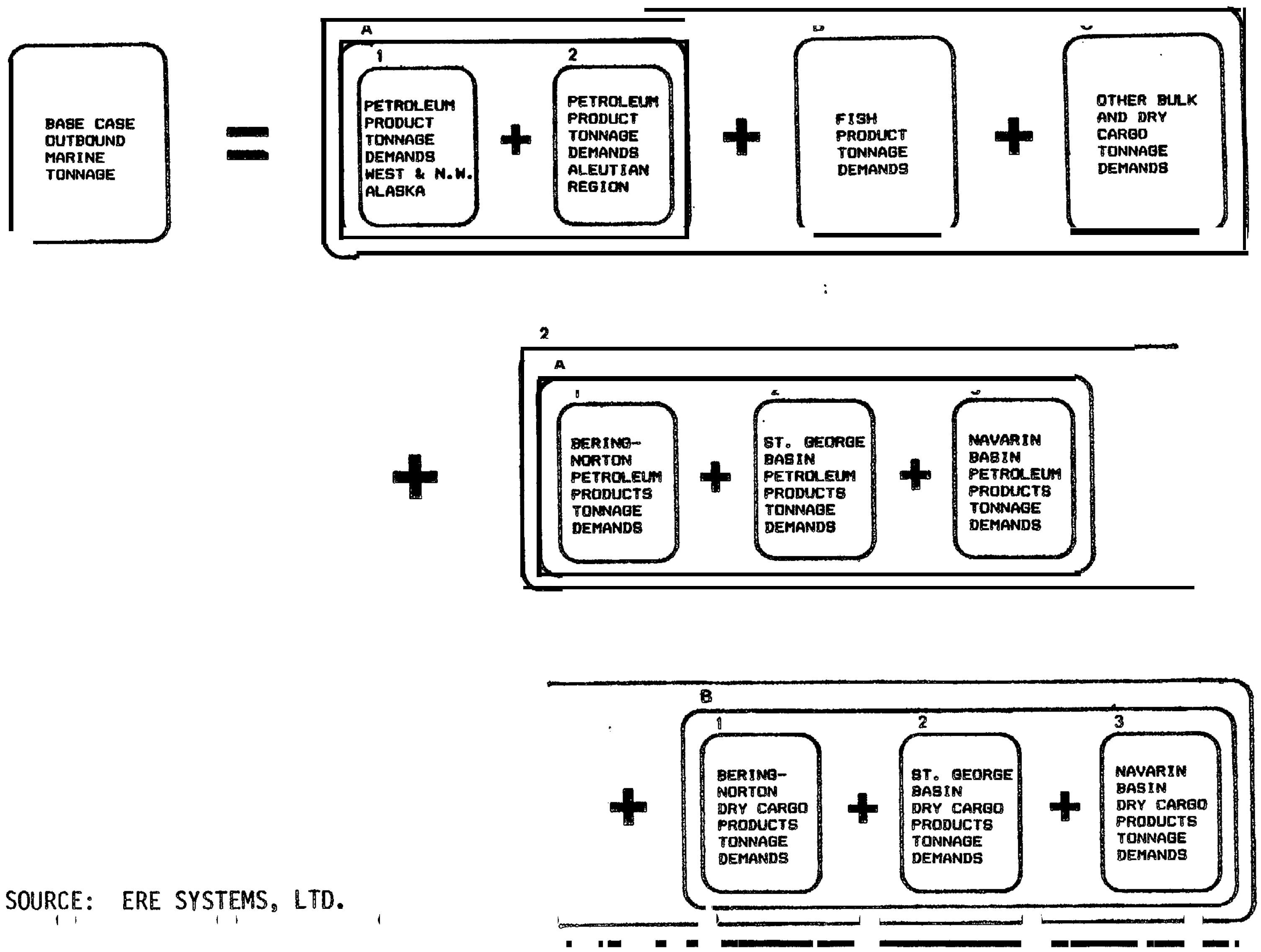


FIGURE 4 (Continued)

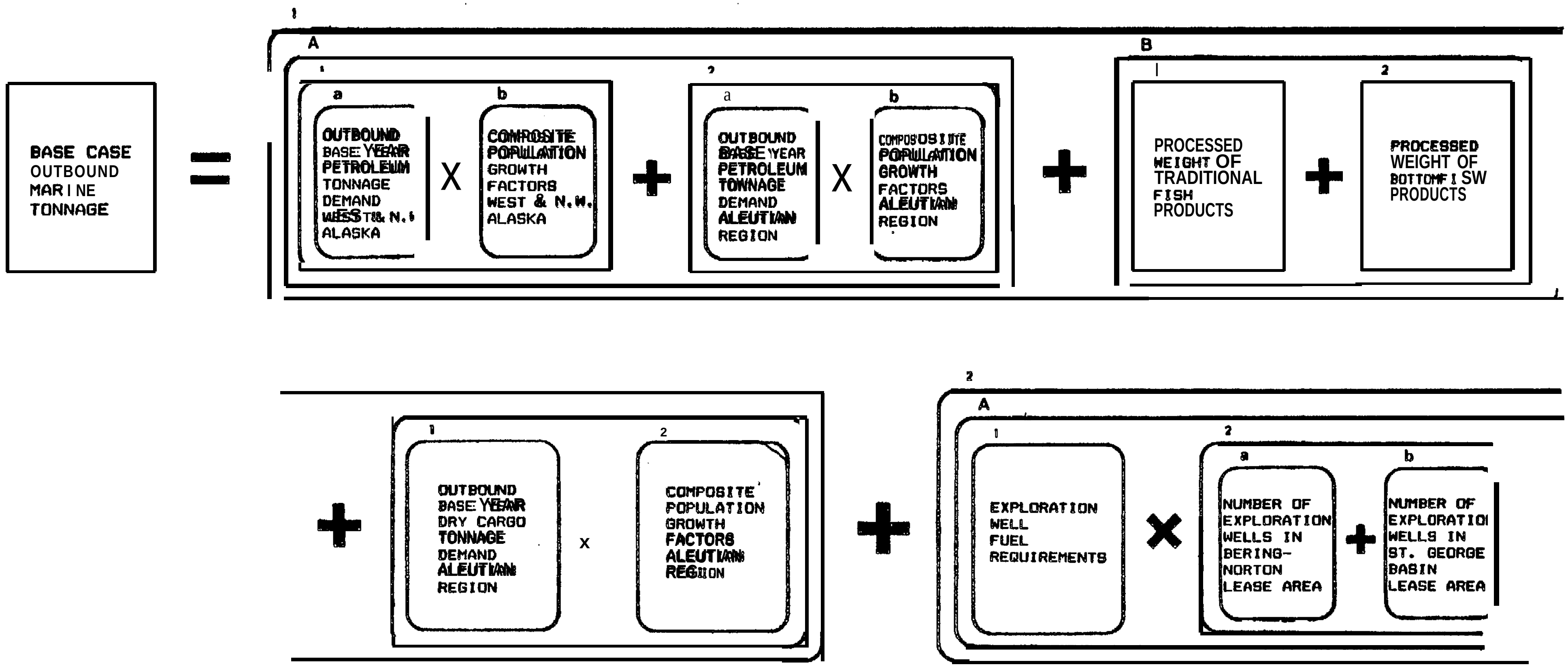
FORMULA FOR BASE CASE OUTBOUND MARINE ONNAGE
AT UNALASKA/DUTCH HARBOR



SOURCE: ERE SYSTEMS, LTD.

FIGURE 4 (Continued)

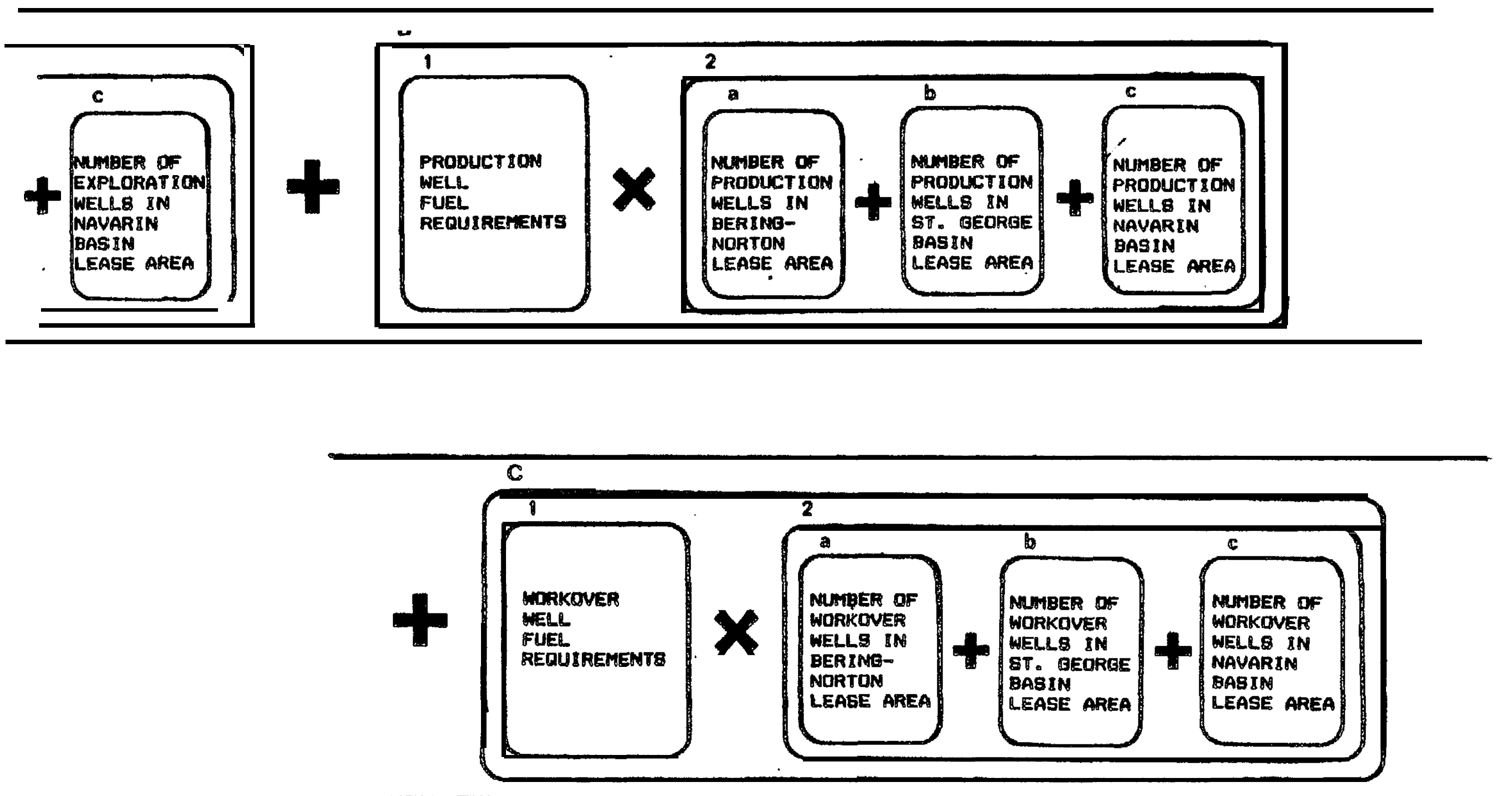
FORMULA FOR BASE CASE OUTBOUND MARINE TONNAGE
AT UNALASKA/DUTCH HARBOR



VERSION "D"

FIGURE 4 (Continued)

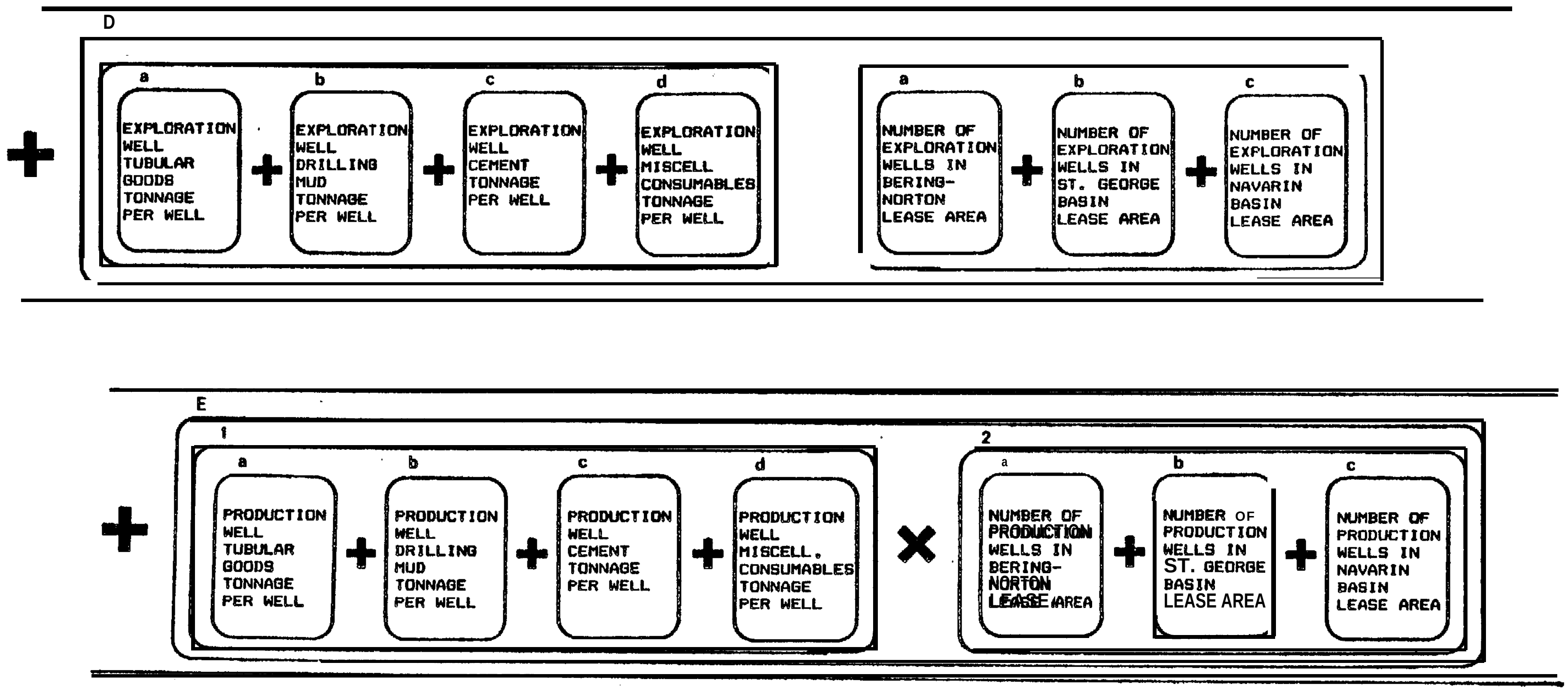
FORMULA FOR BASE CASE OUTBOUND MARINE TONNAGE
AT UNALASKA/DUTCH HARBOR



VERSION "D"

FIGURE 4 (Continued)

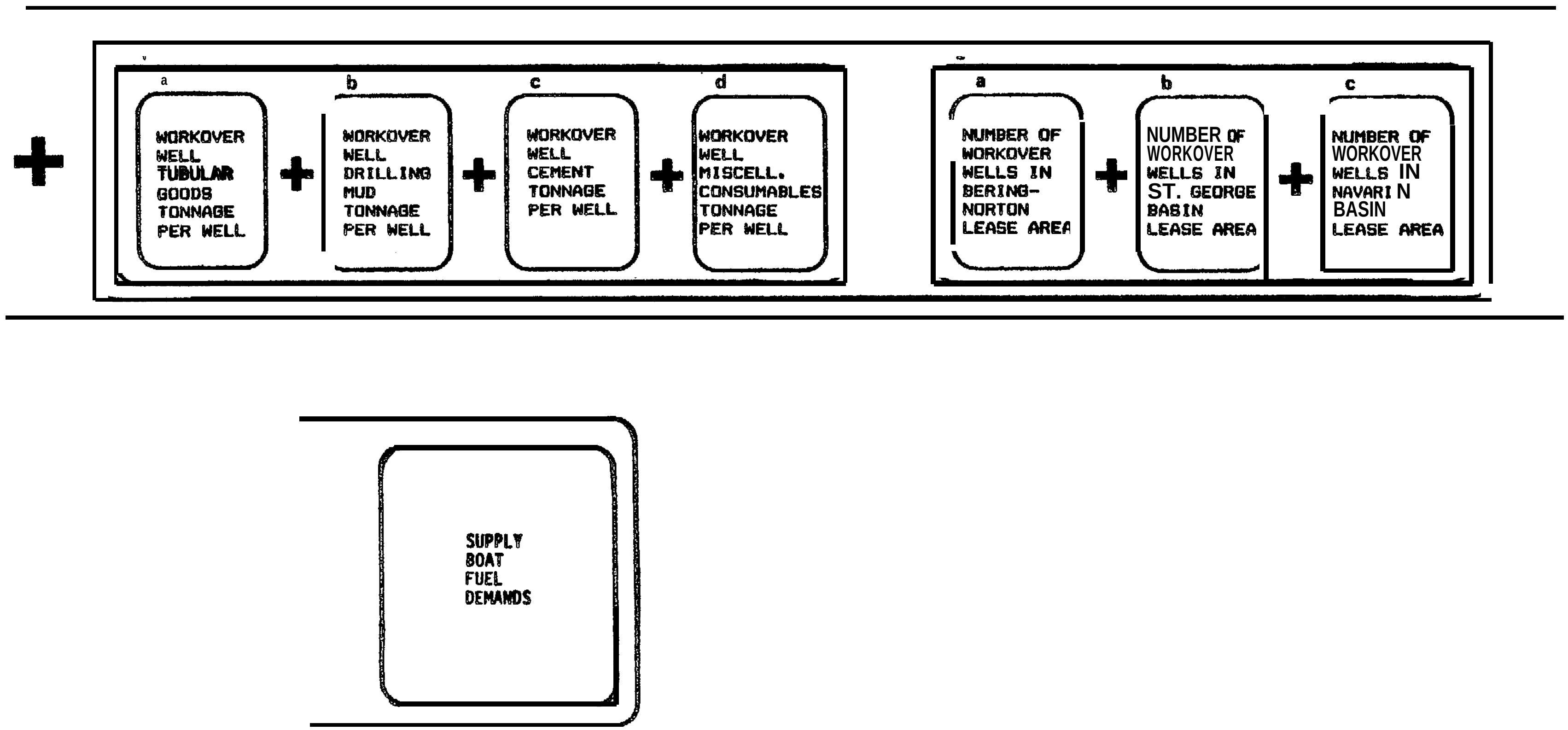
FORMULA FOR BASE CASE OUTBOUND MARINE TONNAGE
AT UNALASKA/DUTCH HARBOR



VERSION "I)"

FIGURE 4 (Continued)

FORMULA FOR BASE CASE OUTBOUND MARINE TONNAGE
AT UNALASKA/DUTCH HARBOR



VERSION "D"

oil and gas development activities in the Norton, Navarin, and St. George Basin lease areas. Version [B], Figure 4, redefines [A] in terms of cargo categories and version [C] expands [B] to reflect geographical considerations. In version [B], the cargo categories reflect the major cargo handling categories at Unalaska/Dutch Harbor.

The principal non-OCS related outbound products are petroleum and fish. Petroleum products are distributed to other transshipment ports throughout western and northwestern Alaska or to smaller villages in the Aleutians, as shown in the first component of version [C], Figure 4. Fish products are distributed to Lower 48 and Far Eastern foreign ports with no geographical differentiation in the formula. The remaining elements in the first component of version [B] collects non-OCS related dry cargo and any other non-OCS related bulk products into a single category.

With respect to OCS related outbound tonnage, differentiation is made with respect to petroleum or non-petroleum products in formula version [B], and these are expanded further by lease offering area in version [C].

The final transformation of this outbound tonnage formula is given in version [D], Figure 4. The individual components are more fully explained in the following paragraphs. For reference purposes, each component in Figure 4 is identified by a corresponding number in the following text.

Local Economy. Outbound tonnage from the local economy is represented in Figure 4 by components beginning with the number "1". The factors in Group 1 represent outbound tonnage demands generated in the various regional areas served through Unalaska/Dutch Harbor. Group 1 also includes factors that reflect regional export of commercial fishing products. Group 2, represented in Figure 4 by components beginning with the number "2", deals with the-demands of the petroleum industry in the Norton, Navarin, and St. George lease areas. The characteristics of Group 2 are discussed later.

1.A.1.a. Base year outbound tonnage demand for western and northwestern Alaska areas serviced through Unalaska/Dutch Harbor is determined from an analysis of historic tonnage demand data. Historic outbound tonnage data for Unalaska/Dutch Harbor must be collected in a way that allows the researcher to separate outbound tonnage delivered to western and northwestern ports and to all other ports. From a time series of such data it is possible to determine the current trends in tonnage growth using regression analysis. If sufficient historic data is available to give acceptable statistical tests, and the forecast economics do not indicate rapid or widely fluctuating growth, the resulting regression equation could be used to generate the factor 1.A.1 without separately developing the "a" and "b" subfactors.

In the absence of acceptable statistical results, the regression equation could be used to bring the historic data forward to the base year selected for starting the analysis. This is necessary because Corps of Engineer data (see U.S. Army Corps of Engineers, annual) typically lags the current date by two to three years. Then, the growth factor technique (see below) or some other approach could be used to generate the forecast.

1.A.1.b. The population in western and northwestern Alaskan areas served through Unalaska/Dutch Harbor is some fraction of the cumulative populations of the North Slope Borough, Nome, Wade Hampton, and Bethel census areas. In Technical Report 58 (Peat, Marwick, Mitchell & Co. and ERE Systems, Ltd., 1981), it was assumed that 80 percent of the cumulative population of these census areas was served through Unalaska/Dutch Harbor. These population data are presumed to be determined as part of the MAP Model output. Growth factors for this composite population are developed by dividing a given horizon year population by the base year population. The base year tonnage demand is multiplied by the growth factor for each year to estimate tonnage demand for that year.

The inherent assumption in this approach is that increases in transportation demand are proportional to population. However, the researcher may want to consider an additional factor which reflects that rising income levels (if applicable) are likely to produce slight increases in per capita tonnage demand. This entails adding a multiplier reflecting the expected average annual increase due to income or some other related characteristic. This element would be referenced as 1.A.1.c., but is not illustrated in Figure 4.

1.A.2.a. This factor is similar to that developed for 1.A.1.a. except this reflects trends in the southwest regional area serviced through Unalaska/Dutch Harbor. Historic outbound tonnage to this southwest region is evaluated using regression analysis and a base year tonnage estimate can be established as described in 1.A.1.a. above.

1.A.2.b. The population in the southwest service area is presumed to be determined separately from this analysis. The southwest service area encompasses the Bristol Bay Borough, Dillingham, and Aleutian census areas. Growth factors are developed as described above in 1.A.1.b.. As mentioned above, a third factor reflecting income or other related characteristic could be included.

1.B.1. Fishing products are a major outbound commodity at Unalaska/Dutch Harbor. Although tonnage estimates could presumedly be developed for each fish species, in this analysis fish products tonnage is consolidated into traditional and underutilized species (groundfish). Component 1.B.1. treat% the traditional fish products. Since the State of Alaska and several federal agencies have an interest in fish economics, it is assumed that estimates of future fish volumes will be generated outside the framework of this analysis. Depending on the source, these future estimates may have to be converted from round weight to processed weight.

1.B.2. This category treats the underutilized fish species, exclusively. The groundfish segment is currently considered the fastest growing sector of the commercial fishing industry in this region of Alaska. Various fishing activity forecasts prepared by others have demonstrated a broad diversity of opinion regarding future growth potential for this segment of the industry. For this analysis, it is assumed one of the analyses done by others will be selected and used to derive annual levels of processed groundfish products (see Earl R. Combs, Inc., 1981) .

the fuel requirement for a 15,000 foot exploration well. For this analysis, a 3050 meter (10,000 foot) well depth is assumed for each of the three prior lease sales (Dames & Moore and Harrison, G.S., 1982). The figures in Table 1 must be proportionally adjusted to reflect the lessor depth. The resultant fuel requirement per well is multiplied by the total number of exploration wells operating in the three lease offering areas each year.

2.A.2.a., b., and c. The annual number of exploration wells in the Norton, Navarin, and St. George Basins are determined by MMS independent of this effort. It should be noted that the formula in Figure 4 assumes all of the well supplies move through Unalaska/Dutch Harbor. If this is contrary to the final set of assumptions for the combined lease offerings, appropriate adjustments must be made.

2.B.1. The fuel requirement for production wells is also shown in Table 1. This figure must be proportionally adjusted to correspond to the assumed 10,000 foot well depth.

2.B.2.a., b., and c. The annual number of production wells in the Norton, Navarin, and St. George Basins is determined by MMS independent of this effort.

<u>2.C.1.</u> The fuel requirement for workover wells is given in Table 1. This figure must be proportionally adjusted to correspond to the assumed 10,000 foot well depth.

<u>2.C.2.a., b., and c.</u> The number of workover wells in the Norton, Navarin, and St. George Basins is determined by MMS independent of this effort.

<u>2.D.1.a.</u> Dry cargo requirements for an exploration well can also be found in Table 1. These requirements combine the tubular goods, drilling mud, cement, and miscellaneous consumables. Component 2.D.1.a. is for tubular goods. The figures in the table must be proportionally adjusted to the assumed well depth.

<u>2.D.1.b.</u> Drilling mud can be reused from well to well. The figures in Table 1 are based on an assumption that the mud is used in up to four wells. After the depth adjustment has been applied, the resultant figure must be divided by four to obtain the per-well data.

<u>2.D.1.c.</u> Cement tonnage for an exploration well comes from Table 1 and must be adjusted for the assumed well depth.

<u>2.D.1.d.</u> Miscellaneous consumables tonnage for an

exploration well comes from Table 1 and must be adjusted for the assumed well depth.

2.D.2.a. through 2.D.2.c. These factors are the same as 2.A.2.a. through 2.A.2.c.

2.E.1.a. through 2.E.1.c. These factors are the same as 2.D.1.a. through 2.D.1.c., except the figures come from the column labeled "production well" in Table 1. As with other figures from this table, an adjustment must be made for the assumed well depth.

2.E.2.a. through 2.E.2.c. These factors are the same as 2.B.2.a. through 2.B.2.c.

2.F.1.a. through 2.F.1.d. These factors are the same as 2.D.1.a. through 2.D.1.c., except the figures come from the column labeled "workover well" in Table 1. As with other figures from this table, an adjustment must be made for the assumed well depth.

2.F.2.a. through 2.F.2.c. These factors are the same as 2.A.2.a. through 2.A.2.c.

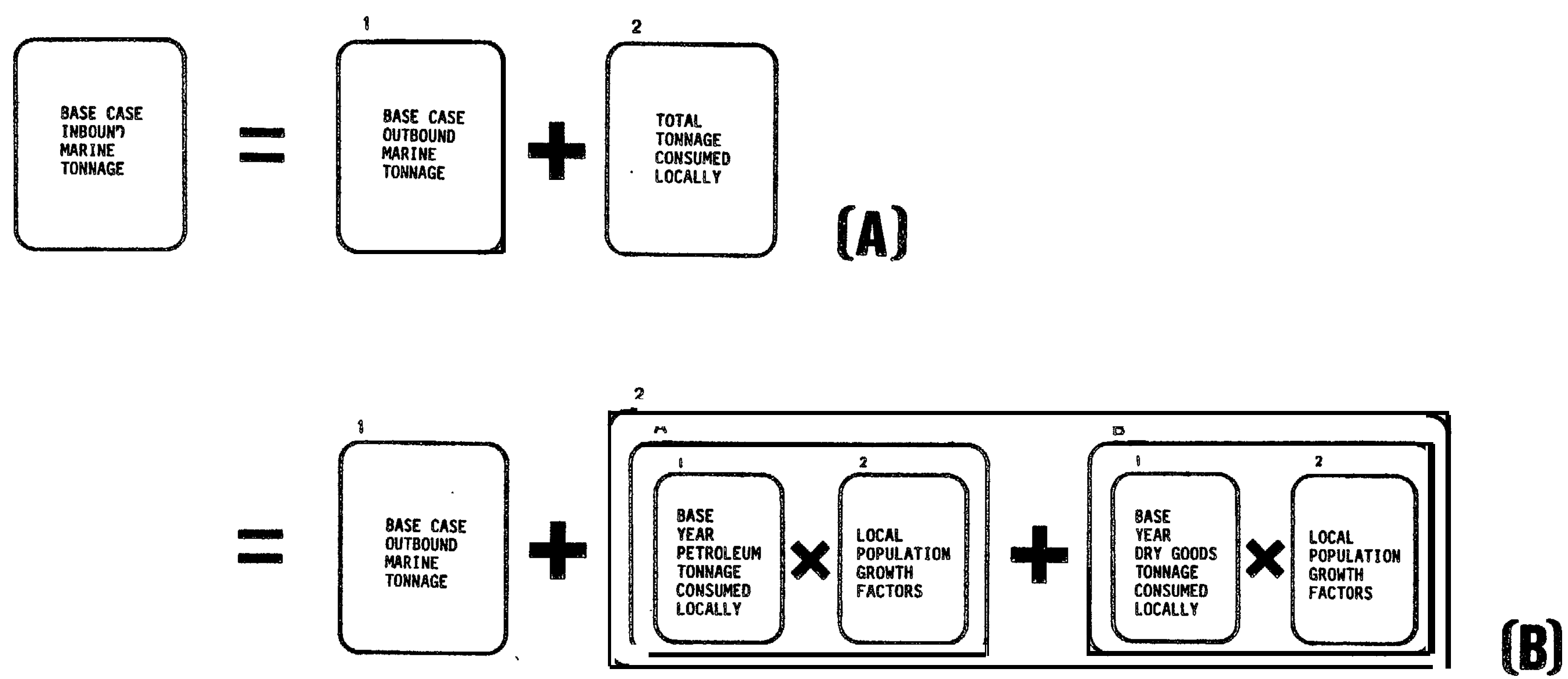
2.G. Fuel and other petroleum products are needed for the work boats. As a rule of thumb, such fuel requirements are estimated as being equal to the total fuel demand for drilling the various wells. However, if the fuel requirements of each work boat can be estimated from boat operating characteristics, then a more informed estimated might be derived by multiplying that estimate by the number of work boats. Greater refinements of this approach could be achieved if the fuel demands were linked to boat trips. In which case, estimates of the number and length of boat trips would have to be made.

Inbound Tonnage. Inbound marine tonnage at Unalaska/Dutch Harbor for the Base Case is given by the formula in Figure 5. Generally, inbound tonnage includes tonnage ultimately shipped outbound plus tonnage that comes in and is consummed locally. Version [A] of the formula illustrates these two principal components. The outbound tonnage component was discussed in the preceding section. The focus of this discussion is on tonnage consumed locally (i.e. in Unalaska/Dutch Harbor). In version [B] of the formula in Figure 5, this second factor is expanded to reflect two basic elements of marine tonnage: bulk petroleum and dry cargo products. These elements are further explained in the following text.

Bulk Petroleum. Bulk petroleum products consist mostly of refined fuels and oils including automotive and aviation gasolines, heating fuels, lubricating oils, and other such products moved and

FIGURE 5

ORM A FOR BASE CASE INBOUND MARINE TONNAGE
A' UNALASKA/DUTCH HARBOR



stored in bulk. Large quantities of fuel in 55 gallon drums also constitutes a bulk product.

2.A.1. From a historical perspective, the difference between inbound petroleum product tonnage and petroleum product tonnage transshipped provides a measure of the petroleum tonnage consumed locally. This relationship can be seen by taking factor 1 in version [A], Figure 5, and transposing it to the other side of the equal sign. Since this component can be derived from historic data, regression analysis or the growth factor technique can be employed to develop a forecast. Relevant historic information is found in waterborne commerce data published by the Corps of Engineers (see U.S. Army Corps of Engineers, Annual).

2.A.2. The population referred to here is the population of Unalaska/Dutch Harbor and adjacent road connected areas. A population forecast for Unalaska/Dutch Harbor sould be available from MMS or other Social and Economic Studies Program contractor. Growth factors are developed as described earlier for element 1.A.1.b., Figure 4, outbound tonnage. The use of the growth factor technique may be inappropriate if industry is the principal user of petroleum products in place of the local population. When industry is the principal user, it may be more appropriate to develop growth factors for the specific industry and use those in place of population growth factors. If both industry and population are relatively significant, a weighted average of the two set of growth factors should be used.

Dry Cargo. The term "dry cargo" products as used in this analysis consists of any product not falling into the bulk petroleum category.

2.B.1. Base year dry cargo tonnage consumed locally is derived from historic dry cargo tonnage data in the same manner described above for petroleum tonnage (reference 2.A.1., Figure 5).

2.B.2. Dry cargo tonnage has a high correlation with population level. Since the focus is on locally consumed goods, population estimates should include both permanent and on-site transient people. In Unalaska/Dutch Harbor, the transient segment should include all on-site fishing employment. Growth factors are developed as described in reference 1.A.1.b., Figure 4.

Cold Bay

The primary economic function of Cold Bay in the southwest region is as an aviation hub for Aleutian Island communities. The port at Cold Bay serves no transshipment function and, thus, has little or no outbound tonnage. This simplifies calculations, since the outbound tonnage factor in the formula in version [A], Figure 3, becomes zero and throughput tonnage then equals inbound tonnage. Similarly, in calculating inbound tonnage, version [Al, Figure 5, outbound tonnage becomes zero and inbound tonnage (and, therefore, throughput tonnage) equals tonnage consumed locally. In this framework, the discussion above pertaining to locally consumed tonnage, formula version [B], Figure 5, applies to the Cold Bay analysis. The major difference is in developing the growth factors for elements 2.A.2. and 2.B.2.. In element 2.A.2., the expansion of petroleum product tonnage in Cold Bay is linked principally to growth in aircraft operations and only secondarily to population. Aircraft operations data for this analysis should come from the aviation analysis presented later in this report. In element 2.B.2., transient aviation or OCS personnel rather than transient fishermen are the relevant population issue.

St. George Island

Based on the scenario of events for the Norton, Navarin, and St. George Lease Sale areas, as described in Chapter I, St. George Island is expected to function as the jumping off point for the offshore work force employed in the St. George Basin. This implys the stationing of two or more helicopters at St. George Island and requires start-up operations of a shuttle aircraft from Cold Bay. These aviation activities increase fuel utilization at St. George Island. Dry goods tonnage and heating fuel demands should also increase due to the stationing of aircraft crews and related support personnel. As long as St. George Island supports no fishing operations, it has no outbound tonnage demands, so the determination of throughput tonnage is reduced to determining the volume of locally consumed tonnage, as was done for Cold Bay. The required calculations are represented by locally consumed petroleum and dry goods components (2A and 2B, respectively) in formula version [B], Figure 5. The assessment of aircraft operations at St. George Island, performed later in this methodology, should provide a clue as to whether population or aviation growth factors, or some weighted average, should be utilized in determining petroleum tonnage. The potential addition of groundfishing activities at St. George Island will also have to be considered in determining affects on population and, subsequently, on petroleum product usage. The factors influencing dry cargo tonnage are similar to those described earlier for Unalaska/Dutch Harbor.

St. Matthew Island

During the exploration, development, and production phases of activities in the Navarin Basin, St. Matthew island is assumed to be used as a forward marine support base. In addition to storing the various drilling materials (mud, cement, etc.), it is expected that fuel for the work boats, platforms, and generators will be maintained at the base. The inbound fuel requirements for the platforms, work boats, and helicopters can be calculated from parts of formula version [D], Figure

4. Exploration, production and workover wells are serviced, so only components 2.A.,2.B.,2.C., and 2.G. are applicable to the fuel calculations. Within these components, the number of wells serviced in the Norton and St. George lease areas goes to zero and elements 2.A.2.a., 2.a.2.b., 2.B.2.a., 2.B.2.b., as well as 2.C.2.a. and 2.C.2.b., dropout. Only elements 2.A.1., 2.A.2.c., 2.B.1., 2.B.2.c., together with 2.C.1. and 2.C.2.c., need be calculated, then repeated to get 2.G..

Dry cargo tonnage at the St. Matthew base can be calculated from components 2.E. and 2.F. in formula version [D], Figure 4. Elements 2.E.1.a. through 2.E.1.d. and 2.E.2.c. provide data for production wells; elements 2.F.1.a. through 2.F.1.d. and 2.F.2.c. provide data for workover wells. Additional dry cargo tonnage will be generated during construction of the service base. However, insufficient information about the character of the base prevents calculating the related tonnage at this time.

If the petroleum products and dry cargo products for the Navarin Basin are shipped directly to the marine service base instead of through Unalaska/Dutch Harbor, the tonnage figures previously developed for Unalaska/Dutch Harbor must be reduced. This is accomplished by dropping elements pertaining to the number of Navarin Basin production and workover wells.

Aleutian Transshipment Terminal

Based on assumptions presented earlier in this report, an Aleutian Transshipment Terminal would be established to handle crude oil from the St. George and Norton Basins. Resources from the St. George Basin would be piped to the terminal; resorces from the Norton Basin are transported from the lease area to the terminal in ice strengthened shuttle tankers. The crude oil would be stored and subsequently shipped to Lower 48 markets in VLCC tankers. Based on these expected resource movements, inbound marine tonnage to the terminal equals the annual output of recoverable resources for the Norton lease area, while outbound marine tonnage equals the combined annual output of recoverable resources from the Norton and St. George lease areas,

Resources recovered from the Navarin Basin are assumed to be shipped directly to Lower 48 refineries by ships loading at an offshore terminal located in that lease offering area. The quantity of resources shipped is assumed to equal the annual production from this basin. Information pertaining to the quantity of resources recovered is developed by MMS as part of the scenario prepared for the prior lease sales. If Navarin Basin resources are shipped by marine carriers through the Aleutian Transshipment Terminal, the annual production of the basin must be added to the inbound and outbound tonnage calculations for the terminal, OCS CASE

The OCS Case assumes the addition of North Aleutian Basin economic activities to those of the Base Case. In this situation, certain development. changes are assumed to take place. The principal change is that after exploration is complete in the North Aleutian Basin and a decision is made to proceed with development, a supplemental marine base is constructed to support the North Aleutian activities. Primary staging of marine support to the North Aleutian area will continue to occur at Unalaska/Dutch Harbor.

However, because the location of this new base is closer to Lower 48 ports than Unalaska/Dutch Harbor, and because direct shipments reduce handling at Unalaska/Dutch Harbor, it may be more efficient to ship some products directly to the base instead of through Unalaska/Dutch Harbor. To the extent these products can be identified and measured, in terms of product tonnage, inbound and outbound tonnages at Unalaska/Dutch Harbor can be adjusted. On the other hand, the advantages of shorter distance and reduced handling could be offset by physical limitations of the harbor and/or dock facilities at the new base. Both circumstances must be evaluated when greater details about the North Aleutian scenario are available.

Unalaska/Dutch Harbor

During the exploration period in the North Aleutian Basin, outbound tonnage demands at Unalaska/Dutch Harbor should increase over Base Case levels because an additional volume of petroleum products and dry cargo will be moved. To reflect this added volume, several elements need to be added to formula [D], Figure 4. Specifically, the number of exploration wells in the North Aleutian Basin should become element 2.A.2.d. and element 2.D.2.d.. If petroleum products are transshiped through Unalaska/Dutch Harbor during the development and production phases of the North Aleutian Basin, the number of development wells should become element 2.B.2.d. and the number of production wells should become element 2.C.2.d.. If petroleum products for the North Aleutian Basin are shipped directly to the new marine support base, along with dry cargo products, outbound tonnage at Unalaska/Dutch Harbor will be reduced or will grow more slowly, Other changes in formula [D], Figure 4, relate to the use of population or industrial growth factors. Due to the additional economic activities, the annual growth factors are expected to increase slightly and these revised factors should be substituted for the Base Case factors.

Inbound marine tonnage demands at Unalaska/Dutch Harbor continue to be governed by formula [B], Figure 5. The only significant change is the substitution of new growth factors for Unalaska/Dutch Harbor.

Cold Bay

Aviation activities at Cold Bay should increase with the added economic activities of the North Aleutian Basin. The OCS Case for Cold Bay continues to be represented by formula [B], Figure 5. Due to the importance of aviation to Cold Bay, aviation growth factors should probably be used in element 2.A.2., in place of population growth factors. Revised growth factors reflecting OCS related population changes should also be substituted in element 2.B.2..

St. George Island

Unless some change is made regarding aviation operations assumptions or assumptions pertaining to population levels on St. George Island, the OCS Case calculations will be identical to those for the Base Case. In short, no changes are expected at St. George Island as a result of the North Aleutian lease offering.

St. Matthew Island

No changes are expected at St. Matthew Island as a result of the North Aleutian lease offering.

Aleutian Transshipment Terminal

Resource production from the North Aleutian Basin is expected to be piped to the Aleutian Transshipment Terminal. Thus no increase is expected in inbound marine tonnage. Outbound marine tonnage will, however, reflect the added volume each year of' expected North Aleutian lease area field production, as determined by MMS in the North Aleutian petroleum development scenarios,

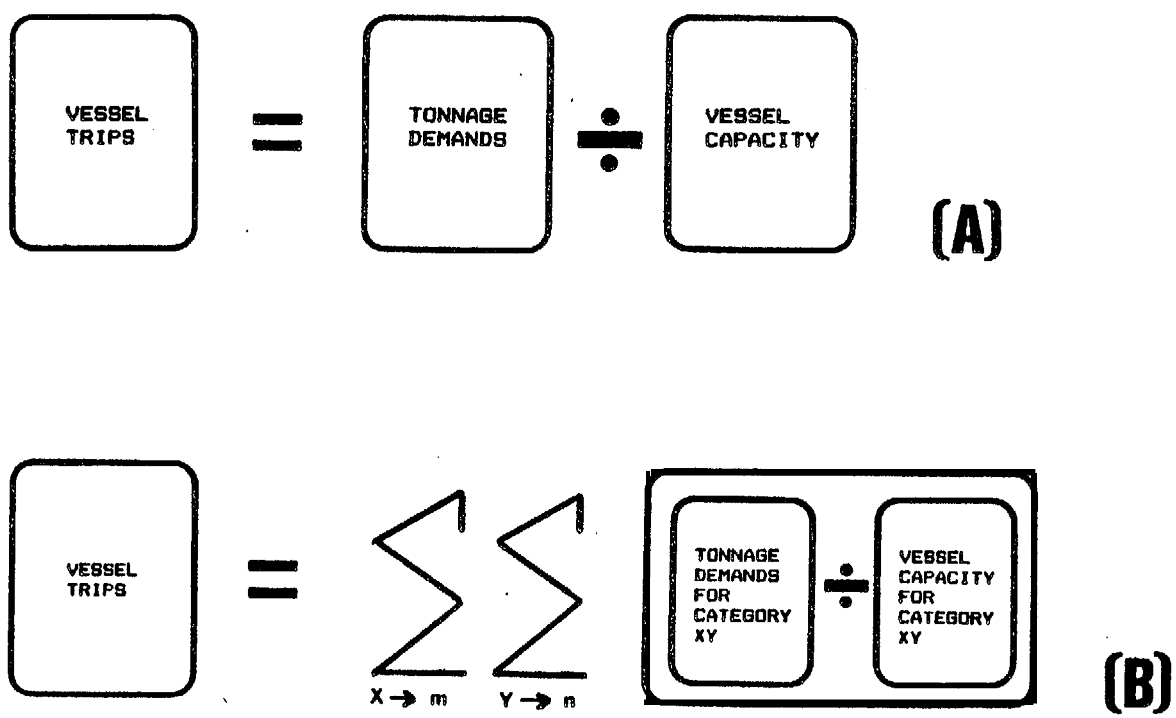
Marine Vessel Requirements

Marine vessel requirements are measured as the number of vessel round trips required to serve expected tonnage demands. The general formula for vessel round trips is given in Figure 6, version [A]. Because there are several different combinations of vessel capacity and tonnage demand categories, the formula in version [A] transposes in version [B] to a summation of the different combinations. In this latter version, the term "xy" is used to identify the different combinations of vessel capacity and tonnage demand categories. The variable "x" denotes the range of tonnage demand categories; the variable "y" denotes the range of vessel capacities. Some of the more common combinations used in prior SESP studies are illustrated in Table 2.

Additional vessel trips are related to the movement of rigs, platforms, construction equipment and accommodation barges, pipeline laying and

FIGURE 6

GENERAL FORMULA FOR DETERMINING VESSEL ROUND TRIPS



SOURCE: ERE SYSTEMS, LTD.

TABLE 2

EXAMPLES OF THE RANGE OF VESSEL CAPACITIES (1)

VESSEL TYPE	AVERAGE CAPACITY
Fishing Boats	28 short tons
Barges	
Dry Cargo Barge	6,000 short tons
Tanker Barge	7,000 short tons
Lighters	
Dry Cargo	24 short tons
Tankers	38 short tons
OCS Work Boats	
Dry Cargo Exclusively	400 short tons
Bulk Fuel and Water	780 short tons
Tankers	
Intra Coastal	35,000 short tons
Shuttle Tankers.	75,000 short tons
VLCC Tankers	250,000 short tons

NOTE: (1) The "average tonnage delivered" or "average tonnage loaded" by tankers and general cargo ships should be used in place of vessel capacity to calculate number of vessel trips.

SOURCE: ERE Systems, Ltd.

related supply and hopper barges, as well as the movement of OCS facility modules such as gas separation units. The number of vessels assumed to be involved in these various OCS activities is illustrated in Table 3.

BASE CASE

Marine vessel movements are calculated for bulk fuel and dry cargo tonnage categories. Since the type of vessel is likely to be different inbound and outbound, separate calculations are performed for each direction.

Unalaska/Dutch Harbor

This community has a single bulk fuel facility that receives fuel shipments delivered by commercial tankers of 35,000 dwt average size. Regardless of the ultimate use of the fuel, it is assumed bulk fuel deliveries will be made in the same fashion throughout the forecast period. To determine the number of vessel round trips, inbound fuel demands calculated earlier for the Base Case must be summed and divided by the 35,000 dwt tanker capacity. More specifically, the researcher should add elements 1.A.1., 1.A.2., 2.A., 2.B., 2.C., and 2.G. presented in the outbound tonnage formula, version [D], Figure 4, and element 2.A. presented in the inbound tonnage formula, version [B], Figure 5. For each year of the forecast, the populations in the various areas serviced

TABLE 3

ASSUMED NUMBER OF MARINE VESSELS FOR SPECIFIC OCS ACTIVITIES

CATEGORY	NUMBER AND TYPE VESSEL
Rig or Platform	1 Rig/Platform 8 Supply/Anchor/Tug Boats
Construction Camp	3 Accomodation Barges 3 Construction Equipment Barges 3 Tug Boats
Pipelaying Construction Spread	2 Dredges 4 Hopper Barges 1 Accomodation Barge 3 Tug Boats
Modular Equipment	15 Barges assigned per year.

SOURCE: ERE Systems, Ltd.

and the number of wells serviced in each lease area should reflect the role of Unalaska/Dutch Harbor as assumed by the researcher.

Outbound fuel shipments must be calculated separately for each outbound fuel category because different kinds of vessels provide the transportation. Fuel shipments to villages in western and northwestern Alaska and in the Aleutian region are assumed to be made in 7,000 ton capacity tanker barges. Elements 1.A.1. and I.A.Z., as presented in the outbound tonnage formula, version [D], Figure 4, are summed and divided by the 7,000 ton capacity of these barges.

Fuel used on the rigs and platforms in the Norton", St. George, and Navarin lease areas is assumed to be delivered to the respective support base in 7,000 ton tanker barges and from there to the rigs/platforms in OCS work boats. The calculation of the number of barge trips is based on dividing total fuel requirements, including work boat fuel demands, by the 7,000 ton capacity of the barges. Assuming all fuel for OCS needs is distributed from Unalaska/Dutch Harbor, the researcher needs to sum elements 2.A., 2.B., 2.C., and 2.G., as presented in the outbound tonnage formula, version [D], Figure 4. With respect to OCS work boat trips, only the fuel requirements of the rigs/platforms is considered, elements 2.A., 2.B., and 2.C.. The fuel cargo capacity of these work boats is assumed to be about 718 tons. Dividing total rig/platform fuel demands by the work boat fuel capacity gives work boat round trips.

During the later stages of the development phase and during the production phase, rig/platform fuel demands might be reduced or eliminated by burning the free gas typically found with crude petroleum products (New England River Basins Commission, 1976). Such demands might also be reduced by treating the crude petroleum sufficiently to use in specially designed equipment. Employment of either technique requires the researcher to adjust the annual rig/platform fuel demands by some percentage of offset.

The maximum number of work boat trips may be goverened by OCS needs other than fuel, such as drill water. Drill water requirements for a 15,000 foot well are stated in Table 1. These water requirements are considerably greater than those for fuel, yet the drill water capacity of the work boats is less. The implication is that drill water related tripmaking could be almost 13 times greater than the trip requirements for fuel. However, some of these tripmaking requirements for drill water are offset by the fact that most rigs or platforms have the capacity to produce drill water from the ocean (Kramer, L.S., Clark, Vet., and Cannelos, G.J., 1978). The particular characteristics of the rigs/platforms for each lease area need to be examined in order to determine the appropriate number of drill water trips and whether or not these should be used in place of expected fuel trips to capture the upper limit of trip requirements.

With respect to dry cargo vessel movements at Unalaska/Dutch Harbor several categories must be considered. Foremost is the catching and regional exporting of fish products. Also included are dry cargo shipments supporting local population demands at Unalaska/Dutch Harbor and those shipments supporting OCS needs in the Norton, St. George, and Navarin lease sale areas.

Fishing activities at Unalaska/Dutch Harbor are responsible for only some defined percentage of total fish caught and processed in the Aleutian - Bristol Bay region. An estimate of fishing boat activity at Unalaska/Dutch Harbor can be developed either from a forecast of round weight of fish by species or from a forecast of catch by vessel type. Dividing the catch size (in terms of weight) by an average vessel catch size per trip or vessel capacity produces an estimate of the number of round trips by fishing vessels.

The export of processed fish to foreign and Lower 48 ports will also generate vessel trips. The number of trips can be estimated from forecasts of processed fish tonnage, which are identified as elements 1.B.1. and 1.B.2. in the outbound marine tonnage formula, version [D], Figure 4. In Technical Report 58 (Peat, Marwick, Mitchell & Co. and ERE Systems, Ltd., 1981), it was assumed each outbound cargo vessel carried an average of 150 short tons of dry cargo. To determine the number of vessel trips, elements 1.B.1. and 1.B.2. are summed and divided by the 150 ton average cargo per trip.

It should be noted that a distinction is made here between vessel capacity and the average size of cargo loaded or unloaded. Commercial cargo ships and tankers travel from port to port picking up and delivering products. When arriving at a particular port the ship may be empty, loaded to capacity, or any point in between. A particular ship is unlikely to either empty all its cargo or to fill available capacity at any one port. In order to model this characteristic, this methodology employes the terms "average tonnage delivered" and "average tonnage loaded". An estimate of the values of these terms for a given port can be derived by dividing total product tonnage inbound and outbound by the total number of vessels of a particular type calling on the port. For example, in Unalaska/Dutch Harbor dividing total dry cargo tonnage inbound and outbound by the number of dry cargo ships calling on the port gives average dry cargo tonnage delivered and loaded, respectively. The long term trend in an improving economy should be that these averages increase over time, but this must be verified through a review of historic data to determine the direction of this trend. In Unalaska/Dutch Harbor one would expect to find this trend tied to the fortunes of the fishing industry.

Inbound dry cargo tonnage demands of the local population are developed in element 2.B. of the inbound marine tonnage formula, version [B], Figure 5. Based on an analysis of historic data, it was assumed in Technical Report 58 (Peat, Marwick, Mitchell & Co. and ERE Systems, Ltd., 1981) that each cargo vessel visiting Unalaska/Dutch Harbor delivered an average of 65 short tons per trip. To arrive at an estimate of inbound vessel trips at Unalaska/Dutch Harbor, the annual tonnage demands given in element 2.B. are divided by the 65 ton average cargo per trip.

The movement of OCS dry cargo supplies into and out of Unalaska/Dutch Harbor may generate significant levels of vessel activity. Inbound deliveries to the OCS service base are as likely to be made by scheduled commercial carriers as by special contract carriers. The range of inbound vessel trips can be derived by dividing bulk and dry cargo inbound tonnage, first, by the average tonnage delivered, and second, by 6,000 short tons, the assumed average maximum capacity of inbound cargo barges. It should be noted here that the average tonnage delivered per ship will rise significantly when OCS contract ships deliver their entire cargo. Outbound shipments to the smaller, sale specific, marine support bases are expected to be made by contract carriers utilizing the full capacity of the vessel. Outbound shipments to the *rigs* and platforms in the St. George lease area are expected to be made by OCS work boats. The volume of tonnage to be moved is estimated in elements 2.D., 2.E, and 2.F. of the outbound marine tonnage formula, version [D],

Figure 4. For each year of the forecast these elements should reflect the degree of support provided by the base at. Unalaska/Dutch Harbor. The number of vessel trips each year can be estimated by summing these elements and dividing by the appropriate ship capacity or average cargo figure.

The range of outbound vessel trips can be estimated by dividing the outbound tonnage by either the work boat deck cargo capacity of 350 short tons, or the average tonnage loaded. With regard to work boat trips, fuel and drill water resupply requirements should be checked against the other capacities of the work boat. In particular, if drilling mud is delivered to the rig or platform in a premixed form, it would be carried in the bulk cargo hold, which has an assumed average capacity of 140 short tons based on the weight of an equivalent volume of water. To determine the number of trips, the dry drilling mud tonnage {elements 2.D.1.c., 2.E.1.c., 2.F.1.c. in Figure 4) must be converted to an assumed liquid-state tonnage. Based upon data supplied by MMS a 10,000 foot exploration well *requires* about 1,300 tons of mud while a 10,000 foot. production or workover well requires about 1,100 tons of mud. Multiplying these per well demands by the number of wells serviced through Unalaska/Dutch Harbor provides an estimate of total mud tonnage demand. Dividing by the work boat's assumed bulk cargo mud capacity of 260 short tons (see Table 2) provides an estimate of vessel round trips.

Cold Bay

Marine vessel trips to and from Cold Bay revolve about the movement of fuel and cargo into the community. If a groundfish processing plant is constructed in the community, some inbound tonnage will increase by the round weight of caught fish and outbound tonnage will increase by the processed weight of the fish. The number of vessel trips generated can be calculated as follows. In Technical Report 58 (Peat, MarWick, Mitchell & Co. & ERE Systems, Ltd., 1981), the average inbound tanker was assumed to carry 3,000 short tons of fuel each trip and dry cargo ships were assumed to carry 400 short tons per trip. If a fish processing plant is located in the community, outbound cargo ships were assumed to carry 100 short tons each trip. Fishing boat vessel activities would be governed by the assumed capacities cited in Table 2. To determine vessel trips, the respective inbound and outbound tonnage demands developed earlier are divided by the appropriate ship capacities per trip.

St. George Island

The general tonnage demands and vessel movements at St. George Island are similar in type and kind to those at Cold Bay. However, assumed vessel capacities per trip are smaller: 800 short tons per trip for inbound fuel; 450 short tons per trip for inbound dry cargo. These values are for commercial vessels. Since the island must be served by lighters, it was assumed each lighter has a capacity of about 38 short tons with the ability to handle both bulk liquids and dry cargo. Dividing fuel and dry cargo tonnage demand respectively by the commercial vessel inbound fuel and dry cargo capacities provides an estimate of line haul traffic between Unalaska/Dutch Harbor and an offloading point located offshore the island. Dividing total tonnage demand by the lighter capacity provides an estimate of vessel trips between the offshore loading point and the island.

St. Matthew Island

The operational characteristics at St. Matthew Island revolve about its use as an OCS service base for the Navarin Basin. The base is likely to be the main service point for all offshore activities and the only per% for inbound aviation fuel supplies. Navigational constraints at and near St. Matthew Island are unknown, but this analysis assumes barges and work boats could be unloaded from a dock at the service base, thereby eliminating the need for lighters. From the tonnage demands developed earlier, the number of vessel trips can be determined by dividing bulk petroleum and dry cargo tonnage by the respective vessel capacities shown in Table 2: 7,000 short tons for an inbound tanker barge; 6,000 short tons for an -inbound dry cargo barge. To determine the round trip movements of OCS work boats, tonnage bound for the rigs/platforms is divided by the various work boat capacity values shown in Table 2.

Aleutian Transshipment Terminal

Oil resources inbound to the terminal via marine transportation originate in the Norton Basin. The number of such shuttle tanker trips is determined by dividing the annual production of the Norton field (expressed in tons) by the assumed tanker capacity of' 75,000 dwt. Outbound resources combine the annual production of the Norton and St. George Basins. The much larger VLCC tankers are used to move these resources to Lower 48 markets. The combined production of the two lease areas is divided by the 350,000 dwt capacity of these tankers. In addition to the movement of these tankers, at least two accompanying tugs would be needed to-berth the ships and provide transportation for the harbor pilot. For each tanker round trip, three additional round trips are assumed to be made by local tugs.

OCS CASE - EQUIPMENT AND SUPPLIES

The movement of OCS equipment and supplies covers a broad range of activities pertaining to OCS. Of particular interest with respect to marine transportation is a determination of the traffic generated by these various activities and their location. Specific marine activities *in* this discussion include work boats and tug boats, as well as other supporting vessels. These *are* presented separately in following sections.

Work Boat and Tug Boat Trip Making

Work boats and tug boats support the installation of platforms, resupply of offshore facilities, offshore pipeline construction, and the docking and undocking of the shuttle and VLCC tankers. A typical work boat supporting a drilling rig or production platform in other areas of the State is characterized in Table 2. Tug boats are expected to be about half the size of a work boat, with an average crew size of 5 and no cargo capacity. Throughout the exploration, development., and production phases workboats operating in the St. George Basin will be based at Unalaska/Dutch Harbor. . The number of trips made by these boats were calculated in the Base Case. Similar boats will also operate from Unalaska/Dutch Harbor during the exploration and early development phases of the North Aleutian Basin. After development of the secondary support base near the Aleutian Transshipment Terminal, these boats will primarily operate from the new support base. Total trip making for these boats is the sum of trip making for each of several different components. Each of these components are discussed in the following paragraphs.

Rig and Platform Support. Semisubmersible rigs are expected to be used for drilling during the exploration phase, while steel jacketed, ice reinforced, platforms are expected to be used during the development and production phases (Dames & Moore and Harrison, G.S., 1982). Both the rigs and platforms require tug and work boat support while being towed and positioned offshore. In addition, platforms carry a substantial load of deck equipment, which must be transported to the site and installed on deck by a barge mounted derrick. Tug boats are needed for movement of the equipment and derrick barges, while work boats are needed to maintain a supply line. Based on the development schedule suggested in Table 2-1, Technical Report 80 (Dames & Moore and Harrison, G.S., 1982) most such tripmaking would take place at Unalaska/Dutch Harbor. The number of monthly work and tug boat trips in support of these activities is summarized in Table 4.

Once the rigs and platforms are in place and operating, work boats are used to resupply these facilities. Much of this activity is expected to be centered at the Transshipment Terminal support base. The factors needed to determine the number of trips generated were identified earlier in Figures 4 and 6. However, the empirical data in Table 4 greatly reduces the calculations to determining the number of rigs or platforms being serviced monthly and the number of months of drilling activity. Seasonal drilling restrictions may be imposed, thereby limiting the actual number of months of drilling activity. During exploratory drilling monthly work boat trips are assumed to be 26 per rig; during developmental drilling 15 trips per platform; and during production 5 per platform.

TABLE 4

TYPICAL MONTHLY SUPPLY BOAT MOVEMENTS

OPEFMTION	MONTHLY ROUND TRIPS
Exploratory Drilling	26 per rig
Platform Installation	24 per platform
Developmental Drilling	15 per platform
Production Platform .	5 per platform
Pipeline Lay Barge	75 per barge
Pipeline Bury Barge	25 per barge

SOURCES: Northern Resource Management, 1980; Kramer, L.S., Clark, Vat., and Cannelos, G.J., 1978.

Pipeline Support. Offshore marine pipelines will take several years to complete. The support requirements differ with the technique employed to lay the pipe. For this analysis, the conventional lay barge method was assumed, rather than the bottom-tow method (Dames & Moore and Harrison, G.S., 1982). These marine activities are expected to be based at the Transshipment Terminal support base. To determine the number of work and tug boat trips requires knowledge of the number of lay barge spreads, the length of the construction season, and the average number of trips per spread. Only one equipment spread is assumed. This lay barge spread is estimated to be able to lay up to 50 km (31 miles) of pipe per construction season (estimated from data in Dames & Moore and Harrison, G.S., 1982). The length of the construction season was assumed to be 180 days or 6 months. The average number of monthly round trips per lay barge spread is assumed to be between 75 and 100 depending on whether or not the bury barge is part of the spread (see Table 5).

Tanker Support. Tanker support activities, which involve the docking and undocking of the shuttle and VLCC tankers at the Aleutian Transshipment Terminal, should not affect Unalaska/Dutch Harbor, although the various tugs may put into port there from time to time. The average size of the shuttle tankers is 75,000 dwt or 0.6 MMBBL (Dames & Moore and Harrison, G.S., 1982). As discussed earlier, shuttle tankers will be used between the Norton and Navarin fields and the transshipment terminal. From the transshipment terminal, VLCC tankers, will carry the crude petroleum to Lower 48 markets. These tankers vary in size from 100,000 to 300,000 dwt (Kramer, L.S., Clark, V.C., and Cannelos, G.J., 1978). To determine the number of trips required by the tugs it is first necessary to determine the number of tanker trips per year. This latter value is arrived at by dividing the total annual field output in millions of barrels by 0.6 mmbbl, the capacity of the shuttle tanker. This result is then multiplied by an assumed number of tug boat trips per tanker visit.

When each of the individual components of work and tug boat trips are calculated and summed the result is a composite value for total trips. Depending upon how the individual components were calculated, this value may have to be adjusted. Work boats serving the offshore rigs and platforms may visit more than one facility and stop in another port before returning to its support base. If the researcher developed the work and tug boat estimate without accounting for this characteristic, an adjustment factor must also be estimated and applied to the results to reduce double counting. It was estimated the reduction could be as high as 20 percent, leaving the adjustment factor at 80 percent. However, this aspect of the estimate has already been accounted for in the empirical monthly trip observations shown in Table 4.

Other Vessel Traffic

In addition to the work and tug boats, the various barges and other ships working in the area contribute to marine traffic levels in the North Aleutian area. The major components of this additional traffic include: equipment spreads for pipelaying, support barges for additional deck equipment on the platforms, barges used to bring the construction equipment and materials for the marine terminal, and barges used to transport coated pipe for the marine feeder and trunk pipelines. An estimate of the number of these other vessels and their activities depends in part on the technology employed. Typical construction spreads can be estimated from prior Social and Economic Studies Program reports, environmental impact statements, and other special OCS related studies or reports.

OCS CASE - RESOURCE MOVEMENTS

Marine transportation is one of two alternatives considered for the movement of recovered oil and gas resources. The other alternative is a pipeline. The principal objective in evaluating the movement of these ships 'is to determine the additional traffic they contribute to other ship movements in the Bering Sea and in the major passes through the Aleutian Islands. The calculation of the annual number of tanker round trips was given in the previous section as part of the discussion pertaining to the use of tugs to dock and undock these ships. The number of trips was derived by dividing the annual output of a particular field or facility, expressed in tons or millions of barrels, by the tonnage or million barrel capacity of the assumed type of ship.

III

AIR TRANSPORTATION

Air transportation is the principal means for moving population in the Aleutian region. It also offers an alternative transportation mode for the movement of consumer goods, particularly perishable goods such as groceries. A similar relationship exists for OCS related activities. Air transportation is vital for moving OCS personnel between work place and residence, the latter of which is typically far from the development area. The petroleum industry also employs air transportation in the movement of important tools and equipment and supplies needed immediately.

The analysis of air transportation is conducted from both a facility and systems perspective. The facility perspective focuses on the , measurement of total passenger and cargo emplacements and deplanements, as well as the measurement of total aircraft operations. At a particular facility, the emplacements/deplanements and aircraft operations can be assembled from the air transportation demands of a community's normal population and economy (hereinafter referred to as non-OCS related demands) and the air transportation demands of the petroleum industry, by lease area (hereinafter referred to as OCS related demands). When evaluating a particular facility these two sets of demands are combined to create the Base Case and OCS Case relationship discussed in Chapter I.

The systems aspect of air travel focuses on the transshipment or through travel function. The transshipment characteristic is similar to marine travel, in that cargo or passengers may have be unloaded from one aircraft and reloaded on *another to* continue the journey. These same through travel cargo and passengers are also important. because they limit the space or seats available for boarding new cargo or passengers.

The material presented in this chapter discusses the methods employed to develop adequate forecasts of the Non-OCS and OCS air transportation demands and how they are combined to produce Base Case and OCS Case situations for the analysis of a particular facility.

Non-OCS Related Transportation Demands

DEFINING THE SYSTEM

At the start of this process the researcher needs to define what portion of the aviation system is to be studied. On the surface, this implys identifying the various communities to be included in the analysis. However, in identifying these communities consideration must be made for systemic relationships, the influence of potential infrastructure" changes, and the influence of technological changes. To identify included communities, these factors are initially considered in a synergistic manner. Subsequently, these same factors must be evaluated individually for each facility.

With regard to systemic relationships, existing and likely future air transportation patterns must be reviewed. Of importance are principal origins and destinations of passengers and cargo, identification of system functions that occur at each airport, and the role of each airport in the system. Evolving economic patterns may also affect the systemic relationships, although these are often accompanied by infrastructure changes. For example, the growth of the groundfishing industry in the Aleutians may position major new processing facilities in places different from current major economic activities. If that development creates a major change in transportation demand, airlines may alter their schedules and/or routes to accommodate the new demand, potentially lowering the quality of service to other nearby communities.

With regard to infrastructure changes, of particular importance are construction projects that might influence origin - destination patterns. For example, construction of a new longer runway or the lengthening of a runway. Such runway changes may allow landing or basing of larger aircraft, possibly changing the role of the facility in the system. Another example is construction of a new airport in support of petroleum development or other major economic event.

With regard to technology, the changes over time tend to be more subtle. However, the Introduction of jet aircraft in place of propeller driven aircraft could be quite sudden. This substitution is a likely event in the Aleutians during the forecast period.

Sources of information about existing airport operations, numbers of flights, types of aircraft utilized, emplaned passengers, and other related data can be obtained from several sources. The Federal Aviation Administration (FAA) publishes annual summaries of aviation activity in their "Airport Activity Statistics of Certified Route Air Carriers" and long range plans for Alaska in their "Ten Year Plan - Alaska Region"." The Alaska Department of Transportation and Public Facilities (ADOT/PF) sponsors aviation systems studies in major regions of the state, master planning studies of specific facilities, and studies of major problems at selected facilities. An example of the latter was a study of the runway extension at Unalaska/Dutch Harbor (see Dames & Moore, 1980b). Another source of information are the airlines serving specific communities. However, the airlines tend not to disclose information that describes their market position in a particular community.

Many of these various studies have included allowances for OCS activities in their forecasts. The researcher needs to determine, as best possible, the nature of such activities and how they differ from the scenario events being used in the current evaluation. In most instances, OCS activities are highly generalized in these studies and, within the context of this analysis, the forecasts serve only as a standard for subsequently judging impacts.

AIR TRAVEL DEMANDS

Aviation activities fall into different categories such as scheduled commercial services, charter services, air freight, and general aviation, among others. To adequately assess impacts at a particular airfield, a forecast for each of the categories must be made. In the methodology that follows, this requires an understanding of the dynamics of each category relative to the other. Knowing these dynamics, one can forecast activities in one category and develop a forecast of' the other categories by reference to the dynamic relationship. Scheduled, commercial services are used as the central tool in this methodology. This was done because commercial aviation data is most easily obtained and because commercial aviation is the principal category impacted by OCS employment. Another related reason is that the OCS Petroleum Employment Model (discussed later) provides a straightforward means to develop OCS employment commercial travel demands. The dynamic relationships of other aviation categories can be developed from historic data and from the various aviation studies and statistical reports referenced earlier.

The principal users of the existing aviation system are assumed to be the people living or working in the region served by the system. The exception, which happens to be the rule in *this* analysis, is that, because of prior lease offerings, air transportation demands are likely to exceed those levels normally expected from the regional population. As discussed later, this situation is dealt wit% by separately evaluating OCS and non-OCS air travel demands and combining them to create the Base Case situation, which simulates conditions without the proposed North Aleutian lease sale.

It is a basic assumption of this methodology that any economic and/or population changes occuring in the region stimulate either additional or fewer demands for air transport services. Based on this approach, the researcher needs to correlate historic emplaned passenger data with regional or community population growth. This can be accomplished in *a* simple way by using historic data to develop a trend in per capita travel demands (trips per person per year, or per month). However, this rate must be evaluated for its applicability to future conditions, potentially resulting in some assumed annual adjustment to the ratio.

A more complex approach is to use regression or multiple regression analysis, in which case the researcher may want to introduce other variables, such as employment or income, in addition to population. This methodology assumes these other variables come from sources outside this analysis. In many of the smaller remote communities, data is scarce or the future situation is one of rapid change. Under these conditions, the historic data does not provide a sufficient base for regression analysis, nor do future events appear to provide a basis for saying historic patterns can be applied to future events. Consequently, a per capita trip rate is often developed as a surrogate.

Introducing the independent variable into the regression equation, or multiplying the per capita emplacement ratio by the independent variable, produces the required commercial emplacement forecast. If historic data and/or future events suggest an annual adjustment to the per capita ratio, the adjustment is applied at this time.

AIRCRAFT OPERATIONS

Emplacements are converted to aircraft operations by "loading" the emplacements onto aircraft. To accomplish this requires that several assumptions be made regarding aircraft type, configuration characteristics, load factors, and routing. Frequency of operation can be ignored, if the routing and local field conditions do not restrict operations. Typically, the smaller communities do not have runway lighting systems, nor instrument landing systems. Although FAA has a long range development program that may equip many airports with such equipment, the lack of it prevents night time operations and limits bad wheather operations. *For* example, if a current route serves six communities, but takes most of the daylight hours to do so, it is unlikely that additional aircraft service will follow the same route since the circuit cannot be completed within the environmental limitations. New routes must be assumed; most likely these would serve the linkages with the greatest demands. The researcher needs to think through such possible changes and make the assumptions necessary to determine the route structure before loading the 'aircraft.

Scheduled Commercial Operations

The level of service to smaller communities, as defined by types of aircraft and frequency of service., can be expected to change very slowly under normal economic conditions. In part, this trend reflects the need for smaller air carriers to maximize utilization of their aircraft, as well as their inability to obtain financing for new equipment due largely to very slow growth in passenger emplacements (Parker Associates, 1979). In part this trend also reflects the limits of the aviation facilities, in that some community's facilities cannot handle larger aircraft, either because of the physical condition of the runway, or its length, or both. Unless the physical conditions are expected to change, or rapid economic growth is expected, it is generally assumed that existing types of aircraft will continue in use.

Market. structure, which includes factors such as travel demand, operational costs, and other items, has much to do with how the airlines operate their aircraft. Two additional market factors which affect seating capacity in a particular type aircraft, and therefore effect revenue, are aircraft configuration and expected operational load factor. Configuration refers to the way in which passengers and freight are arranged within the aircraft. Due to the remoteness of many communities, scheduled air carrier aircraft are typically configured to carry both. This reduces seating capacity. Configuration data can usually be obtained from the airlines.

Theloadfactor reflects the actual use of available seating. Ideally, the air carriers would like a 100 percent load factor on all flights. However, even during peak periods, the 100 percent level is not always reached because the air carriers have found they can provide better service by adding more flights at reduced load factors. Load factors can still be quite high. Smaller airlines operating smaller aircraft are more likely to operate at 90 to 100 percent of capacity since they need to maximize utilization. Larger air carriers are likely to plan operations using load factors between 70 and 90 percent, and may operate a specific route at a level as low as 50 percent in order to stay in a particular market.

Generally, load factor data is difficult to obtain because its an indicator of market success. Load factors can be inferred from historic data, however, by dividing total annual emplaned passengers for commercial airlines by the total number of commercial seats available. This latter number is estimated from the annual number of flights by type of aircraft and the typical configuration of each type aircraft. Unless market conditions change, it is generally assumed load factors are rising to some predetermined point, at which time additional flights are added to the schedule. Since load factors less than 100 percent offer the airline greater flexibility, it is assumed in this methodology that, during peak conditions, commercial aircraft load factors will be in the range of 85 to 95 percent.

To calculate the number of commercial aircraft flights, total travel demand, expressed as emplacements, is divided by the average number of seats per aircraft, as determined by applying the configuration and load factor components. However, in the situation for which this methodology was prepared, OCS activities in the St. George and Navarin Basins will add petroleum employment air travel demands to the normal commercial demands of the resident population. Depending upon how these additional demands are met, the above calculation might be modified. If the researcher assumes these added air travel demands will be accommodated totally on chartered flights, the OCS travel demands for each lease offering can be converted to charter flights using the same approach described above. If the researcher assumes these demands will be accommodated on scheduled commercial flights, these demands must be added to those of the resident population before computing the number of commercial flights.

The procedure to develop OCS worker emplacements is described in detail in a following section of this report. That procedure must be followed for each lease sale scenario; that is, two sets of OCS worker emplacement data need be calculated. It should be noted that the OCS emplacements are calculated as trips between the lease sale area and general residence location (i.e. one-way trips). These trips must be distributed and assigned to specific routes, and, therefore, specific airports. All these OCS trips constitute emplacements at each airport they pass through and these must be doubled to reflect the two directional flow (i.e. from residence location to the lease sale area).

Other Operations

Once total commercial aircraft operations are determined, other types of aircraft operations can be inferred. Historic aircraft operations data should provide the basis for determining a relationship between scheduled commercial operations and those pertaining to charter or contract operations, general aviation, or military (if significant). The historic operational relationships, together with any adjustment factors used to account for deviations from historic trends, are applied to the total scheduled commercial operations developed above. The *results,* when added to the scheduled commercial operations, should provide an estimate of total aircraft operations.

Depending upon how emplaned passenger data was generated, it may be necessary to make seasonal and other adjustments to the operational data to get a true picture of the busier periods at a particular facility. Typically, seasonal peaks in air travel occur during the summer months between May and September, with late June and early July being the busiest four-week period. This is subject to some variation depending on the cause for such peaking. The typical situation throughout Alaska consists of tourist travel and construction activities, however, the change of fishing seasons in the Aleutians may also create significant peak demand periods, The indicator of peak demand used in this methodology is peak daily operations. Peak daily operations are determined as a ratio of average daily operations. Typically this ratio varies from about 1.5 to 2.0. Some sense of the correct ratio can be gleened from historic data.

The last step in the process is to determine impacts. One of the more common measures of potential impact is a comparative analysis of peak demands and capacity limitations at a facility. A capacity estimate can be made for each of the major features of an airport: runway capacity, air terminal capacity, etc. In general, each of these capacities is a function of many variables and the measurement of most of these beyond the scope of this type analysis. Consequently, a surrogate must be found. For this analysis methodology, runway capacity was chosen. Runway capacity also is a function of many variables that are beyond the scope of this analysis, however, some standard estimates have been prepared for certain runway configurations by ignoring issues like air traffic control, aircraft mix, and others. At smaller airports with low traffic volumes disregarding these variables should have little consequence. At the larger airports such as Anchorage or Fairbanks, which are operating under direct air traffic control, a more sophisticated approach must be taken. The capacity estimates suggested to be used in this methodology come from the classic airport planning text "Planning and Design of Airports", by the late Robert Horonjeff . (McGraw-Hill Series in Transportation - 1975). These "crude" estimates, however, are sufficient for the small communities in this analysts:

OCS RELATED TRANSPORTATION DEMANDS

The OCS work force generates additional emplaned passenger travel demands at facilities they pass through between their home and work locations. Although some OCS work force travel demands are handled by contract or charter air carriers, the majority of travel is done on scheduled commercial air carriers. Within the schema of this methodology, these travel demands are distributed to airport facilites along the principal travel routes and subsequently converted to aircraft flights. The added operations and passengers at each affected airport can then be evaluated for their influence on reducing available airfield capacity. The discussion that follows details this process including the distribution of OCS related operations to affected airports. The analysis of impacts is the same as described earlier.

The beginning point in developing OCS work force travel demands is the OCS Petroleum Employment Model used by MMS. The model breaks OCS employment into 21 major tasks and some tasks are further refined to show transportation support employment. For each major task, estimates are made (by MMS) of crew size, rotation factor, and task duration, among other factors. The percentage of out-of-state commuters and distribution of in-state commuters is also included as input to the model. Output from the model includes average annual employment by task, as well as a summary of jobs by place of permanent residence.

The employment model tasks can be identified as onshore or offshore activities. This distinction is useful for determining offshore travel requirements, therefore, this methodology organizes the tasks into these two categories. The first step involves converting the average annual employment output by the model to peak month employment and distributing these in accordance with the residence rules of the model. The model's inherent assumptions pertaining to task duration are used to develop peak month employment. To do this, total annual employment is divided by expected task duration (instead of dividing by 12 months per year for average monthly employment). Multiplying average peak month employment by the model-is percentage of out-of-state commuters gives peak month employment from outside Alaska. The remaining number of peak month employment is then distributed on the basis of the model's assumptions pertaining to employment distribution within the State. The *result* of these different distributions for each task is peak month employment by place of permanent residence.

Using rotation factors and assumptions about actual time onsite and offsite, a peak month trip factor must be developed for each model task. The trip factor is defined as the ratio of 30.4167 days per month (based on 365 days per 12 months) and the sum of number of days offsite plus number of days onsite. This factor attempts to identify the number of trips made during the peak month.

$$\text{Trip Factor} = \frac{30.4167 \text{ days per month}}{\text{number of days offsite} + \text{number of days onsite}}$$

The peak month employment developed earlier for each major region of Alaska and Outside is multiplied by the trip factor. The result for each task/sub task is a distribution of peak month air travel demands, by origin/destination, by year. The term “origin/destination” is used here to refer to the location where an OCS worker originates and ends each rotation to the job site (i.e. residence location).

In the next step, all the onshore tasks are summed and the offshore tasks are summed to get total offshore and onshore travel demands. The total offshore travel demand represents the number of round trips to be served by helicopter. In the last step, both total onshore and total offshore trips *are* then summed to arrive at total OCS employment air travel demand.

Based on the routing selected for OCS trip making, as suggested by the petroleum development scenarios and the origin/destinations used to distribute trips, the next step is to sum the trips flowing to and through each of the facilities along-the route. *As* mentioned above, offshore helicopter trips to a local community or to the service base are determined from the total offshore travel demand. If activities are widely disbursed around the periphery of the lease offering area it may be necessary to break out these demands by locality and treat each separately.

For simplicity, the trips should be summed going in one direction, for example from the lease area to permanent residence. Trips would be summed first for the service base or bases, then for the next major hub enroute, the second major hub enroute, and so forth until all destinations are accounted for. The resultant number of trip demands for each route into each facility must then be converted to aircraft operations. The requirements for this conversion were discussed in the previous section of this chapter treating non-OCS related travel demands. Total trip demands along each route are divided by assumed aircraft passenger capacity taking into account aircraft configuration and expected load factor, also discussed previously.

In the case where charter aircraft are used exclusively, each resultant aircraft requirement represents both a landing and a takeoff (since workers are traveling in each direction), therefore, to obtain a total charter operations estimate, the requirements must be doubled. This is done for all OCS routes into an airport. Total OCS charter operations are assumed to represent a portion of total air carrier operations at each affected airport. The OCS Case operations are then added to those developed for the Base Case (non-OCS related operations) to produce a new estimate of total air carrier operations. From this point, the evaluation of local facility impacts is as discussed earlier under the section on non-OCS related transportation demands.

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