NORWAY REFINERY

LOCATION STUDY

STANDARD OIL COMPANY (N. J.)

November 15, 1957

ACKNOWLEDGEMENT

The Committee acknowledges its appreciation of the cooperation and valuable assistance rendered to it by all the experts and the members of their organizations who assisted the Committee. These included Mr. G. S. Ranke of the Project Coordinator's Office, Oslo; Captain H.C. Fellingham, Mr. E.H. Harding, and Mr. S.H. Meadows-Taylor of Transportation Coordination, London; Mr. Matthew Radom of Employee Relations; Mr. J. Acquaviva, Mr. R.C. Wilson, and Mr. J.E. Lyons of Esso Research and Engineering Company; Mr. Wilhelm Bugge and Mr. Fredrik Bugge, Legal Counsel, Oslo; members of Norske Esso, Svenska Esso, and many others within and without the Jersey organization.

Mr. Radom is the author of the Human Relations Section of the report and Captain Fellingham of the Marine Section, for which each deserve special commendation. The other portions of the report were prepared by the various Committee members to whom the Committee, as a whole, is likewise indebted.

November 15, 1957

Mr. Brian Mead
Refining Coordination
30 Rockefeller Plaza
New York, New York

Dear Mr. Mead:

In your letter of February 13, 1957, to Mr. C. E. Paules, Mr. D. W. Ramsey, and Mr. J. J. Winterbottom, you asked that a committee be appointed to evaluate potential sites for a new refinery in Norway.

The Committee was appointed. Its study of potential sites for this refinery has been made. Out of more than 30 sites studied only two were found acceptable. By far the better of these is at Slagen, on the west side of the Oslofjord. It consists of about 450 acres and is entirely satisfactory for a refinery. The Committee recommends it as the site for the new Norway Refinery for the reasons set forth in the report.

Yours very truly,

A. J. Ely, *Chairman*
M. H. Clapp
J. A. Knowlton
A. F. Holler *(Alternate)*
C. M. Lathrop
R. B. Spears

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INTRODUCTION

After approximately eighteen months negotiations between Jersey representatives and a Government team headed by the Ministry of Industry, the proposal to build a refinery in Norway as outlined in Jersey's letter of November 27, 1956, was accepted by the Ministry of Industry in their letter of December 19, 1956. These letters according to the terms agreed were submitted to the Norwegian Storting in Report No. 17 from the Ministry of Industry and received an overwhelming approval by that body on March 7, 1957.

Refining Coordination in anticipation of this development appointed Mr. Milton H. Clapp as Project Coordinator and Mr. Gunnar Ranke as Assistant Project Coordinator. They also requested the assistance of interested departments in forming a Refinery Site Committee to cooperate in the development of a suitable location for the refinery. The membership of this Committee is as follows:

Mr. A. J. Ely, Chairman	Esso Research & Engineering Co.
Mr. C. M. Lathrop	Esso Research & Engineering Co.
Mr. R. B. Spears (Imperial)	Transportation Coordination
Mr. J. A. Knowlton	Marketing Coordination
Mr. A. F. Holler (Alternate)	Marketing Coordination
Mr. M. H. Clapp	Refining Coordination

As consultants to the above group, the following have participated actively in the development of this problem:

Capt. H. C. Fellingham	Esso Petroleum	Marine Terminal Facilities
Mr. Matthew Radom	Employee Relations	Human Relations Factors
Mr. James Acquaviva	Esso Research & Engineering Co.	Engineering Field Studies
Mr. G. S. Ranke	Assistant Project Coordinator	Norwegian Business & Political Contacts
Mr. Wilhelm Bugge	Legal Council	
Mr. Fredrik Bugge		Norwegian Business Procedures

Norske Esso, Svenska Esso and Mr. Cronham's office in London have also contributed substantially in the preparation of basic product distribution and transportation studies.

As a basis for this program and to provide adequately for later expansion in throughput and possibly chemical manufacture, the following general characteristics for a refinery site for an initial capacity of 40,000 B/CD were agreed upon:

1. Reasonably level ground with minimum rock.
2. Adjacent or near to ice-free deep water, sufficient for receiving tankers up to 100,000 DWT.
3. Preferred close to rail and road connections.
4. Access to power supply.
5. Good supply of fresh water.
6. Reasonable distance from population center with good labor supply plus housing.
7. Access to mechanical shops for repair work and temporary workers for major overhauls.
8. Size – approximately 500 acres, 2,000 Maal (dekar).

The following general program was adopted for the logical development of this problem based on preliminary assumptions, which were later confirmed by detailed studies, that the Oslofjord would be the most economical location for distribution of the products:

A. Mr. Lathrop and Capt. Fellingham in cooperation with Mr. Clapp as Project Coordinator and Mr. Ranke his assistant made a preliminary inspection of proposals submitted by several communities located on Oslofjord and of other potential sites selected from marine charts and topographical maps of the area. This included inspection of both the land areas and offshore marine aspects.

B. Mr. Holler and Mr. Spears in cooperation with Norske Esso and Svenska Esso prepared basic supply and transporation studies for the principal areas under consideration.

C. Mr. Radom made an on-the-spot review of the effect of Human Relations factors for the principal areas.

D. Local firms specializing in foundation studies and offshore soundings were engaged to obtain preliminary engineering information with respect to the most important of the potential sites.

In the course of the investigations the special soil conditions which were found in the Oslofjord made it necessary to expand the field engineering studies to include practically all possible sites in the area. This has accordingly prevented the Refinery Site Committee from presenting any earlier recommendations.

B SUMMARY

SUMMARY

CONCLUSIONS AND RECOMMENDATIONS

The Committee recommends for the new Norway Refinery a site at Slagen, on the west side of the Oslofjord, based on the following conclusions:

1. The site is entirely satisfactory for the refinery and by far the best one found out of over thirty studied.
2. The only other one considered acceptable is at Jeloy on the east side of the Oslofjord. It is a poor second choice, should Slagen become unavailable for any unforeseen reason.
3. Transportation costs dictate the refinery should be located along the Oslofjord.
4. A products pipe line to Sweden is not economically attractive and should not affect refinery location.
5. Human Relations Factors favor the west side of the Oslofjord – i.e., labor conditions, community acceptance, and National Government preference.
6. Ships of the 100,000-ton class can be accommodated at Slagen or Jeloy without undue delay year round. Ice would be a problem at many other locations.

THE SLAGEN AND JELOY SITES

Slagen

This site is located on the Slagen peninsula about midway between the towns of Tonsberg and Horten. It consists of about 450 acres mostly wooded, with a small amount of farm land. The subsoil is largely rock, sand and gravel with about 50 acres of soft or quick clay. Most of the rock is fairly flat and usable with a small amount of blasting. The Slagen site is adequate for a 40,000-barrel refinery. It will allow for expansion to double that amount or more and, in addition, provide land for the development and growth of chemical plants and other fringe industry.

Jeloy

The only other site considered acceptable is on the north end of Jeloy Island. It is near the town of Moss. It consists of about 275 acres largely farm land, with some woods. It appears to be largely sand and gravel over rock. There is some soft clay on one corner of the property. The refinery could be built on the amount of land in this site but more would be highly desirable.

TRANSPORTATION AND MARKETING

The first step in the Committee study was an analysis of the effects of transportation and marketing costs on the refinery location. Product forecasts show that approximately one-half of the refinery capacity would be consumed in Norway in 1960, with remainder going to Sweden. By 1970, Norway is expected to consume the full refinery output. About 60% of the Norway market is in the vicinity of Oslo. Cost comparisons were made which indicated it would be more economical to locate the refinery along the Oslofjord. They disclosed an operating advantage in favor of the Moss-Horten area (Slagen-Jeloy) over Kristiansand or Stavanger, which

are outside the fjord, of around $350,000 per year. With that advantage site searches were limited to the fjord, although Stavanger on the west coast was inspected.

Included in the transportation costs studies was a possible product pipe line to Sweden which proved wholly unattractive as an investment. It had a return of less than 5% after taxes. It was, therefore, concluded that it should not affect the choice of a refinery site.

HUMAN RELATIONS FACTORS

Factors concerning human relations were investigated and found to be satisfactory in the areas being considered in Norway, and particularly for Slagen and Jeloy. Most of these factors tend to favor Slagen over Jeloy. Both the National Government and community acceptance is better on the west side of the fjord, so are labor availability and labor relations. This also applies to the attitude of employers toward an Employers' Association for joint collective bargaining. Housing is also better. Some of these conditions are brought about by declining whaling industry on the west side of the fjord and the removal of a Naval base at Horten.

LOCATING POSSIBLE SITES

The search for suitable sites was confined to the eastern and western shores of the Oslofjord. Thirty-one were carefully examined before an acceptable site was found. It was known that subsoil of the land along the Oslofjord contained pockets of quick clay that should be avoided when found over extensive areas. A highly qualified local soils expert was engaged to advise the Committee and develop further information on the subsoil conditions. A number of large contractors, who had had extensive foundation experience in Norway, were also consulted. Only limited information was available about the subsoil on flat land normally sought for refinery sites because that type of land had not been investigated previously for industrial use. The expert consultant's advice was that some quick clay might be found but it would be in small amounts; however, field tests revealed extensive quantities throughout the fjord area. The Slagen and Jeloy sites are virtually free of this difficult material.

C MARKETING AND TRANSPORTATION

MARKETING AND TRANSPORTATION

The first Transportation and Marketing study with the view of determining the most economical and practical location for the refinery on the Oslo fjord or elsewhere in Norway was completed in May, 1957.

The refinery is intended for a production of approximately 40,000 barrels per C/D of finished products to supply Norske Esso and Svenska Esso beginning in 1960, and it is estimated that Norske Esso alone will sell and distribute the total refinery output in 1970. Norske Esso has a market position in Norway this year of 25.5% and it is estimated that their position will increase in 1960 to 29.7%, and in 1970 to 32%. This increase can be attributed mainly to increase in fuel oil and distillate sales.

It is estimated the following sales by Norske Esso would be supplied from the proposed new refinery and the Vallo refinery:

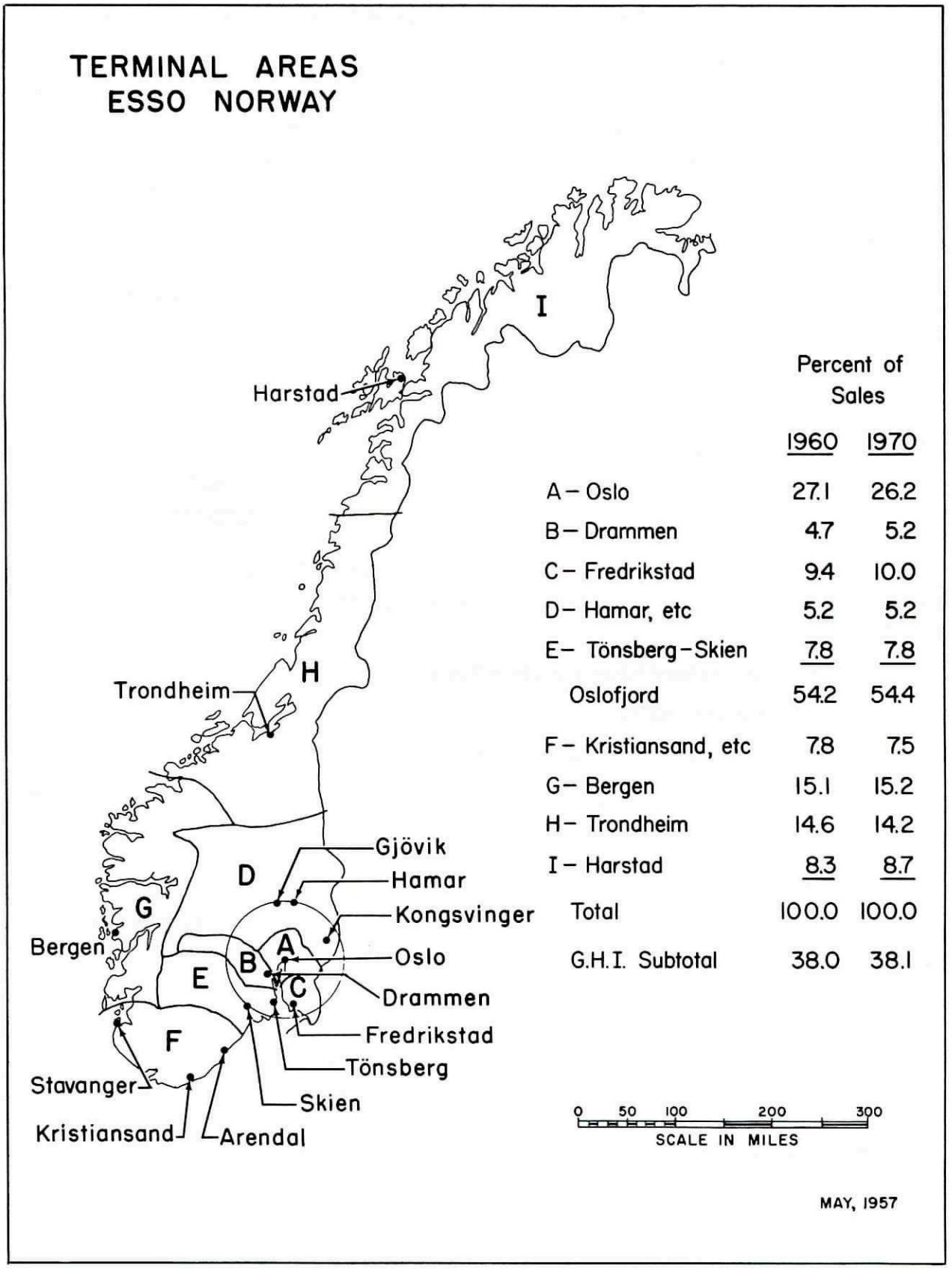
	Norske Esso Sales (Bbls.)	
	1960	1970
From New Refinery	7,752,000	12,520,000
From Vallo Refinery	568,000	710,000
Total	8,320,000	13,230,000

Four cases or locations were originally considered to determine an approximate area favorable from a transportation and marketing viewpoint. The factors involved in this study included:

1. Cost of crude oil transportation to the refinery,
2. Economic size of vessels,
3. Cost of all water deliveries from the refinery to terminals, depots and consumers,
4. Cost of construction of a marketing terminal at the refinery,
5. Marketing plant operating expenses,
6. Marketing distribution by tank truck and tank car,
7. Direct deliveries from the refinery by truck-trailer and/or tank car to western Sweden,
8. A possible pipeline from the refinery to Oslo
9. A possible Swedish pipeline.

The Committee early decided that tanker deliveries from the refinery to Swedish terminals would not vary materially with the different locations and this factor was, therefore, considered a constant. Further, a special study was made in June and July, 1957 by Transportation Coordination, Marketing Coordination, and Svenska Esso to determine the economics of a Swedish pipeline at which time it was not considered practical.

Figure C-1


TERMINAL AREAS
ESSO NORWAY
I
Harstad
H
Trondheim
D
G
Bergen
A
B
E
C
F
Gjövik
Hamar
Kongsvinger
Oslo
Drammen
Fredrikstad
Tönsberg
Skien
Stavanger
Kristiansand
Arendal
Percent of Sales
1960 1970
A – Oslo 27.1 26.2
B – Drammen 4.7 5.2
C – Fredrikstad 9.4 10.0
D – Hamar, etc 5.2 5.2
E – Tönsberg – Skien 7.8 7.8
Oslofjord 54.2 54.4
F – Kristiansand, etc 7.8 7.5
G – Bergen 15.1 15.2
H – Trondheim 14.6 14.2
I – Harstad 8.3 8.7
Total 100.0 100.0
G.H.I. Subtotal 38.0 38.1
0 50 100 200 300
SCALE IN MILES
MAY, 1957

BASIC CASE STUDIES

The May Transportation and Marketing Study report covered the following locations to determine the approximate desirable site:

Case I or Kristiansand which is at the southern-most point of Norway, outside the Oslo fjord, and more favorably located to receive crude oil deliveries and make deliveries by water of finished products to terminals on the west coast of Norway.

Case II or Moss which is on the east side of the Oslo fjord, and about half distance to the end, is in the largest industrial area and ideally situated for overland transport to west Sweden and/or a Swedish pipeline.

Case III or Skjeberg is also on the east side of the fjord and near the southern end.

Case IV or a site near Oslo.

The attached summaries of these calculations are shown on Figures C-2 through C-6 and C-8. Figure C-6 covers another site at Horten on the west side, directly across the fjord from Moss. Alternate I in this case considers water deliveries from a refinery at either Moss or Horten to the present Drammen depot for distribution to the Drammen area. The water deliveries to Drammen and Oslo are the same from either Moss or Horten. Alternate II in this case considers closing the present depot at Drammen and making distribution to the Drammen area directly from the refinery (the possibility of an advantage for Horten versus Moss). The results of this study on Figure C-6 indicate that it is more economical to retain the Drammen terminal and, therefore, a refinery site at either Horten or Moss are economically equal for Transportation and Marketing to the Drammen area.

It should be pointed out here that Alternate I, Case I (Kristiansand) considers all tank car deliveries transported by water from the refinery to Oslo with tank car deliveries from Oslo, whereas Alternate II, Case I considers all tank car deliveries directly from the refinery. Figure C-3 shows that water movement of tank car volumes from refinery to Oslo and from there by tank car is considerably cheaper.

A review of Case II, or Moss, on Figure C-4 covers in Alternate I retaining the present depots at Sjursoya (Oslo) and Drammen as compared to Alternate II with a possible elimination of these two depots to be replaced by new depots at the refinery, and at a location on the west side of the fjord near Holmen to serve north and west Oslo. The study indicates Alternate I the most economical. However, it is proposed that a future study be made to ascertain the need or economy of another depot at or near Holmen to provide for the future expansion of business in the Oslo area, instead of increasing the storage at the present Sjursoya depot where construction will be very expensive due to excavation in rock, long pipelines, etc. This future study will depend on future sales and will not affect the refinery location.

It can be seen from these studies that Alternate I predominates in each case.

The location of the sites mentioned are indicated on Figure C-1. Skjeberg is near Fredrikstad, Horten is south of Drammen and rather near Tönsberg. This sketch also indicates

clearly the concentration of Norske Esso's sales around Oslo which is important in determining the Transportation and Marketing economics. There is a concentration of 54+% of the volume through terminals and depots within a 65 mile radius of Oslo, and 28% of the volume is distributed from the Oslo depot. A refinery site near Oslo would, therefore, be ideally situated for Transportation and Marketing operations economy for Norske Esso's sales and considering that the total refinery production will be distributed in Norway approximately 1970.

Another approximate location was studied in September, 1957 when it was evident that there were foundation difficulties along the Oslo fjord. This location is near Stavanger on the west coast (Figure C-1) and the results of Transportation and Marketing study of variable costs are shown on Figure C-7 and C-8. This indicates that operations from Stavanger are $323,500 more expensive than Oslo.

Regardless of the refinery location (presumably on Oslo fjord) the present terminal for imports located on the island of Steilene in Oslo fjord will be eliminated (except possibly for future compulsory stock storage) and the operating expenses, $79,822 in 1957, will be saved. This saving will be a constant for either location. The present terminal is an expensive operation primarily since it is located on an island requiring double handling of products. A refinery on Oslo fjord will provide means for direct shipping barge deliveries to terminals, depots, and large consumers. These factors have all been considered in the studies of variable costs.

A perusal of the variable Transportation and Marketing Costs for both 1960 and 1970, as shown on Figure C-8, shows the validity of the aforementioned assumption that a refinery located near Oslo would provide the lowest Transportation and Operating expenses for Norske Esso. These variable costs are $11,949 in 1970, less than the next favorable location at Moss or vicinity, and $363,603 in 1970, less than the least favorable location near Kristiansand, although there is $120,000 saving per year in crude transportation in favor of Kristiansand, and the same for Stavanger. Since no site is available close to Oslo this case is ruled out. The nearest sites to Oslo which were considered available were at Svelvik on the west side of the fjord, and Son (near Moss) on the east side. However, neither location was considered desirable due to subsoil conditions as reported in the site section.

The next favorable location in terms of variable operating expenses was Moss and/or Horten. Sites were investigated near Moss at Festa, Rigge, and Jeloy Island, and sites near Horten at Nykirke, Borre, and Saltkop. However, as stated in the site section of this report, there were foundation and/or area difficulties with each of these sites.

The studies herewith reviewed did point out the fact that from a Transportation and Marketing viewpoint, a site on Oslo fjord was considerably more desirable than a site outside of Oslo fjord. The economic advantages are shown in the summary on Figure C-8 based on the comparable use of 8000 ton coastal vessels for deliveries to the west coast terminals and the use of 2000 ton and 750 ton barges within the fjord.

Finally, two sites were found on the Oslo fjord, after much investigation, which provided ample area for expansion and acceptable foundation conditions. These sites were Jeloy on an island connected by bridge with the mainland at Moss on the east side, and Slagen on the west side located approximately 7½ direct miles south of Horten, and about 4 miles north of Norske Esso's small refinery at Vallo.

There are certain contributing factors that should be considered pertaining to these sites in conjunction with the economical studies for Transportation and Marketing. First, Jeloy Island is adjacent to Moss which is the most highly developed industrial section in Norway. There is now full employment occasioning a short labor market and housing is difficult to obtain. In order to make tank truck deliveries from a new depot at a Jeloy refinery, the trucks would have to cross a drawbridge, pass over a railroad crossing, and pass through the city of Moss. These conditions are objectionable from an operating viewpoint and are hazardous, although the drawbridge is only opened an average of 4000 times per year and the openings are scheduled to avoid rush hours. It is believed that further regulation could be obtained.

Slagen has a larger usable area and there are no obstructions for tank truck deliveries. The whaling industry centered at Tönsberg is diminishing which would help the labor market and there is more opportunity for housing at this location.

The road conditions from either location are satisfactory but there are no main towns to traverse with deliveries from Slagen. There is at present more neighborhood business near Jeloy due to industry, but it is thought that a refinery at Slagen will stimulate industry in that area and encourage a growing market in the vicinity. However, the tank truck deliveries directly from the refinery at either location are small in relation to the total sales and, therefore, not very influential in the refinery location. The estimated tank truck deliveries from Jeloy are 70,000 bbls. in 1960, and 118,000 bbls. in 1970, as compared to Slagen with 87,000 bbls. in 1960, and 143,000 bbls. in 1970. There is a larger volume from Slagen due to the fact that part of the Moss area will be delivered from a present depot at Fredrikstad. These tank truck deliveries would be made from a small new depot at either location and involve approximately five tank trucks.

A refinery at either location will provide berths for ship bunkering at the dock which service is not now available to Norske Esso. It is estimated that at either location there will be 150 ships bunkered at the pier in 1960 with a volume of 44,200 bbls. and 220 ships in 1970 with a volume of 68,000 bbls. The total estimated bunker sales (barge and pier) 1960 equals 502,000 bbls., and 1970 equals 760,000 bbls.

It should be noted that there are no railroad facilities at either location, although a railroad runs along the mainland shore line at Jeloy Island which would require a railroad bridge to extend the tracks to the island. It has been established previously that the most economical operation for tank car shipments is to transport the products by water to Oslo, and ship the tank cars from this point. However, there is no assurance that conditions in the future might not change and make railroad facilities desirable.

In this connection, a pipeline from Moss to Oslo was studied to determine possible pipeline transportation costs from the refinery to Oslo for certain products versus barge deliveries. It is estimated one 6" line 45 miles long for gasolines, kerosene, gasoil, and diesel would cost $1,320,000, including pump stations, right of way, etc. Considering depreciation, and operating expenses this would show a transportation cost thru the pipeline of 5.4¢/bbl. in 1960 as compared with the barge rate of 2.63¢/bbl.

SWEDISH PIPELINE STUDY

With possible refinery sites available on either side of the Oslo fjord, it was essential to ascertain if a products pipeline from a location on the east side of the fjord into or even across south central Sweden could be justified. It was recognized that with the natural growth of the Norwegian market, product availability for such a movement would decrease yearly but it was anticipated that west coast Norway product demand might be exchanged with Svenska Esso thus releasing sufficient product for movement through the pipeline to Sweden to maintain volume at a relatively constant level.

Subsequently it was established that although the exchange would provide a sea mileage saving of 10%, resulting transportation savings were slightly more than offset by higher port charges applicable to cargoes of foreign origin delivered to Norwegian ports. This calculated disadvantage was of minor significance and was not considered in the pipeline studies.

Transportation Co-ordination with the assistance of Marketing Co-ordination and Svenska Esso prepared the various studies summarized on Figure C-11. The low returns on investment shown for the various cases considered, varying from 1.6% to a maximum of 5.5%, indicated that this project was not attractive. The Site Selection Committee therefore felt that the selection of a site would not be affected by a possible products pipeline across Sweden.

Details of the case studies 1-A through 11-C are shown in the Appendix, reference Figure G-38 through Figure G-43 along with a map of the proposed route of the line from a refinery near Moss.

COMPARISON OF SITES

The study of the Slagen site versus the Jeloy site from the viewpoint of Transportation and Marketing economics is detailed on Figures G-1 through G-4 in the Appendix. This study included all variable expenses, including depreciation for a new depot at the refinery; other plant expenses such as labor, electricity, heating, maintenance, telephone and taxes; tank truck delivery expense, refinery expenses charged to marketing such as tank thru-put charges, barge loadings and bunkering; and also tank car transportation charges from Sjursoya, as well as all water transportation charges from either location to terminals, depots, and consumers. The recap of these costs are shown on Figures C-9 and C-10. Also is shown the savings in crude transportation in 1960 and 1970 of $17,131 in favor of Slagen. The result of this study as shown amounts to a total savings in 1960 of $25,887, and in 1970 of $32,917 in favor of Slagen.

It should be remembered that Slagen is on the west side of the fjord and in the event a refinery is built there no pipeline can be extended economically into Sweden. Also, no savings could be realized by shipping some products by truck or tank car from the refinery directly into western Sweden. However, these savings are small estimated from Moss or Jeloy in 1960 to total only $8,600, and this saving would be eliminated entirely about 1970 when all of the refinery production is consumed in Norway.

Considering all of the factors enumerated, including the economic studies outlined, also considering the cost of land will probably be considerably less at Slagen and more favorable land available, it is concluded that Slagen is the most desirable of the usable sites as evaluated by the Transportation and Marketing analyses.

NORWAY REFINERY LOCATION STUDY

SUMMARY

	KRISTIANSAND				MOSS				SKJEBERG		OSLO	
	CASE I				CASE II				CASE III		CASE IV	
	Alt. I		Alt. II		Alt. I		Alt. II		Alt. I			
	1960	1970	1960	1970	1960	1970	1960	1970	1960	1970	1960	1970
Gross Annual Cost	$1,263,504	$2,123,596	$1,498,238	$2,495,298	$1,115,532	$1,784,142	$1,314,360	$2,108,681	$1,159,220	$1,855,580	$1,101,783	$1,759,993
Swedish Savings(3)	None	None	None	None	8,600	12,200	8,600	12,200	12,200	16,800	None	None
Net Annual Cost	$1,263,504	$2,123,596	$1,498,238	$2,495,298	$1,106,932	$1,771,942	$1,305,760	$2,096,481	$1,147,020	$1,838,680	$1,101,783	$1,759,993

Note: 1. Moss location might be more desirable for a pipe line to Stockholm and Gavle than Skjeberg and would be definitely desirable for a pipe line from the refinery to Oslo.

2. 8000-ton coastal vessels used for deliveries to West Coast of Norway.

3. For deliveries across border by tank truck and tank car.

Figure C-2

NORWAY REFINERY LOCATION STUDY

CASE I – REFINERY AT KRISTIANSAND

	All figures in U. S. $			
	ALT. I		ALT. II	
	1960	1970	1960	1970
Water Transportation Costs with 8000 T. ship and 750 T. barges – see marine sheet 10	1.093.230	1.784.700	1.052.269	1.719.294
Tank Car Transportation	269.590	429.938	549.843	876.664
Tank Car loading	24.552	39.024	32.737	44.284
Sub-Total No. 1:	1.387.372	2.253.662	1.634.849	2.640.242
Deduct from above: Plant expense, close Kristiansand depot	29.955	43.761	29.955	43.761
Transportation Inland, same as present – no change	–	–	–	–
Sub-Total No. 2:	29.955	43.761	29.955	43.761
Addition to above: Plant Expense – new small depot at Ref.	23.636	29.757	10.893	14.879
Transportation Costs – Coastal customers (not in No. 1)	2.451	3.938	2.451	3.938
Transportation Inland – no change	–	–	–	–
Sub-Total No. 3:	26.087	33.695	13.344	18.817
Grand-Total:	1.383.504	2.243.596	1.618.238	2.615.298
Savings for Crude Transportation favor of Kr.sand	120,000	120,000	120,000	120,000
Total:	1,263,504	2,123,596	1,498,238	2,495,298

Figure C-3

The present depot at Kristiansand will be closed and a new depot constructed beside the Refinery. The deliveries to coastal customers in the Kristiansand area are not included in the Water Transportation costs (as in Case II).

Alt. I assumes that all deliveries north of Oslo will be delivered from the Refinery (Kristiansand) by 8000 tanker to Sjursoya and then delivered from Sjursoya by tank car.

Alt. II assumes that all the tank car deliveries north of Oslo will go directly from the Refinery.

Alt. III What savings could be effected by using a 16.500 ton vessel to deliver products from Kristiansand refinery to Oslo. Saving between 16.500 and 8000 ton vessels is 252.560 – 175.560 = 77.000. Therefore – Total Cost Case I Alt. I 1960 = $1.244.634. However, in order to take deliveries at Sjursoya from full, 16.500 ton vessels additional tankage would have to be built at Sjursoya which would increase this Kristiansand total cost.

REFINERY LOCATION STUDY

CASE II – REFINERY AT MOSS – NORWAY

	Unit U. S. $			
	ALT. I		ALT. II	
	1960	1970	1960	1970
Water Transportation:	821.390	1.315.180	777.390	1.245.880
Tank Car Transportation	269.590	429.938	323.356*	515.543
Tank Car loading	24.552	39.024	20.460	26.049
Sub-Total	1.115.532	1.784.142	1.121.206	1.787.472
Reduction in Present systems				
Plant Cost (present locations, nothing deleted)	no change	no change	153.149†	195.754
Transport Cost (coastal) included in No. 1			0	0
Transportation Costs – Inland Customers – same as present	0	0	198.661†	318.390
Sub-Total			– 351.810	– 514.144
Additions to above for new system				
Plant Cost	0	0	121.974‡	167.250
Transportation Cost (Coastal) included in No. 1	0	0	0	0
Transportation Cost – Inland Customers – same as present	0	0	422.990‡*	668.103
Sub-Total	+ 0	+ 0	+ 544.964	+ 835.353
Grand-Total	1.115.532	1.784.142	1.314.360	2.108.681

Savings – Cost Steilene 1957 = $79.822 – assumed that Steilene will be eliminated for marketing needs in all 3 cases of refinery location.

*Includes part of deliveries (inland) made in Alt. I from Sjursoya and Drammen. Alt. I included 308.000 Tons delivered to Sjursoya by water and Alt. II includes 112.000 tons delivered from Moss to Holmen by water. The difference is included in direct water deliveries, tank car and tank truck deliveries. Alt. I based on the present distribution system including depots at Sjursoya and Drammen. Alt. II eliminates these two later depots and adds new depots at Moss Refinery and a new site on the west side of the Fjord at Holmen.

†Deductions for elimination of plants at Sjursoya and Drammen with the inland transportation from these plants.

‡Additions for new depots at Moss Refinery and Holmen with the new inland transportation costs.

Figure C-4

Figure C-5

NORWAY REFINERY LOCATION STUDY

CASE III – REFINERY AT SKJEBERG

	All figures in U. S. $	
	ALT. I	
	1960	1970
Water Transportation	840.940	1.345.070
Tank Car Transportation	269.590	429.938
Tank Car Loading Expense	24.552	39.024
Sub-Total	1.135.082	1.814.032
Deductions from above		
Plant Expense	49.421	59.363
Inland Transportation	44.337	66.230
Sub-Total	93.758	125.593
Additions to above		
Plant Expanse	41.209	47.614
Coastal Transportation (not in Water Trans.)	9.303	19.789
Inland Transportation	67.384	99.738
Sub-Total	117.896	167.141
Grand-Total	1.159.220	1.855.580

Case III with Refinery at Skjeberg would close the Fredrikstad depot and require a new depot at the Refinery. It is assumed the tank car deliveries north of Oslo would be cheaper from Sjursoya (as indicated in Case I) than from the refinery.

There is no saving in delivery of crude oil to Skjeberg vs. Moss.

Figure C-6

NORWAY REFINERY LOCATION STUDY

REFINERY AT HORTEN (ACROSS THE FJORD FROM MOSS)

Transportation and supplies estimates that all water deliveries from Horten or Moss are the same. Therefore the difference in cost to determine any advantage for Horten over Moss would be determined by the cost of water deliveries for the Drammen area from the refinery to Drammen with tank truck deliveries to the Drammen customers versus the tank truck deliveries to the Drammen customers directly from a depot at the refinery.

	Unit U. S. $			
	ALT. I		ALT. II*	
	1960	1970	1960	1970
Water deliveries refinery to Drammen depot (for area customers):	25.200	49.800		
Inland Transportation from Drammen depot	29.312	52.958		
Inland Transportation from Horten Ref. depot to Drammen area customers (consider closing Drammen depot)			71.651	129.453
Sub-Total	54.512	102.758	71.651	129.453
Consider saving in plant cost at Refinery vs. Drammen depot including depreciation			5.428	4.904
Grand Total			66.223	124.549

It is evident that Alt. I is cheaper operation than Alt. II – Alt. I can be a refinery either at Moss or Horten. However, the Swedish study for transporting products directly across the Swedish border to S. S. and depots shows that there is a saving of $8.600 for 40.900 bbls. in 1960 and a saving of $12.200 for 57.000 bbls. in 1970. This saving to Svenska Esso can only be effected from Moss (not Horten). Also there would be an advantage for a refinery with depot at Moss since tank truck deliveries can be made economically from the refinery to the Moss area which has a larger volume of business than the Horten area. Also depots now exist at Drammen and Tonsberg (Vallo refinery) and this small depot will remain for Vallo refinery products. Also, in the event a Swedish pipeline should become economical it would be advantageous to have the refinery on the east side of the fjord.

*With depot closed at Drammen and deliveries out of refinery at Horten.

Figure C-7

NORWAY REFINERY LOCATION STUDY

SUMMARY

	Unit U.S. $	
	STAVANGER	
	CASE V	
	1960 **Alt. I**	**1970**
	Using 8000 DWT vessels to west coast	
Total Cost – Kristiansand	$1,263,504	$2,123,596
Savings transportation favor Stavanger	23,920	40,080
Total cost Stavanger	$1,239,584	$2,083,516
	Transportation 1960 8,000 DWT Vessels	**Transportation 1970 8,000 DWT Vessels**
Kristiansand	$1,093,230	$1,784,700
Stavanger	1,069,310	1,744,620
In favor Stavanger	$ 23,920	40,080
Assume crude oil delivery costs same as Kristiansand.		
	STAVANGER	
	CASE V	
	1960 **Alt. I**	**1970**
	Using 16500 DWT vessels to west coast	
Total Cost – Kristiansand	$1,263,504 (8000 DWT vessels) 203,880 Saving 16500 vs. 8000	$2,123,596 323,140
Total Cost – Kristiansand	$1,059,624 (16500 DWT vessels) 40,760 Saving Stavanger	$1,800,456 – Total Kristiansand using 16500 DWT instead of 8000 DWT
Total Cost – Stavanger	$1,018,864	$ 73,330 – Transportation saving in favor of Stavanger
However, additional tankage required at Sjursoya and Harstad for 16500 DWT vessels.		$1,727,126
	Transportation 1960 16,500 DWT Vessels	**Transportation 1970 16,500 DWT Vessels**
Kristiansand	$889,350	$1,461,560
Stavanger	848,590	1,388,230
In favor Stavanger	$ 40,760	$ 73,330
Assume crude oil delivery costs same as Kristiansand		

Figure C-8

SUMMARY

TOTAL VARIABLE TRANSPORTATION AND MARKETING COSTS

NORWAY REFINERY				
	1960		1970	
Alt. 1	8000 D. W. T. Vessels* to west coast		8000 D. W. T. Vessels to west coast	
		In addition to Case IV		In addition to Case IV
Kristiansand	$1,263,504	$161,721	$2,123,596	$363,603
Stavanger	1,239,584	137,801	2,083,516	323,523
Skjeberg	1,147,020	45,237	1,838,680	78,687
Moss	1,106,932	5,149	1,771,942	11,949
Case IV (Oslo)	1,101,783		1,759,993	
	*16,500 D. W. T. Vessels to west coast		16,500 D. W. T. Vessels to west coast	
Kristiansand	$1,059,624		$1,800,456	
Stavanger	1,018,864		1,727,126	

*However, additional tankage would be required at Harstad terminal to receive 16,500 ton tankers (tankage at Bergen and Trondheim sufficient) which will reduce somewhat the saving by using 16,500 ton vessels instead of 8,000 ton. Also, new piers and some pipelines will probably be required at all west coast terminals. These details and actual savings must be determined by a future study. Transportation Coordination recommends basing the study on the use of 8,000 ton coastal vessels to the west coast.

Figure C-9

SUMMARY – VARIABLE MARKETING EXPENSE

NORWAY REFINERY LOCATION

	JELOY		SLAGEN	
	1960	1970	1960	1970
Plant Exp. (Ref. depot)	$ 9.550	$ 12.400	$ 9.090	$ 10.700
Tank Truck (Ref. depot)	7.650	12.900	15.200	24.700
Refinery charges	452.000	731.000	451.750	730.400
Sub-Total	$469.200	$ 756.300	$476.040	$ 765.800
Tank Car charges from Sjursoya (Transportation T.C. without loading charges)	$269.590	$ 429.938	$269.590	$ 429.938
Total	$738.790	$1.186.238	$745.630	$1.195.738

Figure C-10

TOTAL VARIABLE COSTS FOR WATER TRANSPORTATION AND MARKETING

A/S NORSKE ESSO

	JELOY		SLAGEN	
	1960	1970	1960	1970
Water Transportation	$ 915.251	$1.465.932	$ 899.655	$1.440.646
Marketing	738.790	1.186.238	745.630	1.195.738
Total	$1.654.041	$2.652.170	$1.645.285	$2.636.384

Savings in favor of Slagen 1960 = 1.654.041 – 1.645.285 = $8.756

Crude transportation saving 1960 in favor of Slagen = $17.131

Total saving in favor Slagen 1960 = 8.756 + 17.131 = $25.887

Savings in favor of Slagen 1970 = $15.786

Crude transportation savings 1970 in favor of Slagen = $17.131

Total savings in favor Slagen 1970 = 15.786 + 17.131 = $32.917

Note: The expenses tabulated cover variable expenses only that are affected by the Norwegian Refinery location. Plant and distribution expenses of other terminals and depots which do not vary with the refinery location are not included.

Figure C-11

SWEDISH PRODUCTS PIPE LINE

SUMMARY OF CASE STUDIES

Case Studies	Return on Investment
1A – Products Line from Norwegian Refinery to Terminal at Uppsala Sweden using 1960 Requirements	1.6%
1B – Same as 1A using 1970 Requirements	5.4%
1C – Same as 1A using 1970 Requirements 8" – Refinery to Karlstad 6" – Karlstad to Uppsala	4.5%
1D – Same as 1C, 1970 Requirement (2 Station Operation)	4.1%
11A – Products Line from Norwegian Refinery to Vasterdas with Spurs to Gavle and Stockholm using 1960 Requirements	2.4%
11B – Same as 11A using 1970 Requirements (12,000 maximum)	5.5%
11C – Same as 11A using 1970 Requirements with maximum of 12,000 B/D. Remainder to be Ocean Transported to Stockholm	4.8%

D HUMAN RELATIONS

HUMAN RELATIONS FACTORS

As stated in the summary, a site on the west coast of Oslofjord would be more favorable than one on the east coast, from the standpoint of manpower, industrial relations, community relations and public relations.

Manpower

There are many more industrial establishments in Ostfold than in Vestfold (524 to 336), and the number of employed workers are in about the same ratio (53,518 to 30,900). The respective total population figures, however, are not so disproportionate especially the number of people living in cities and towns:

Population 1954 Census

	Ostfold	Vestfold
In cities and towns	56,937	48,371
In rural districts	135,615	115,051
Total	192,552	163,422

Thus, it can be seen that Vestfold has a slightly larger labor market available for new establishments for if one divides the number of present establishments into the two populations, the quotients are 367 for Ostfold and 487 for Vestfold.

In addition, a downtrend is expected in the whaling industry – which is centered in Vestfold – and this will ease the labor market in that area even more in the future. On the other hand, industry is expanding in Ostfold and the already tight labor market will become even tighter on the east coast of Oslofjord.

Due to the manpower shortage, as well as other factors, the manufacturers in Ostfold have expressed some apprehension about the refinery being located there whereas this sentiment has not been voiced in Vestfold. The National Government has already indicated its hope that the refinery would be located in Vestfold because of the factors mentioned above.

Industrial Relations

The voting behavior in the two areas gives some indication of the kind of thinking which may be encountered in the development of attitudes towards the new private enterprise. In both the National and Municipal elections, the Labour Party has consistently polled a majority of votes in Ostfold whereas the Conservatives and allied parties have won majorities in Vestfold. In addition, it is known that in the Skjeberg area of Ostfold, the local union leaders have from time to time opposed their national leaders and caused them embarrassment by unauthorized strikes.

The new company will undoubtedly be under considerable pressure to join the local Employers' Association for joint collective bargaining. As there are no large companies in Vestfold, it is possible that this pressure can be withstood more successfully there than in Ostfold (the whaling industry is not represented in the Employers' Association).

Community and Public Relations

The Ministry of Industry has emphasized throughout the refinery negotiations their desire to develop the west coast of the Oslofjord by construction of new industries. It was with great reluctance that approval was finally given for this project to be located on the east coast of the fjord.

While neither Moss nor Sem submitted proposals for locating the refinery in their community, both sites under consideration have the full approval of the community councils. It is believed that this project will have a generally favorable acceptance at either location.

The proximity to Vallo should be helpful to the new refinery. Not only will it be possible to make arrangements to carry out orientation training for new workers in basic refining processes, but the people in the area should have fewer fears about a refinery being located in their area. Vallo Refinery has established itself over the years as a safe and good place to work. It has been an important wage and tax source to the community. It has had stable operations. These items should add up to a favorable community attitude towards a new refinery.

The fact that few people will be uprooted for the Vestfold site and very little farm land will be involved, should help to provide a favorable climate for the new enterprise. Good community and public relations naturally has a better chance to develop in such a climate. Vestfold offers this kind of weather.

Ever since the project was announced, one has the impression that the sum total of feelings about a refinery on the Oslofjord has not been exactly unadulterated happiness. There are many Norwegians who can only visualize the beautiful scenery spoiled, the waters contaminated. The new project needs all the warmth of good public and community relations that it can get. It appears that Vestfold will give it more warmth than Ostfold.

E MARINE

MARINE REPORT

The marine considerations which must influence the selection of prospective sites for a Marine Terminal for the Oslofjord area are:

1. In winter months there are only six to eight hours daylight each day.
2. Most of the inner arms of the Fjord are ice-bound for two to three months each year.
3. Drift ice from the Skagerak is sometimes blown into Oslofjord, blocking the entrances to harbours.
4. The entrances to many Fjords are impeded by submarine pinnacles of rock extending to a few feet below the sea surface.
5. There is no appreciable tide in the Oslofjord, the main fluctuations in water level being due to meteorological influences.
6. Heavy snowfall in winter months makes land difficult to distinguish, even with radar.
7. Fog is most prevalent in winter months.
8. Owing to the great depth of water, suitable anchorages are rare.
9. Gales (winds over 35 m.p.h.) are more frequent in winter months. The prevailing winds are S/SW for the greater part of the year (March to October, inclusive) whilst N or NE winds prevail from November to February, inclusive.

Having regard to the above, sites were sought which have easy unimpeded access from the sea and the main Oslofjord, are reasonably ice-free and sheltered and have suitable anchorages within a reasonable distance. The marine site selected is to be suitable for safely accommodating tankers from 100,000 DWT (OAL 950/1,000 ft., beam 135 ft., summer draught 49 ft.) down to 300 DWT and dumb barges. In general, a least depth of 50 ft. in the approaches to and in the berth area, with a turning area of at least 2,000 ft. off the berth, were considered desirable.

The marine investigation took the form of visits to sites on the Oslofjord having suitable marine access:

(1) Which appeared from charts to have good marine possibilities, or

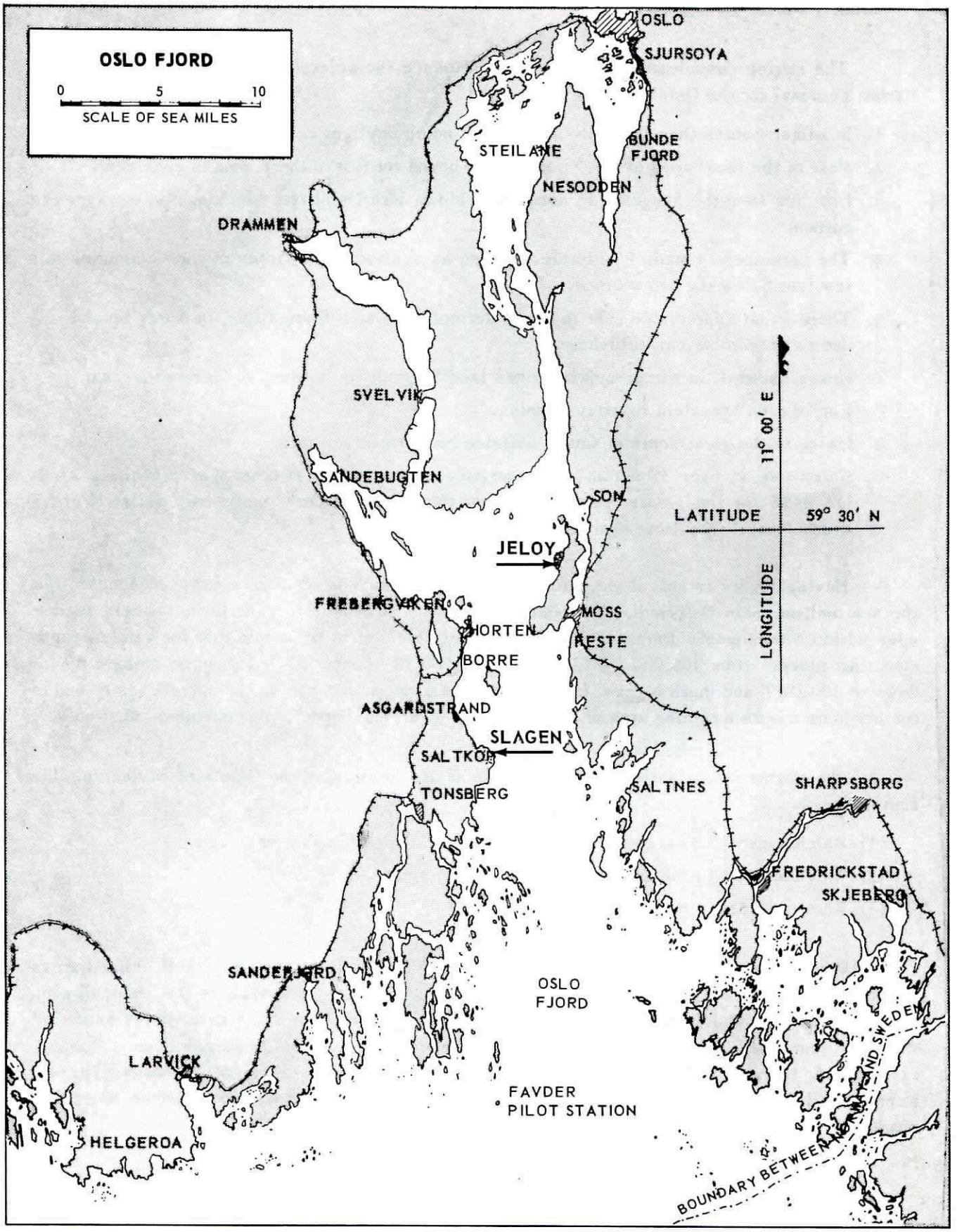
(2) Which appeared to offer good land possibilities, or

(3) Which had been offered for sale.

Wherever possible, the foreshore was inspected from launches. Certain well defined areas in the Oslofjord are obviously unsuitable from a marine point of view such as the archipelagoes south of Tonsberg and in the Frederikstad area. These archipelagoes are extensively scattered with rock pinnacles and shoal spots. Other than these points, the Oslofjord has been thoroughly explored. At the conclusion of site visits the Harbour Directorate, Pilotage Authority, Tugboat Representatives and Meteorological Institute were consulted and prospective marine sites discussed. In addition, some local Harbour Masters were consulted.

Initial stages of the marine investigation were made by Captain H. C. Fellingham in conjunction with Mr. Carl Lathrop of Esso Research and Engineering Company and at its conclusion

Figure E-1


OSLO FJORD
0 5 10
SCALE OF SEA MILES
OSLO
SJURSOYA
STEILANE
BUNDE FJORD
NESODDEN
DRAMMEN
SVELVIK
SANDEBUGTEN
SON
JELOY
FREBERGVIKEN
HORTEN
MOSS
RESTE
BORRE
ASGARDSTRAND
SLAGEN
SALTKOP
TONSBERG
SALTNES
SHARPSBORG
FREDRICKSTAD
SKJEBERG
SANDEFJORD
OSLO FJORD
LARVIK
FAVDER PILOT STATION
HELGEROA
BOUNDARY BETWEEN NORWAY AND SWEDEN
11° 00' E
LATITUDE 59° 30' N
LONGITUDE

the following five locations were put forward as acceptable marine sites:

(1) Skjeberg
(2) Saltnes
(3) Feste
(4) Borre
(5) Saltkop

A summary of these marine sites is given in Table E-1 attached.

Subsequent to the selection of these sites, the land sites with which they are associated were proved to have unsatisfactory load bearing qualities and consequently it became necessary for the site investigation to be approached from a new angle. With the exception of Sandebugten which was later thought to have good marine possibilities, each subsequent marine site was selected because of it being the nearest suitable marine location to a prospective land site. Sites which come under this category are – Son, Frebergviken and Svelvik which together with Sandebugten, are summarised in detail on Table E-2 attached. The search for land sites was now also directed to certain locations outside Oslofjord as a result of which the Langesund area south of Larvik and the Stavanger area on the west coast, were examined from a marine point of view. As a result, three further possible marine locations were selected; at Helgeroa, south of Larvik and at Forus and Randaberg at Stavanger and are summarised in detail on Tables E-2 and E-3.

The latest phase of the land site investigation indicated that two sites in the Oslofjord have distinct possibilities. These two sites, Slagen and Jeloy, appear now to be the most desirable land sites found in the Oslofjord and as a result, were thoroughly inspected and studied from a marine point of view. A detailed summary and comparison of the two marine sites associated with Slagen and Jeloy is contained in Table E-4 attached.

MARINE EVALUATION OF SITES

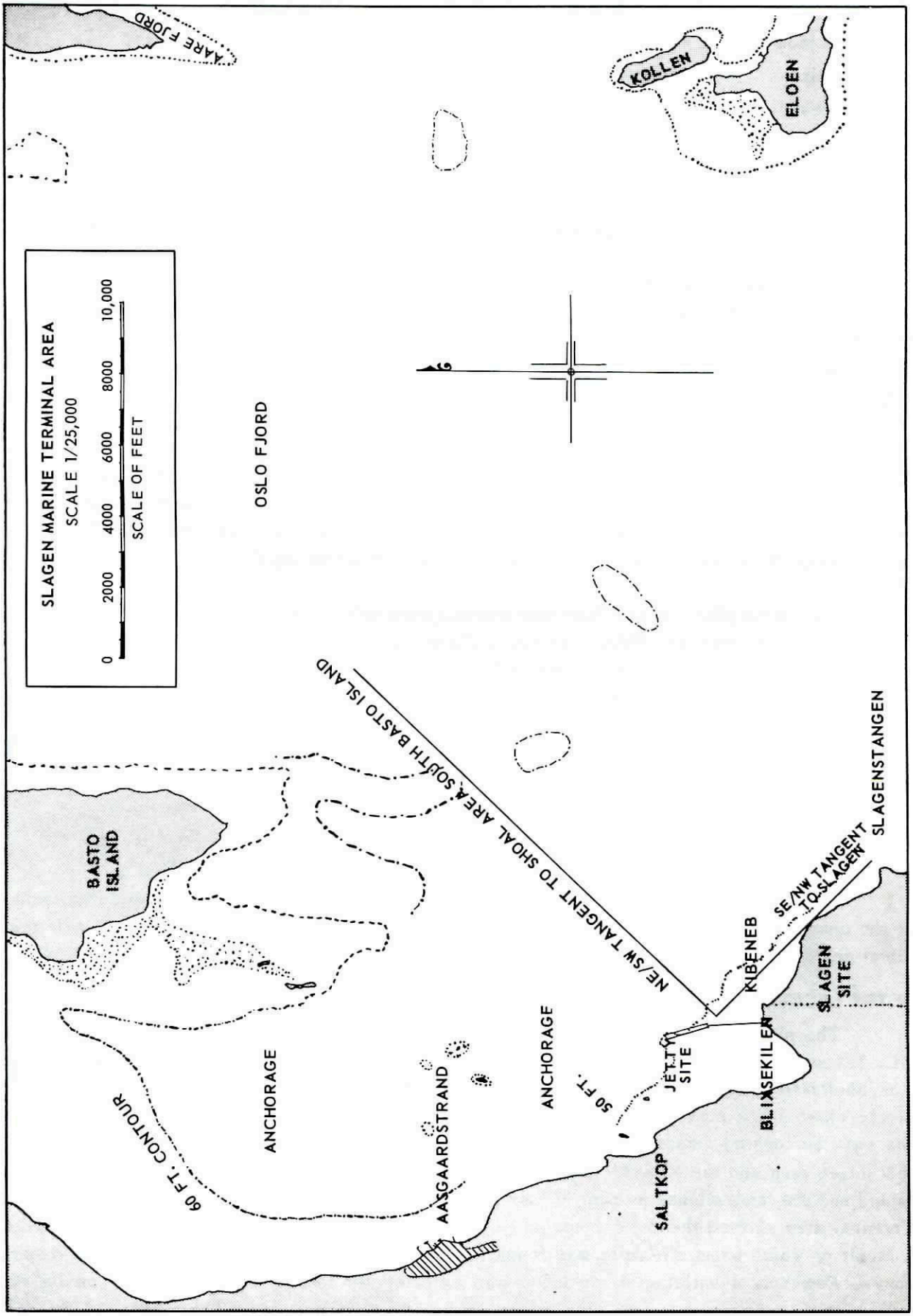
SLAGEN

The Marine Terminal to serve a refinery constructed at the Slagen site would be located at the coastline bordering the north end of the site. The approaches from sea (twenty miles) are direct and danger-free. Extensive, well-sheltered anchorages are in the near vicinity.

JETTY LOCATION:

The site is exposed to the NE and E and the strongest winds blow from the NW, N and NE. Sea swell caused by the prevailing S and SW winds rounds Slagenstangen and radiates into Aasgaardstrand Bay. In order to give maximum protection from the wind and swell, a close study of the chart and a survey trip by boat was made as a result of which it was recommended that the jetty be located outside of the area bordered by the SE/NW tangent to the northern point of the Slagen area and the NE/SW tangent to the southern tip of the shoal extending south of Basto Island and the jetty aligned as near N/S as possible (Fig. E-2). A Soundings Survey of the Marine Terminal area showed the depth contours to be very irregular in direction and closely spaced as a result of which some difficulty was found in locating the jetty site to meet the above requirements. However, a satisfactory location was selected for the jetty which would consist of a

Figure E-2


AARE FJORD
KOLLEN
ELOEN
SLAGEN MARINE TERMINAL AREA
SCALE 1/25,000
0 2000 4000 6000 8000 10,000
SCALE OF FEET
OSLO FJORD
NE/SW TANGENT TO SHOAL AREA SOUTH BASTO ISLAND
BASTO ISLAND
SE/NW TANGENT TO SLAGEN
SLAGENSTANGEN
KIBENEB
SLAGEN SITE
BLIKSEKILEN
JETTY SITE
50 FT.
ANCHORAGE
ANCHORAGE
60 FT. CONTOUR
AASGAARDSTRAND
SALTKOP

finger pier aligned slightly west of north, suitable for accommodating, with minor initial dredging, fully laden ocean tankers up to 100,000 DWT on one side and small coastal tankers and barges on the other. The finger pier would be reached by an approach trestle about 1,400 ft. long.

JETTY USE FACTOR:

This jetty will provide adequate marine facilities for a 40,000 b.c.d. refinery. Delays to tankers at this location due to weather conditions are estimated to average a total of eight days annually due to wind and swell and eighteen days due to fog. Tanker delays due to ice are more difficult to estimate as drift ice only becomes a problem during severe winters which occur on an average every five years. Land-fast ice should not prove difficult at any time. Only on very rare occasions are ocean-going tankers unable to navigate in drift ice without the help of ice breakers. From statistics provided by the Norwegian Meteorological Institute, the average total annual tanker delays due to ice should be about thirteen days. Slagen is considered a good site for avoiding the worst ice conditions.

FUTURE EXPANSION:

For future expansion, this jetty could be adjusted to accommodate up to 100,000 DWT tankers on one side and up to 47,000 DWT tankers on the other. A bulkhead type dock located either inshore or on the approach trestle could then be constructed to accommodate small coastal tankers and barges. Should it become necessary to construct an additional ocean tanker jetty to serve this location, its siting would be difficult, but not impossible.

The Marine Terminal area at Slagen lies within an area used as a Naval practice zone for mine laying, but the authorities have indicated their willingness to release and clear the area, if required.

For a comprehensive summary of this site, see Table E-4.

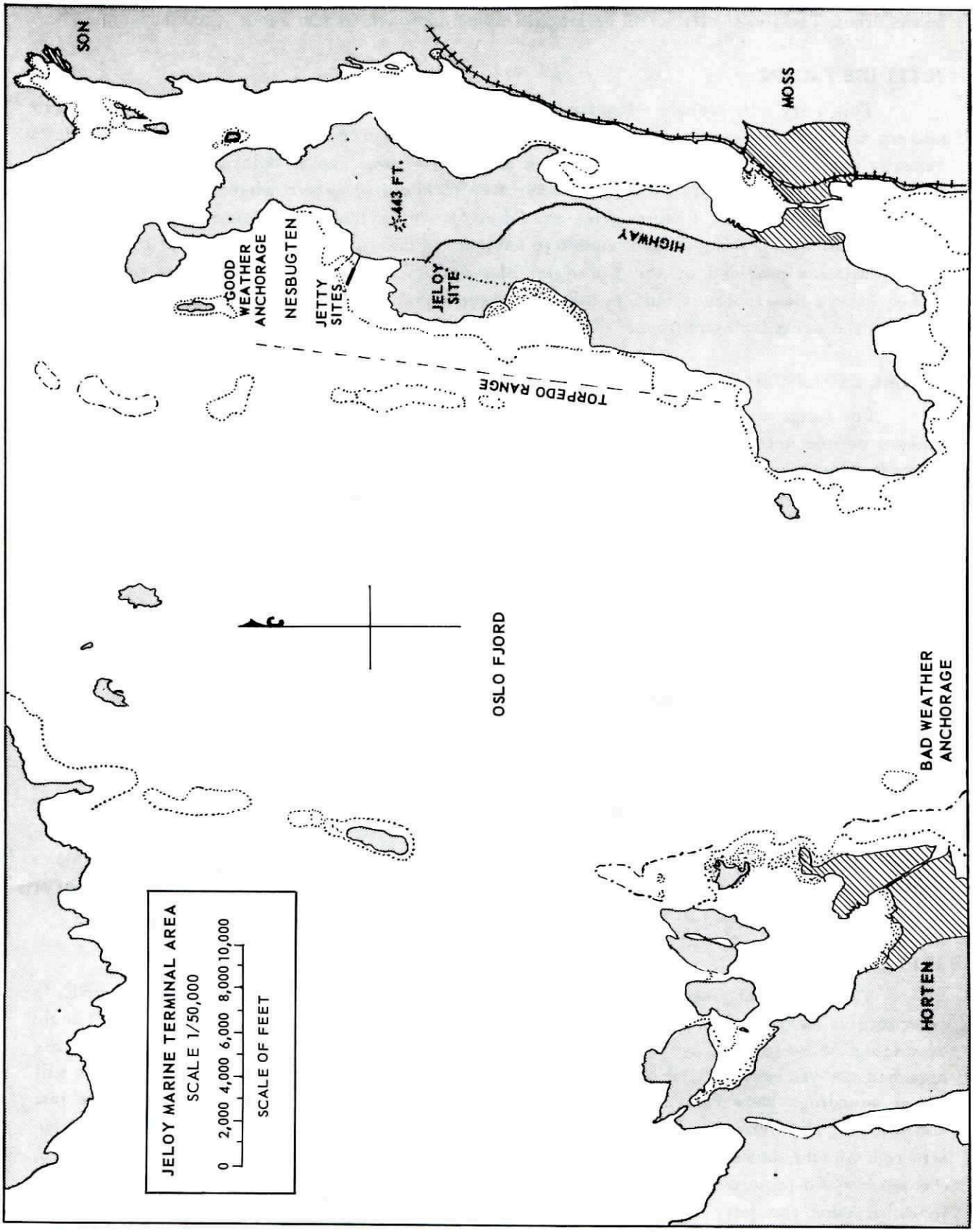
JELOY

The Marine Terminal to serve a refinery constructed at the Jeloy site would be located at the coastline bordering the northern end of the site in the southern part of Nesbugten. The approaches from sea (thirty miles) are easy, the few shoals being easy to avoid, but would require navigational lighting for night navigation. Good anchorages are available for large tankers within one mile of the jetty, but during gales from SW/W/NW, tankers will have to anchor at Langrunden in the vicinity of Horten, six miles away.

JETTY LOCATION:

The site is exposed to SW/W/NW and the strongest winds blow from NW, N and NE. In order to give maximum protection from the wind and swell it is recommended that the jetty should be aligned so as to head in the direction of the worst conditions. As a Soundings Survey of this area has not yet been carried out, it is impossible to say at this stage, what direction this will be. If soundings show that a sufficient deepwater area exists close enough to the shore just northward of the Refinery site, it is recommended that a finger pier aligned about WNW be constructed. Should, however, shoal water force the jetty to be located further out into Nesbugten, the jetty would require to be aligned into the SW swell which may be expected to be prevalent. In either case the jetty will be suitable for accommodating ocean tankers up to fully laden 100,000 DWT on one side and small coastal tankers and barges on the other. The finger pier or

Figure E-3


SON
MOSS
443 FT.
HIGHWAY
GOOD WEATHER ANCHORAGE
NESBUGTEN
JETTY SITES
JELOY SITE
TORPEDO RANGE
OSLO FJORD
BAD WEATHER ANCHORAGE
HORTEN
JELOY MARINE TERMINAL AREA
SCALE 1/50,000
0 2,000 4,000 6,000 8,000 10,000
SCALE OF FEET

island type jetty would be reached by an approach trestle, the length of which will be determined by location and is expected to be from 1,600 to 2,200 ft. Initial dredging may, or may not be required.

JETTY USE FACTOR:

This jetty will provide adequate marine facilities for a 40,000 b.c.d. Refinery. Delays to tankers at this location due to weather conditions are estimated to average a total of 8 days annually due to wind and swell and 20 days due to fog. Tanker delays due to ice will be similar to those experienced at Slagen and are estimated to average about 14 days annually. Jeloy is considered a good site for avoiding the worst ice conditions.

FUTURE EXPANSION:

For future expansion the initial jetty could be adjusted in a similar manner to that recommended for the Slagen site. Should it become necessary to construct an additional ocean tanker jetty to serve this location, its siting would be difficult, but not impossible. The Marine Terminal area at Jeloy is designated as a Naval practice zone for mine laying and a torpedo range is established in its approaches. The authorities would have to be approached for the release and clearing of both these areas before a Marine Terminal could be located.

For a comprehensive summary of this site, see Table E-4.

NOTE: At both the Slagen and Jeloy marine sites tugs will be required for all ocean tankers when berthing or unberthing. At present, there are no tugs in the Oslofjord of a suitable size or horsepower for the volume or size of tankers expected to serve the new Refinery. The local Tug Companies have indicated that they would be interested in providing a tug service for a Terminal at whatever position in the Oslofjord it was located, but have pointed out that as tugs take two years to build they should be advised in good time before tugs are to be required. Tugs serving a Refinery located in the Oslofjord should also be able to perform ice breaking duties.

SUMMARY OF ORIGINAL MARINE SITES

FACTOR	SKJEBERG	SALTNES	FESTE	BORRE	SALTKOP
BASIS FOR SELECTION	Land Site Offered for Sale in Vicinity	Good Marine Site	Nearest Marine Location to Prospective Land Site	Good Marine Site	Nearest Marine Location to Prospective Land Site
APPROACHES FROM FJORD	About 23 miles. Deep but tortuous.	About 3 miles. 4 separate deep approach channels.	Direct and free of dangers.	Direct and free of dangers.	Direct and free of dangers.
MANOEUVRING AT JETTY LOCATION	Good. Tugs required.	Good. Tugs required during bad weather and for very large tankers.	Good. Tugs required.	Good. Tugs required during bad weather and for very large tankers.	Good. Tugs required.
SHELTER	Excellent.	Good but jetty must be sited to give maximum shelter.	Exposed to south-west. Small craft may experience difficulty during winds from this direction. Jetty must be sited to give maximum protection.	Well sheltered. No wind should prove difficult.	Rather exposed to N.E. Jetty should be aligned as near north as possible.
ANCHORAGES	Excellent. Extensive and in near vicinity.	Excellent. Extensive and in near vicinity.	Fairly good, but not extensive.	Excellent. Extensive and in near vicinity.	Excellent. Extensive and in near vicinity.
PUMPING DISTANCE AND HEAD	About 2 miles, 80 ft. More onerous than desirable.	A far greater distance than desirable, about 4 miles. 20-30 feet.	2-4 miles, about 100 ft. Immediate gradient from jetty is steep and may prove difficult for draining operations.	About 1 mile. 30-40 feet.	Adjacent to Refinery Site. 20 feet.
PIER DESIGN	Marginal type with negligible approach trestle.	Marginal type with about 2000 ft. approach trestle over shallow bay.	Marginal type with negligible approach trestle.	Island type with approach trestle about 3,200 ft.	Finger pier or island type. Long approach trestle.
PROSPECTS FOR EXPANSION	Reasonable.	Reasonable.	Limited to about 2 ocean berths maximum.	Good.	Limited.
OTHER FACTORS	Ice may prove difficult during severe winters.	Situated in summer resort area.	Terminal area small and remote from land site.	Regarded best marine location.	Soundings Survey showed depth contours very variable in direction and close together.
DEPTHS AND DREDGING	At all sites a minimum of 50 feet water is available in berth site and approaches, either natural depth or with minor initial dredging. No maintenance dredging will be required. Tides in Oslofjord area are negligible.				
GENERAL RATING	Good.	Good.	Acceptable.	Very good.	Good.

Table E-1

SUMMARY OF OTHER OSLOFJORD MARINE SITES
REJECTED DUE TO LAND SIDE

FACTOR	SON	SANDEBUGTEN	FREBERGVIKEN	SVELVIK	HELGEROA
BASIS FOR SELECTION	Nearest marine location to prospective land site.	Good marine possibilities.	Nearest marine location to prospective land site.	Nearest marine location to prospective land site.	Nearest marine location to prospective land site.
APPROACHES FROM FJORD	Direct and free of dangers.	Direct and except for one easily avoidable shoal, free of dangers.	Direct and free of dangers.	Direct and free of dangers.	This location is not on Oslofjord but 15 miles west. Approaches from sea danger free except for easily avoidable shoals.
MANOEUVRING AT JETTY LOCATION	Space limited; tugs required.	Good; tugs required during bad weather and for very large tankers.	Space limited; tugs required.	Space limited; tugs required.	Space limited; tugs required.
SHELTER	Well sheltered from all directions.	Well sheltered.	Rather exposed to North and N.E., but jetty would be aligned in this direction.	Well sheltered.	Fairly well sheltered from all directions but jetty should be aligned NE/SW.
ANCHORAGES	No suitable anchorage in immediate vicinity. In good weather small anchorage 2 miles distant.	Excellent, extensive and in near vicinity.	Good, but small anchorage in near vicinity.	Good extensive anchorages in near vicinity.	Good anchorages in near vicinity.
PUMPING DISTANCE AND HEAD	Not determined.	Not determined.	Not determined.	Not determined.	Not determined.
PIER DESIGN	Marginal type with negligible approach trestle.	Probably marginal type with negligible approach trestle.	Probably marginal type with negligible approach trestle.	Island type with approach trestle in order of 4,500 ft.	Island type with approach trestle about 2,000 ft.
PROSPECTS FOR EXPANSION	None.	Good.	Limited.	Good.	Good.
OTHER FACTORS	A Soundings Survey of the harbour would be required.	No definite location fixed due to land site considerations. Ice may prove difficult in severe winters.	Difficult land access to terminal site which will be of very limited size.	Strong currents in this vicinity with long approach trestle will make ship handling difficult.	Ice conditions are suspected to be serious quite frequently.
DEPTHS AND DREDGING	At all sites a minimum of 50 feet water is available in berth site and approaches either natural depth or with minor initial dredging. No maintenance dredging will be required. Tides in Oslofjord area are negligible.				
GENERAL RATING	Acceptable for small refinery.	Good.	Acceptable.	Not recommended.	Doubtful.

Table E-2

WEST COAST MARINE SITES

FACTOR	FORUS, STAVANGER	RANDABERG, STAVANGER
BASIS FOR SELECTION	Nearest Marine Location to Prospective Land Site	Acceptable Marine Site
APPROACHES FROM SEA	Thirty miles passage; tortuous but no real dangers. Additional navigational aids required for navigation during darkness or low visibility.	Direct and danger free about 12 miles.
MANOEUVRING AT JETTY LOCATION	Good, but tugs required.	Good; tugs required in bad weather and by very large tankers.
SHELTER	Well sheltered.	Exposed to NW. Jetty should be sited to give maximum protection from this direction.
ANCHORAGES	Good anchorages within 1½ miles.	Good anchorages within 1½ miles.
PUMPING DISTANCE AND HEAD	About 9,000 ft. and 50 ft. involving rail and road crossings.	About 6/10,000 ft. according to route and site. Land site not determined.
PIER DESIGN	Marginal type with negligible approach trestle.	Marginal type with negligible approach trestle.
PROSPECTS FOR EXPANSION	Reasonable.	Reasonable.
OTHER FACTORS	Jetty siting would depend on ability to remove cable crossing Fjord in vicinity.	Terminal area would be remote from refinery site with hills 50/100 ft. intervening.
DEPTHS AND DREDGING	Natural depths exceeding 50 ft. at low water available in berth site and approaches.	Natural depths exceeding 50 ft. at low water available in berth site and approaches.
GENERAL RATING	Very good.	Good.

Table E-3

MARINE COMPARISON OF ACCEPTABLE SITES

FACTOR	SLAGEN	JELOY
BASIS FOR SELECTION	Nearest suitable marine location to prospective land site.	Nearest suitable marine location to prospective land site.
APPROACHES FROM SEA BUOY	20 miles. Direct danger-free approach.	30 miles. Shoals easy to avoid, but preferable to have them lit for night navigation.
DISTANCE BY SEA FROM MAIN DISTRIBUTING PORTS	Oslo 39 miles, Bergen 340 miles, Stockholm 751 miles.	Oslo 28 miles, Bergen 350 miles, Stockholm 760 miles.
SHELTER	Exposed to N.E. and E. Jetty location and alignment can take care of worst conditions.	Exposed to SW/W/NW. Jetty should be aligned so ship will head in direction of worst conditions (to be determined).
ANCHORAGES	Excellent extensive anchorages available 2½ miles from jetty location.	Good anchorages are available within one mile of jetty, but during gales from SW/W/NW tankers will have to anchor near Horten 6 miles away.
PIER DESIGN	Finger pier type. Approach trestle about 1,400 ft.	Finger pier or island type according to location. Approach trestle length to be determined (1,600-2,200 ft.).
DEPTHS AND DREDGING	Minor initial dredging (about 6,000 M^3) will give one berth least depth 50 ft., one berth least depth 37 ft. (negligible tide). No maintenance dredging anticipated.	Soundings Survey required to determine best location for jetty which will give least depth 50 ft. in berth and approaches (negligible tide). Minor initial dredging may be required. No maintenance dredging anticipated.
INITIAL MARINE TERMINAL	One ocean tanker berth suitable for fully laden tankers up to 100,000 DWT on outside of finger pier. Barge and small coastal tanker berths on inside.	One ocean tanker berth suitable for fully laden tankers up to 100,000 DWT on one side of finger or island type pier. Barge and small coastal tanker berths on other side.
PROSPECTS FOR EXPANSION	Inside berth could be made suitable for up to 47,000 DWT tankers and barge and small coastal tanker berths located elsewhere. Initial finger pier could not be lengthened. Additional ocean piers difficult but not impossible to site.	If Soundings Plan shows suitable depths, barge and small coastal tanker berths could be made suitable for ocean tankers. Barge and small tanker berths could be located inshore. Additional ocean tanker finger piers could probably be constructed.
MANOEUVRING AT JETTY LOCATION	Good, but tugs required for all ocean tankers.	Good, but tugs required for all ocean tankers.
PUMPING DISTANCE AND HEAD	<6,000 ft., 100 ft. Satisfactory.	<4,500 ft., 50 ft. Very satisfactory.
FACILITIES	*Tugs:* None presently available – to be developed. *Repairs:* Repair Yards at Horten (6 miles), Tonsberg (5 miles). *Stores:* From Tonsberg. *Fresh Water:* To be developed.	*Tugs:* None presently available – to be developed. *Repairs:* Repair Yards at Moss (5 miles), Horten (11 miles – over ferry). *Stores:* From Moss. *Fresh Water:* To be developed.
ANTICIPATED ANNUAL WEATHER DELAYS: AVERAGE	*Wind and swell:* 8 days (accumulated tanker delays – not consecutive). *Fog:* 18 days (accumulated tanker delays – not consecutive). *Ice:* 13 days (accumulated tanker delays – not consecutive).	*Wind and swell:* 8 days (accumulated tanker delays – not consecutive). *Fog:* 20 days (accumulated tanker delays – not consecutive). *Ice:* 14 days (accumulated tanker delays – not consecutive).
OTHER FEATURES	Terminal area is a naval practice zone for mine laying and will require clearance and release by authorities who have already signified their willingness.	Terminal area is a naval practice zone for mine laying and a torpedo range is established in the approaches. These will require clearance and release by authorities.
GENERAL RATING	An acceptable Marine Terminal site which will adequately serve a Refinery established at Slagen.	An acceptable Marine Terminal site which will adequately serve a Refinery established at Jeloy.

F SITE

SITE SELECTION

Basis for Selection

Preliminary marketing studies indicated that the refinery could best be located along the Oslofjord preferably adjacent to Oslo. Thirty-one possible locations were examined in the search for a suitable refinery site. As a basis for selection the following principles were established by the Committee:

1. A 500-acre tract of reasonably level ground desired.
2. Location adjacent to 50 ft. deep water for year-round operation of 100,000 DWT tankers (initially – 70,000 DWT).
3. Avoid expensive foundation conditions – piling.
4. Road connection essential, rail connections desirable but not essential.
5. Ample fresh water (initially 300 gal./min.).
6. Electric power available (10,000 kw).
7. Convenient to population centers having an available labor supply for both construction and operation (2000 construction workers, 350 permanent force).
8. Access to existing heavy mechanical shops for both day-to-day maintenance and for handling major turnaround work.

Method of Locating Possible Sites

As a result of the presentation before the Storting, there was considerable publicity accorded the project. Newspaper articles brought the word to every community and despite the underlying public feeling that the refinery was to be built at Skjeberg, the Project Coordinator's office received numerous offers by community authorities seeking to have their site favorably received.

Representatives of the Site Committee carefully examined twenty-two such proposals without finding a single worthwhile possibility, including those close to Oslo. The rugged terrain and ice conditions in the Oslo vicinity is such that no suitable site is available. During these investigations, however, six areas were located that outwardly appeared to conform to the basic principles and more detailed examination was begun on the four most attractive. From these it was hoped to select the most suitable.

A local specialist in surface soils and practical geology, retained as an advisor to the Committee, advised that foundation conditions in the Oslofjord were unpredictable. Crews from his organization began a series of preliminary field tests to determine the subsurface soil quality.

In all four cases almost impossible foundation conditions were encountered. The beds of soft clay found in these sites were far more extensive than the experience of local consultants would indicate for two reasons. Firstly, rock foundations form the basis for most construction experience in Norway, as the industrial development has been in relatively small manufacturing

plant buildings requiring small areas as compared to the extensive developments in refinery designs. Secondly, these sites were in farming areas where very little was known of the subsoil conditions as might affect foundations.

Soft Clay Formations – "Quick" Clay

The geology of the Oslofjord is unique in that similar subsoil conditions are found only in one other part of the world – in northern Canada. During the ice age the terrain of the fjord carried an overburden of ice, approximately three-thousand feet thick. The earth's crust was depressed some six-hundred feet. During the retreat of the ice cap the rivers deposited layers of clay material ranging in depth from 3 to 150 feet. As the ice further retreated, the earth's crust regained its shape and these deposits of clay were raised out of the sea to form the present land areas. This peculiar clay structure was originally kept quite firm by its natural salt content. Subsequently, leaching by rain water has removed this natural stabilizing element to the point where many of the clay areas are extremely sensitive to vibration and mechanical working as takes place during construction.

The term "clay" covers a wide range on the scale of structural strength and each location where this material is found must be closely examined. The appended geological map shows the clay areas of Norway in yellow and it can be seen that they were extensive in the Oslo area. Much of these areas, it was found, include a type of clay known as "quick" clay which has been determined by long experience to be a material on which it is extremely difficult and costly to build heavy structures over the extensive areas found in refineries.

Included in this report are photographs of structural failures in this unstable material (See Fig. F-3). For years engineers have worked to perfect ways of containing these quick clays with uncertain success. It was determined from advice of both professional consultants and practical contractors that sites containing quick clay were to be avoided. There remained to find either rock areas that could be easily developed or soil areas other than quick clay. When considering that at least 75% of the Oslofjord shore line is as rocky as Fig. F-4 and much of the soil is clay, there remains very little area to consider suitable for a refinery site.

New Approach to Site Problem

Finding a refinery site took on a new aspect at this point. The eight selection basis principles were again critically examined. Revisions were made to the program as follows:

1. Sites as small as 250 acres would be considered.
2. Rock areas would be considered despite the high cost of development.
3. The search for soil areas containing sand and gravel would be intensified.

The geologist and surface soil consultants advised that the gravel layer or moraine that was formed at the terminal of the ice cap might be of sufficient magnitude for the refinery site. Scattered deposits of sand and gravel could be expected along this narrow band. As only general data was found in the literature regarding the location of the glacial moraine, extensive exploratory soil work was required to define the extent of the moraine. In order to keep investment cost of crude and products lines between the refinery and the dock to a minimum, it was desirable to locate sites on the moraine as near as possible to the point where this sturcture crosses the Oslofjord. This work was further complicated by the fact that the boundary between the clay

soils and the gravel structures is not a clearly defined one. The very nature by which the moraine was formed has created considerable folding and intermingling of clay and gravel deposits. A very preliminary and rapid probing technique was used to search out the more suitable formations. Occasional samples were taken for laboratory examination as a means of calibrating the probe technique. This program was carried out in fourteen new areas reaching from the Swedish border north to Moss on the eastern shore, and from Horten south to Vallo on the west. Visual inspection from Vallo through Larvik, Helgeroa and up the west coast of Norway to Stavanger yielded only two possibilities in the Stavanger area, one of which was worth evaluation.

As a result of this program two acceptable refinery areas were located, one on each side of the Oslofjord. Inspection and quick evaluation indicated that these two sites, Slagen and Jeloy, had sufficient possibilities to warrant a rather detailed engineering evaluation.

SLAGEN

This site is situated on the western shore of the Oslofjord about five miles north of the town of Tonsberg and seventy miles south of Oslo by road. It consists of 450 acres of woodland with a small amount of rather poor farm land at 70-foot average elevation. Most of the area is completely usable for refinery construction. The subsoil conditions consist of sand and gravel in thicknesses from 5 to 25 foot depth to rock. There are soft clay pockets found in about fifty acres of this site so situated that it can easily be bypassed and will present no particular problem. This site is on a remote peninsula jutting out into the Oslofjord; and, as the shore line is rather exposed, it has not developed as a summer cottage area. As a result no special problems in water and air pollution are foreseen; it being expected that the usual design precautions will be sufficient. Fresh water and power are available from nearby Tonsberg.

The Ministry of Industry has expressed a strong preference for situating the refinery on the western side of the Oslofjord. The local community acceptance of this site is favorable and it is expected that their cooperation will greatly aid in acquiring the property. The labor situation in this area is expected to be good, with an adequate supply being available for both construction and operating periods. The decline of the whaling industry, together with the moving of the Naval base from Horten, is expected to contribute materially in this regard.

Being within five miles of Vallo Refinery will prove to be an advantage. Training of operators and mechanics will be facilitated and furthermore an oil refinery will not be a new industry in the neighborhood.

Although the site is not served by a railroad, it is possible to make connections. The line from Drammen and Oslo to Tonsberg and the south is about five miles west of the site. Estimates from the railway authority indicate the cost to be about one-million dollars for a spur to the refinery.

JELOY

This is an island site situated on the northern portion of Jeloy Island approximately forty-one miles from Oslo and three miles from Moss on the eastern shore of the Oslofjord. The fact that it is situated on an island will prove to be no disadvantage inasmuch as adequate communication with the mainland through the City of Moss exists. The island is connected to the

mainland by means of a drawbridge of sufficient capacity for refinery use. This site consists of 275 acres of farm land with some wooded areas included. Its elevation ranges from 15 to 45 feet above the sea. About half of the site consists of sand and gravel of about five foot depth to rock, while the remainder consists of relatively flat sandstone structures that lend themselves to development for refinery use.

This is a summer camp area and a portion of the site is presently being used as a community camping area. It will be necessary to purchase the summer homes as many of them will be rendered unusuable as a result of pier construction. Although there are a few summer cottages along the Oslofjord in this vicinity, air and water pollution are not expected to be major problems in view of the nearby location of pulp and chemical plants in the town of Moss. The usual precautions will suffice.

Adequate supplies of fresh water and power will be available from the town of Moss. The labor situation in the Moss area is one of full employment and the recruiting of operating labor may present some problem. Construction labor will be recruited from all of the Oslofjord area in any of the site developments and, therefore, should present no particular problem at this site. Because of full employment generally throughout the eastern side of the Oslofjord, the Ministry of Industry has been reluctant to give its concurrence to building a refinery along these shores.

Comparative Evaluation

Engineering evaluation studies carried out on the Slagen and Jeloy sites indicated they were about equal from a construction cost point of view; however, the greater availability of land, community acceptance, and labor supply availability favor the selection of Slagen for the proposed refinery. See Table F-1 for a comparison.

It is proposed, therefore, to develop in more detail through the community and the company's legal advisor the procurement of the Slagen site. Should its acquisition prove impossible, which is not foreseen, it would be possible to use the Jeloy site despite its lesser acceptability.

Evaluation of Other Sites

Before selecting the Slagen and Jeloy sites, six of the fifteen areas underwent an engineering evaluation. Table F-2 outlines the results of five of these studies. Saltnes was one of the first investigated but the extensive deposits of quick clay and its remoteness from the sea made this site unattractive. It was estimated to cost a premium of $10,600,000 over the selected Slagen case. Skjeberg was a somewhat similar situation in that the foundation conditions and marine terminal location resulted in a $3,830,000 premium for this otherwise acceptable site.

In the case of Borre not only foundation conditions but lack of area served to disqualify this site. Although it is possible to build a 40,000 B/CD refinery on 100 acres, it was considered that the 75 acres remaining were inadequate allowance for future development.

Saltkop site is adjacent to Slagen and has many of the advantages inherent in the general location; however, the subsoil conditions on this 350-acre site created a $4,400,000 premium that was found to be unacceptable.

Stavanger, on the west coast of Norway, is several hundred miles from the Oslo marketing area. This site was studied in the event it was necessary to go outside the Oslofjord area. It contains the largest acreage of any site examined – there being upwards to 1000 acres available. This site is an abandoned airport and its level terrain has much to recommend it; however, foundation conditions created a $4,400,000 premium. This together with marketing and transportation conditions served to disqualify this site.

Exploratory soils investigation work at Svelvik, Nykirke, Son, Huseby, Feste, Rygge, Dilling and a second site at Borre served to eliminate these possibilities from further consideration. In each instance, extensive deposits of quick clay proved too serious an engineering problem to warrant further work.

Figure F-1

OSLOFJORD

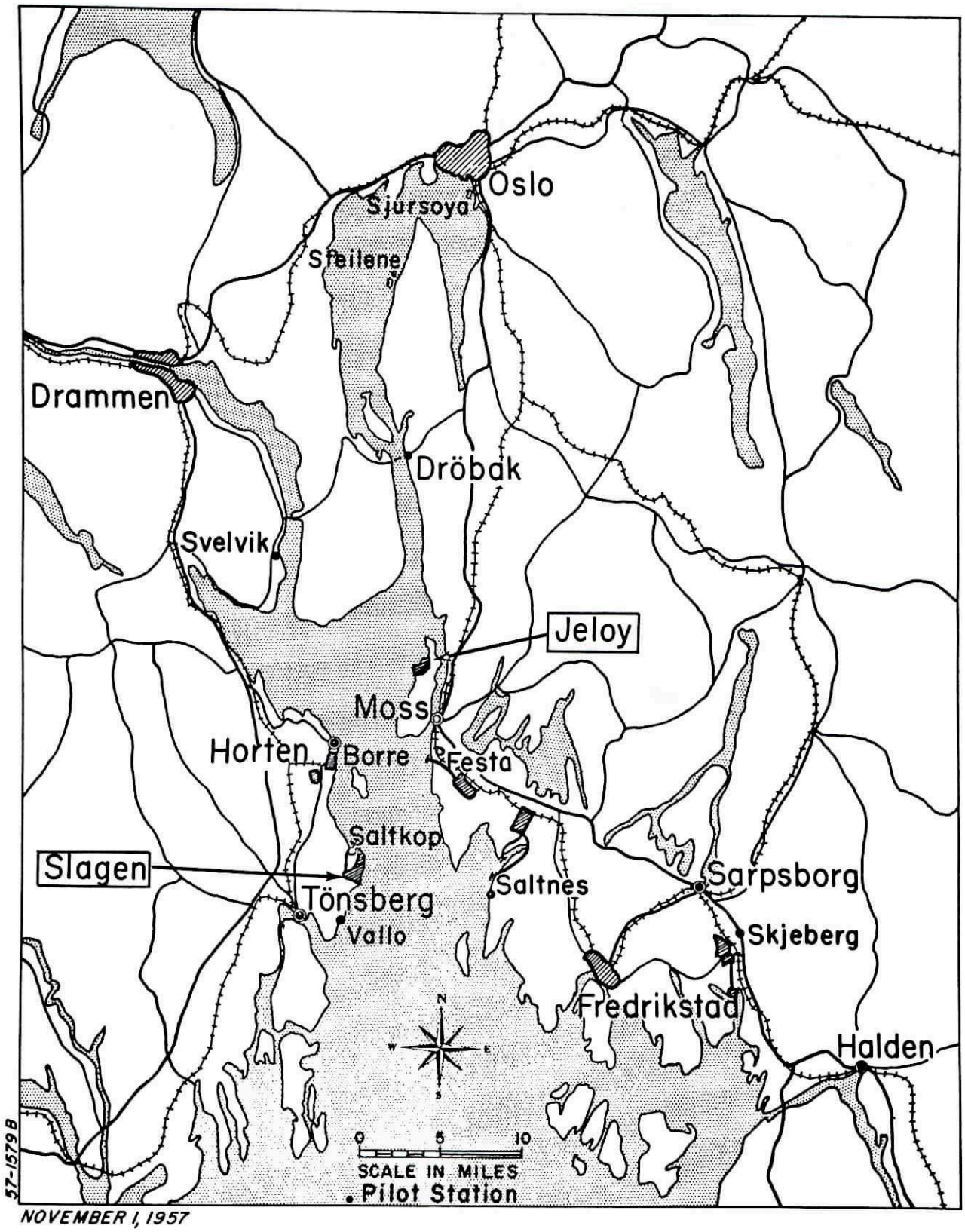
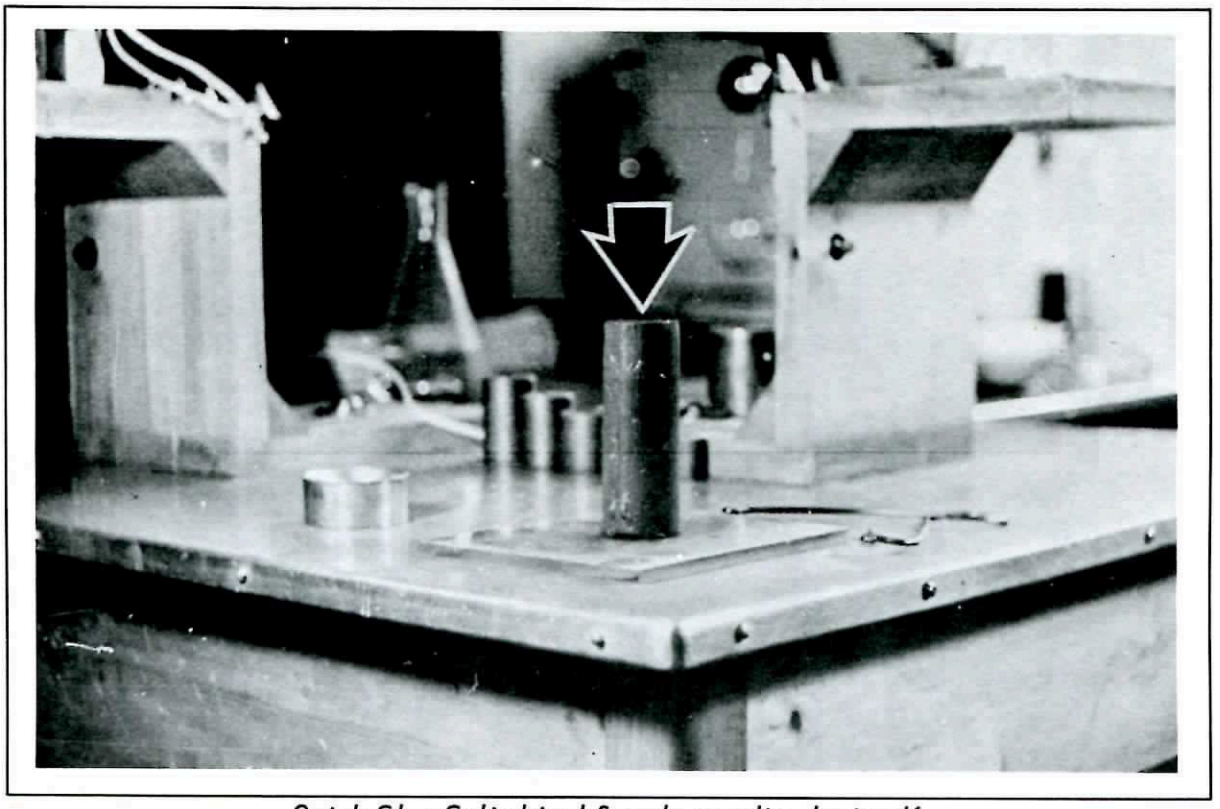
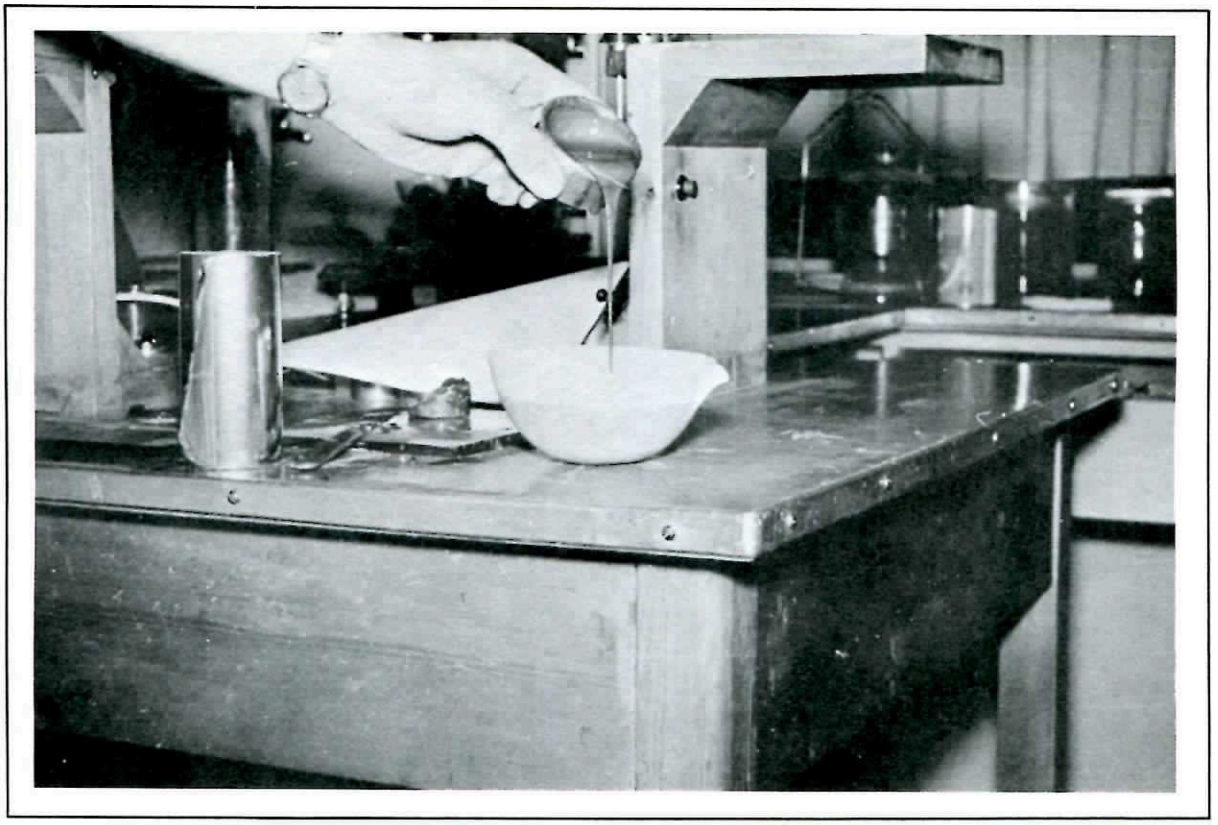


Figure F-2
QUICK-CLAY DEMONSTRATION



Quick Clay Cylindrical Sample standing by itself



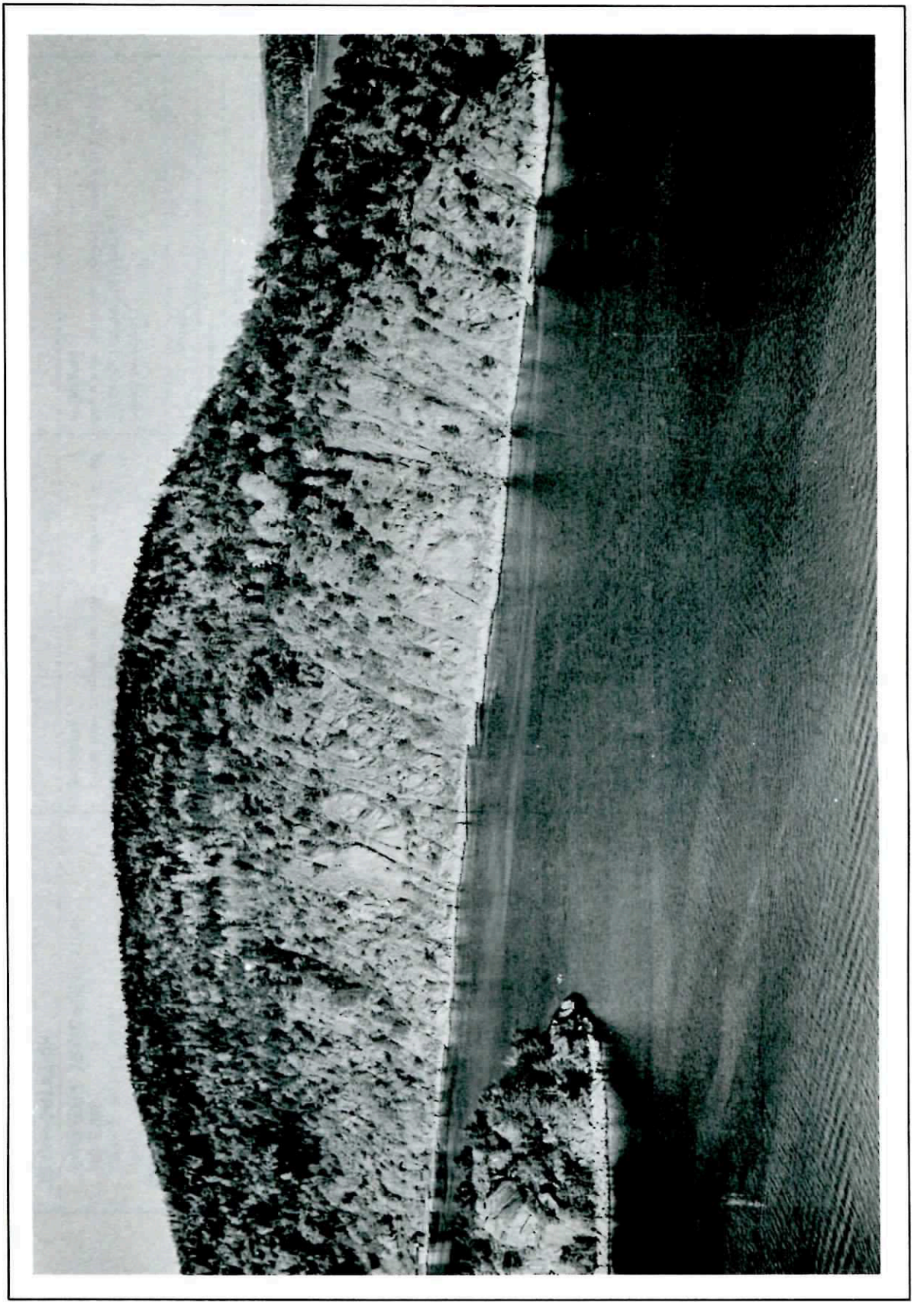
The same clay after agitation can be poured

Figure F-3
QUICK CLAY SLIDES

Highway Entering Oslo

Level farm land flows into adjoining stream

Figure F-4
TYPICAL OSLOFJORD SHORELINE



SUMMARY OF INFORMATION ON TWO BEST SITES

	SLAGEN	JELOY
LOCATION	West Side Fjord – Tonsberg Area 70 miles from Oslo by road, 39 miles by sea	East Side of Fjord – Moss Area 41 miles from Oslo by road, 24 miles by sea
NATURE OF AREA	Isolated rural, with some summer camps	Populous rural, with some summer camps
LAND AMOUNT TYPE ELEVATION SOIL ESTIMATED COST	 450 acres Wooded with some farm land 30 to 100 ft. elevation 5 to 25 ft. sand and gravel over rock Pockets of clay require some piling $2400 per Acre	 275 acres Farm land with some woods 15 to 45 ft. elevation Rock plus 3 to 5 ft. sand and gravel over rock Some piling required in one corner $3600 per Acre
DISTANCE TO JETTY TRESTLE	Adjacent	Adjacent
DRAINAGE & SEWER DISPOSAL	Good	Good
POLLUTION	No problem	No problem
FRESH WATER	7 km of 8 in. line from city	5 km of 8 in. line from city
POWER	Available	Available
STEAM	Not available	Not available
CONSTRUCTION MANPOWER AVAILABILITY MATERIAL HANDLING CAMP SHOPS IN AREA LABOR RATES TRANSPORTATION	 Adequate Thru Oslo, Barge Quay required Contractor estimates $400,000 camp required Shipyard shops nearby Same in both areas Can be readily provided	 Adequate Thru Oslo, Barge Quay required Contractor estimates $400,000 camp required Shipyard shops nearby Same in both areas Can be readily provided
MINISTRY OF INDUSTRY ACCEPTANCE	Strong preference for West Side of Fjord	East Side of Fjord acceptable
LOCAL COMMUNITY ACCEPTANCE	Favorable	Some farmers object
BUILDING PERMITS	No problem	No problem
MUNICIPAL TAXES	15% on income*	17% on income*
REFINERY OPERATIONS MANPOWER AVAILABILITY LABOR RELATIONS HOUSING EMPLOYEE TRANSPORTATION	 Adequate Expected to be good Some new housing required, employee owned Adequate	 Need to attract Expected to be satisfactory More new housing required, employee owned Adequate
TRANSPORTATION RAIL ROAD	 8 km away, not needed now 1 km access road required	 None available, not needed 1/2 km access road required

**There are other Income and Property Taxes but this tax is only major differential between sites.*

Figure F-6
SLAGEN SITE
Reading from top to bottom; northern, middle and southern portion

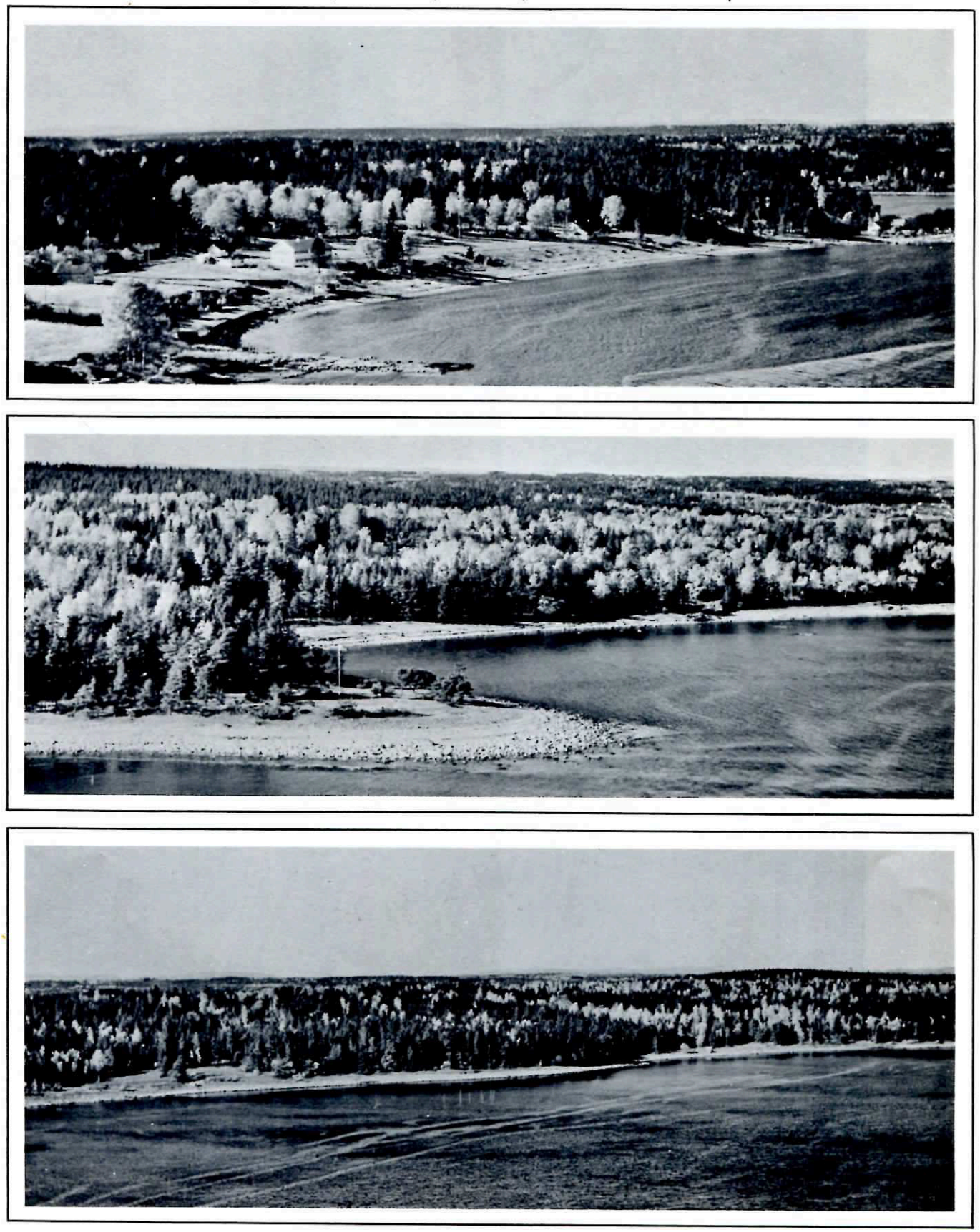
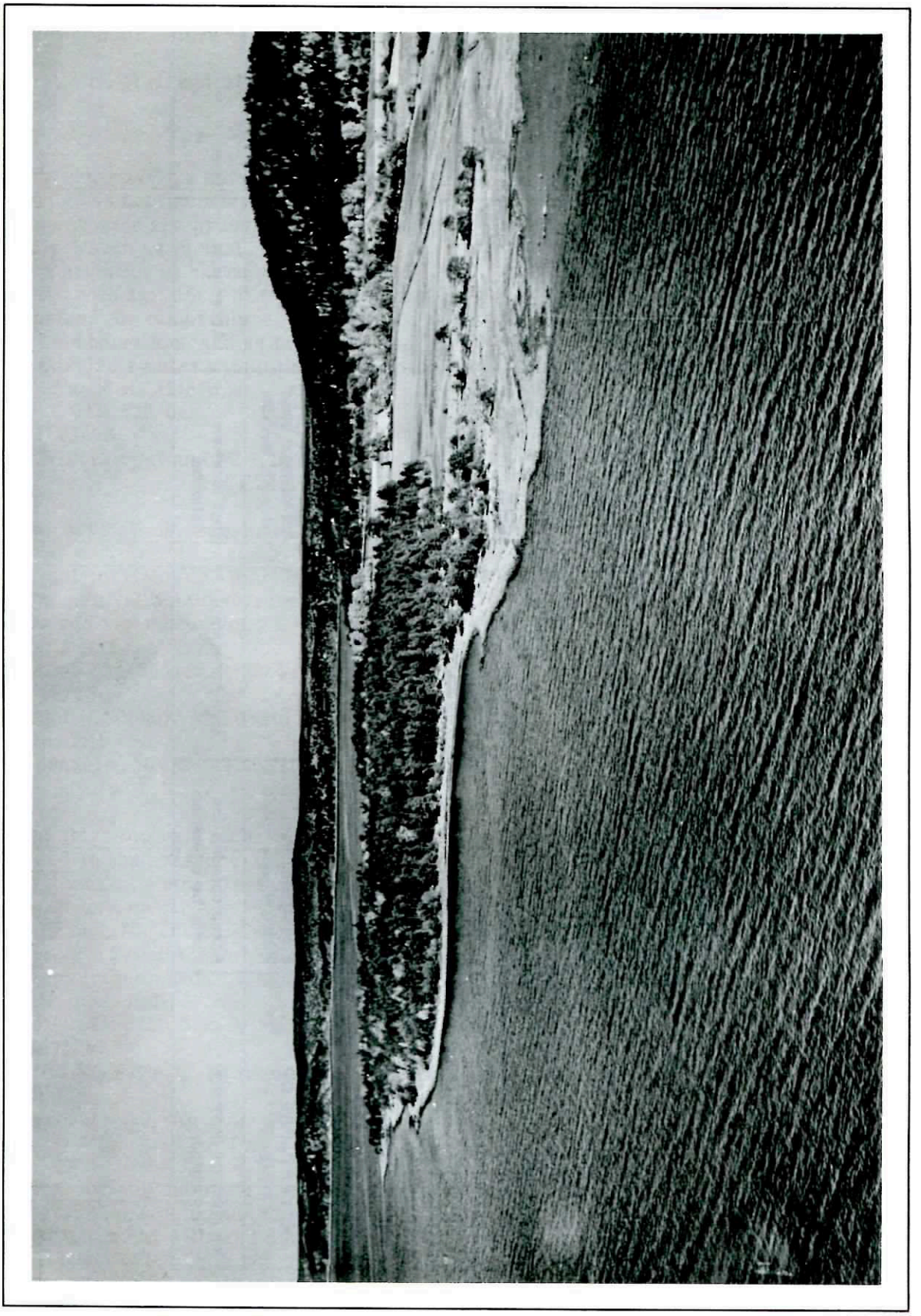


Figure F-7
JELOY SITE LOOKING NORTH



COMPARISON OF SOME REJECTED SITES BY MAJOR FACTOR

	SKJEBERG #1	SALTNES	BORRE	SALTKOP #1	STAVANGER
LAND					
AMOUNT	800 Acres	600 Acres	175 Acres	350 Acres	1000 Acres
TYPE (SOIL, ETC.)	Soft Clay	Quick Clay	Gravel-Clay	Quick Clay	Sand-Clay
ELEVATION	13-30 m.	12-20 m.	0-30 m.	0-13 m.	10 m.
DISTANCES					
TO DOCK	3.4 km	7.3 km	1.0 km	0.9 km	4 km
TO POPULATION CENTER	10 km	15 km	5 km	5 km	4 km
TO RAIL ACCESS	Borders Property	Borders Property	Cuts Property	5 km	
ECONOMICS					
INVESTMENT PREMIUM OVER SLAGEN	$3,830,000	Not Practical to Design	$4,800,000	Not Practical to Design	$4,070,000
COMMUNITY					
ACCEPTANCE OF PROJECT	*With Authorities:* high *With Citizens:* medium	Poor	*Authorities:* good *Citizens:* medium		Not known, Probably Good
RATING OF MARINE TERMINAL	Acceptable but ice may be a problem	Good but remote	Best location studied	Acceptable	Good

Table F-2

Figure F-8

MAP OF SLAGEN