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Economic & Scientific Section

Industry Division

REPORT ON

JAPANESE PACIFIC COAST

PETROLEUM REFINERIES

BY:

JOSEPH K. KELSEY

21 AUGUST 1950

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PREFACE

The report that follows was prepared by Mr. J. K. Kelsey, Visiting Expert Consultant, under the supervision of the Industry Division, Economic and Scientific Section, General Headquarters, Supreme Commander for the Allied Powers.

The services of Mr. Kelsey were obtained through the Department of Army from the Standard-Vacuum Oil Company, New York City, for a temporary duty assignment to the Economic and Scientific Section. At the time of his assignment, Mr. Kelsey was Assistant Superintendent in charge of lubricating oil manufacture at the Paulsboro, N. J. refinery of the Socony-Vacuum Oil Company, Inc.; he has had over twenty-five years experience in refinery operation and construction in the United States and Europe.

His mission, now completed, was to assist and advise SCAP, Japanese Government officials and the petroleum industry on modern and efficient refining operations.

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CONDITION OF REFINERIES AT TIME OF ARRIVAL

The writer arrived in Japan on 4 February 1950, to take over where the work of his predecessor, Mr. H. M. Noel, had ended. The latter's tour of duty ended 10 November 1949. The rehabilitation of the refineries had been started in accordance with the report of the previous consultant and under his supervision; however, the lapse of more than two months' time between Mr. Noel's departure and the writer's arrival was unfortunate. During this period the refineries were preparing to receive crude, finalize further rehabilitation plans, and start initial operations. Largely due to the lack of supervision during this critical period much of the rehabilitation done and future planning was not in accord with the best interests of the program. As a result the refineries in operation at that time experienced more than the usual difficulties incident to starting operations.

The scheduled crude charging rates and actual starting dates are tabulated below:

PACIFIC COAST REFINERIES

	Refinery	Topping Capacity BPD	Crude Alloted BPD	Starting Date
Showa Oil Co.	Kawasaki	6000	4000	29 Jan.
Toa Nenryo Oil Co.	Shimizu	5000	4000	30 Jan.
Nippon Oil Co.	Yokohama	6000	4000	1 Feb.
Nippon Oil Co.	Kudamatsu	6000	4000	30 Jan.
Daikyo Oil Co.	Yokkaichi	1200 (1)	1000 (2)	5 Jan.
Maruzan Oil Co.	Shimotsu	7000	3000	1 Apr.
Toa Nenryo Oil Co.	Wakayama	10000	6000	15 Apr.
Mitsubishi Oil Co.	Kawasaki	4000	3000	1 Aug.
Koa Oil Co.	Marifu	5000	3000	25 Aug.

(1) Vacuum distillation capacity

(2) Topped crude.

The rehabilitation program had expected that topping operations at the first four and vacuum distillation at the fifth refinery were to start on 1 January. All but one were about one month late in starting and none were physically ready to start. This was demonstrated by none of the five refineries being able to maintain their alloted crude rate before mid-April or early May. All had started operating when only able to receive crude and pump it to a distillation unit. A great deal of work on these units and auxiliaries had

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to be done under the handicap of attempted operation. The confusion caused by the premature starts not only reduced product output but also seriously delayed other rehabilitation work.

CRUDE SUPPLIES AND EARLY OPERATION DIFFICULTIES

Rehabilitation plans for all refineries except Yokkaichi had been made on the assumption that a Middle East crude would be processed. The Yokkaichi plant was scheduled to produce kerosene, gasoline, gas oil and lubricating oils from topped crude. The first cargo received contained some cracked components and was not entirely satisfactory, but all successive cargoes have been topped Ras Tanura crude from which satisfactory products have been made. The heavy wax distillate will not be utilized until completion of their B/K dewaxing plant in September.

The specifications on which the first three months supply of crude were purchased for the other refineries, excluding Showa which is covered later, were somewhat loosely written and crudes from a number of sources could fit them. This resulted in obtaining a strictly asphaltic California crude. Immediately following the writer's arrival the Shimizu refinery reported they were unable to produce a satisfactory kerosene. Investigation confirmed the report and, as the crude for the second three months operation was being purchased, negotiations were suspended pending a specification revision. The specification changes were too hastily prepared with the result that the second lot of crude supplied was little, if any, better than the first. Beside failing to produce a good burning kerosene the crudes contained excessive amounts of heavy fuel and asphalt.

All refineries then operating had equipment for making straight and blown asphalt so they started producing at full capacity. Some enlarged their facilities and one cut back its crude charge rate to the amount from which it could make asphalt until facilities could be expanded. This was done without advance knowledge of GHQ and would never have been permitted had it been known. As a result of this scramble, almost from the start of operations, quantities of asphalt far in excess of the small demand were manufactured. In spite of frequent and repeated warnings the manufacture of asphalt was continued at full blast until June. The Shimotsu refinery which started operations on 1 April also launched promptly into asphalt production. By June, refinery inventories, apart from those of distributors, contained more than six months requirements for all of Japan. Production plans for the future will not be below

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the demand until September although some refineries have stopped production.

The Kawasaki refinery of the Showa Oil Company was not included in the crude purchased with GARIOA funds inasmuch as the Shell Oil Company offered to supply them with 4000 barrels per day of Kuwait crude to be purchased with Sterling exchange. This conformed to the topping stage of the program and was approved; however, at the start of operations the Kawasaki refinery received two-thirds Seria and one-third Kuwait crude. As only topping operations were involved no objection was made to this departure from the plan. The Seria crude contains no lubricating oil and when lubricating oil manufacture was started the Kawasaki refinery experienced such difficulty in processing Kuwait crude that their contribution to this part of the program was negligible. They were requested to obtain crudes more suitable to the program but to date have only increased the Kuwait crude to fifty percent of the total.

The fact that the crude purchased for the first six months' operation was not what was orginally planned, was not too big a blow to the program. Being very asphaltic it gave a large yield straight run gasoline of marketable quality with addition of about one cc of TEL per gallon. It also gave the refineries the opportunity to get into production of conventionally treated lubricating oils almost from the start of operations, whereas original plans had called for topping only until May when dewaxing equipment was to be completed.

The specifications for the crude supply for the third quarter operations were very carefully revised to assure that a mixed base crude of low asphalt and fuel oil content was received. Processing of this crude started about 1 August and no production results were available at the time this report was prepared.

REFINERY INSPECTION VISITS

The Yokohama, Kawasaki, Shimizu and Yokkaichi refineries as well as the Navy Arsenal Refinery at Yokkaichi were visited in February. Copies of all inspection reports are attached. With two exceptions, the refineries operating at this time were almost totally devoid of fire protection except for a few portable extinguishers. The safety of personnel and equipment was given last consideration in the programs of rehabilitation. Instructions were issued promptly to all refineries in the program to complete their fire protection at once but this was not done in the majority of cases. The Kawasaki refinery, in

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operation for six months, will not have their fire protection system complete until the end of September.

Another impediment to efficient operation was uncovered during this inspection. All Japanese refineries purchase their electric power from local utilities companies. In the past it has been the custom of the utilities to interrupt services when their distribution systems needed repairs or maintainance. Generally, such interruptions occured with insufficient notice to users. Accordingly, requests were sent to the utility companies serving the refineries proposing no interruption in service unless at least twelve hours advance notice was given. In general the utility companies have complied.

A second inspection trip was carried out between 7-15 March during which time the Kudamatsu, Marifu, Shimotsu, Wakayama and Shimizu refineries were visited. A brief inspection of the bombed Tokuyama Arsenal refinery was also included.

The Marifu, Shimotsu and Wakayama refineries were still in the process of rehabilitation. The purpose of these visits was to see if the work had been done in accordance with agreed plans. The Tokuyama Arsenal, as well as all other arsenal refineries, is not to be rehabilitated and the purpose of the visit was to form an opinion as to what equipment remaining might be transferred to rebuilt plants. In general, except for the Shimotsu refinery, fire protection had been neglected in the refineries visited the first time. Those visited the second time had carried out the recommendations made.

Shimotsu refinery excepted, those visited this time had rehabilitated without adhering strictly to original plans. The Marifu refinery is a case in point. Original plans called for them to rehabilitate the refinery for cracking operations only and to crack a topped crude supplied by another refinery. Their topping unit was completed at this time with work on their cracking unit deferred so that it would not be finished until June. In addition, their boilers were equipped to burn oil and not coal as originally instructed.

The Wakayama refinery, supposed to produce a full line of products, was preparing only a topping still and thermal cracking unit. Their original plans had called for use of equipment transferred from arsenal refineries to be used in lubricating oil manufacture. The Japanese Government had blocked any action on the transfer of this equipment up to this time, therefore, revised plans had to be made using new equipment.

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A third inspection trip was made from 22-30 June. The Kudamatsu, Marifu, Wakayama, Shimotsu, Yokkaichi and Shimizu refineries were visited. One main purpose of this visit, besides the usual inspection of operations and reconstruction, was to determine if inventories of foam powder or liquid maintained in the refineries were adequate for normal fire protection. Pressures and capacities of pumps supplying water for fire protection were also investigated. All refinery pumps were adequate but only Shimotsu had the required inventory of foam producing chemicals; other refineries were instructed to purchase adequate supplies of these chemicals and instructions and data were given for determining the quantity required for each plant.

During the course of this inspection assistance was offered to the Kudamatsu, Yokkaichi and Shimizu refineries in solving any operating problems they might have. In each case assurance was given that no assistance was needed. In the case of the Kudamatsu refinery it should be noted that at the moment their furfural unit was running with an excessive solvent ratio. The yield was very low and it was also being charged at only half capacity.

EFFORTS TO IMPROVE AND COORDINATE PRODUCTION

The refinery program was established for the purpose of minimizing the foreign exchange necessary to supply the Japanese economy with its minimum requirements of petroleum products by importing crude and refining it locally. G-4 Section of SCAP is responsible for the distribution of products and it was necessary to work in close collaboration with them and their Petroleum Advisory Group. To accomplish this purpose the refineries were required to furnish a forecast of planned production for three months in advance. The quantities programmed were firm for the succeeding month and approximate for the other two. It was found that the forecasts were much too optimistic to be useful in determning imports which had to be arranged three months in advance. Several meetings between ESS, G-4 and Japanese Government officials and refinery representatives were held to iron out these difficulties. These conferences indicated that it was desirable to hold a monthly meeting with the foreign advisors of the various oil companies to review forecasts and make changes in production plans where needed and possible. Following these meetings production plans were approved and refineries held responsible for fulfilling them. Refinery performance improved appreciably after this action and imports of finished products were decreased.

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The refineries were also required to supply weekly reports on crude or charge stock consumed and finished and unfinished stock production. These were reviewed as received as a running check on production.

All instructions to the refineries and communications from them were passed through the Ministry of International Trade and Industry and meetings with members of this group were held weekly or more often. They were advised on production problems, installation of refining equipment at various refineries, operating charges proposed by refineries, crude procurement and assignment and miscellaneous problems inherent to the petroleum industry.

The original rehabilitation plan contemplated the use of useable arsenal refineries' equipment to be distributed to the various Pacific Coast refineries. The distribution was to be made to compensate for known refinery deficiences in equipment, particularly for the manufacture of lubricating oils. This plan was almost completely blocked by the Japanese Government on the pretense that without the rehabilitation of the arsenal refineries the installed capacity and planned expansion of the Pacific Coast refineries would be insufficient to meet normal civilian economy needs. This claim was refuted by comparing an estimate of the demand for the next ten years with the total refining capacity now installed and definitely planned for future installation.

Following the above comparison and after insistence from ESS the Japanese Government in July submitted a plan for the equipment distribution of the Tokuyama and Iwakuni arsenals which was acceptable. By this time the operating refineries had arranged to procure most of the equipment needed from other sources and the release of the equipment will now contribute little to refinery capacity.

This arbitrary delay on the part of the Japanese Government is one of the largest factors contributing to present lack of lubricating oil processing facilities. The Wakayama refinery had based their plans for processing lubricating oils on the use of arsenal equipment. They were compelled to change all plans and purchase new equipment. This delay will cost the program 500/600 barrels per day of lubricating oil for more than a year. The production of other refineries was also affected but to a lesser degree.

INCREASED REFINING OPERATIONS

The Shimotsu refinery started operations 1 April 1950, as a complete refinery and on 15 April the Wakayama refinery started their topping unit. Shimotsu was reconstructed with a crude

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topping capacity of 7000 barrels per day; vacuum distillation and lube finishing capacity of 5000 barrels per day of topped crude and assigned 3000 barrels of crude per day. Wakayama was restored to a topping capacity of 10,000 barrles per day although instructions stipulated rehabilitation so as to produce a full line of products from 6000 barrels of crude per day. This brought the original program to its goal of charging 25,000 barrels per day of crude and 1000 barrels per day of topped crude, the quantities orginally calculated as necessary to meet the minimum Japanese requirements.

It is worth noting that the rehabilitation of the Shimotsu refinery was the best observed in Japan. The work was completed very close to schedule dates and very little difficulty experienced in its initial operation. Their fire protection system, though adequate, was not completed until 15 July.

The orignal plans authorized the Mitsubishi Oil Company refinery at Kawasaki to rehabilitate only a thermal cracking plant to be operated on topped crude from another refinery. Never-the-less, they reconstructed a complete combination topping and cracking unit with a capacity of 4000 barrels per day of crude. During April they made formal application for crude to start operating. Yield data from the operating refineries showed that gasoline and fuel demands could be met from the 25,000 barrels per day of crude being supplied them if they topped at their authorized rates. In addition the 25,000 barrels per day of crude were all that were authorized for purchase with Garioa funds and their application had to be rejected. A good deal of pressure was applied both by the Japanese and the United States representatives of the company to supply them with crude either by additional purchase or by taking 3000 barrels per day of crude from other refineries. The basis for this proposal was that the operating refineries were not charging their assigned quantities. However, the Mitsubishi plant was not completed until the end of May and by then the reason for depriving others of crude to their advantage was no longer valid.

An effort was made to supply Mitsubishi with topped crude from one or more of the operating refineries. This failed because, due to the artificial Japanese price structure, no refinery would supply topped crude at a price comparable to delivered price of an imported stock. Unfortunately no charging stock could be made available to Mitsubishi until the Japanese Government in July agreed to allow them Sterling for the purchase of additional crude. Their first cargo was received at the end of July and operations at the rate of 3000 barrels per day started 1 August.

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The Japanese Government at this time also agreed to allow the Koa Oil Company sufficient dollar exchange to permit topping and cracking operation at the rate of 3000 barrels per day. The crude is to be received during the third week in August and operations are scheduled to start about 1 September. At this time crude will be imported for refining operations at the rate of 31,000 barrels per day.

PRESENT REFINING PRODUCTION

At the time of writing, five refineries had been operating six months, two for four months and one just starting operations. Tabulated below are the combined crude and charging stock consumptions and finished stock productions of those seven operating for four or more months. Listed also are demand figures for the principal products which have been reduced by the amounts supplied by the refineries operating on indigenous crude. Quantities are expressed in barrels per day.

SUMMARY OF PACIFIC COAST REFINERIES OPERATIONS

	May	June	July	Demand
Crude	31400	28300	27100	
Topped Crude	1090	1180	1000	
Total Charge	32490	29480	28100	
Gasoline	8230	7900	5960	6400
Kerosene	485	425	740	725
Gas Oil	280	290	665	4150
Light Diesel Fuel	1840	2230	3490	4150
Medium Diesel Fuel	7500	6450	4730	5550
Heavy C Fuel	7350	8450	4550	2970
Asphalt	1760	2160	1560	970
Lubricating Oil	1020	3490	2030	2900

Note: The fuel oil demand figures do not represent the entire requirement but only that part to be supplied by the Pacific Coast refineries, 300,000 barrels per month of Navy Special Fuel Oil is imported for civilian consumption. Lubricating oil production in June and July includes undetermined amounts of blended motor oils from imports stocks.

The excess crude run in May and June was due to the refineries being permitted to charge more than their assigned crude rate to make up earlier deficient charge. As this resulted in too large a percentage of fuel and unfinished products it was terminated in June. Any crude deficiencies existing after 1 July will not be made up.

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The tabulation shows that with only 25,000 barrels per day of Abqaiq crude gasoline production would not quite meet the present demand; however, the gasoline demand figures have been increased over those originally used. The Mitsubishi Kawasaki refinery and the Koa Marifu refinery should add 900 barrels per day each to present production.

Kerosene is already in sufficient supply and now of good burning grade due to the mixed base crude being processed.

The gas oil shortage was caused by the heavy demand for blending marketable fuels. Production in August and after should be adequate to cover the demand and still leave a surplus for heavy fuel blending. However, this will be dependent upon a change in the artificial fuel oil prices now used. Present prices are:

Gas oil	¥ 6557 per kl
Light diesel fuel	¥ 6870 " "
Medium diesel fuel	¥ 5310 " "
Heavy C fuel	¥ 5040 " "

A restudy of all petroleum product prices is presently being made which is hoped will correct the discrepancy between gas oil and light diesel fuel. Unless this is done the present large imports of gas oil must be continued.

Diesel and heavy fuel production should automatically decrease to more reasonable figures due to the type of crude now used. It is not economical to produce all of the Japanese fuel requirements from imported crude.

Asphalt production was described in an earlier section of the report. All refineries now have large inventories stored in drums and some have reported the drums are leaking. Crudes should be imported in the future which will contain less of this product.

The shortage of lubricating oils is not properly shown by the above table. There is over production in the lighter viscosity conventionally treated oils and a dearth of high viscosity solvent or acid refined oils. There is a shortage of 880 barrels per day and, as earlier noted, all lube equipment is not being operated at capacity. Capacity operation would reduce the quantitive shortage to about 700 barrels per day but with negligible effect on the qualitative shortage. The existing shortages are in the following types of products: insulating oils, turbine oils, the medium and viscous grade of machine and motor oils, diesel engine oils, marine engine oils, superheated cylinder oils and bright stocks. Only one

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company now plans to make even the major part of the premium quality oils they sell in Japan.

PROGRAM ACCOMPLISHMENT TO DATE

The results of the effort expended in assisting in the rehabilitation of the Japanese Pacific Coast refineries is shown in the tabulations below of their monthly charging and production rates and also in the record of petroleum product imports for the first half of this year.

PACIFIC COAST REFINERY CRUDE CHARGE AND PRODUCTION FEBRUARY TO JULY INCLUSIVE

(Unit - Barrels per calendar day)

Crude and Topped crude	Feb. 9600	March 12950	April 22400	May 32490	June 29480	July 28100
Gasoline	1870	2360	5150	8230	7900	5960
Kerosene	177	170	388	485	425	740
Gas Oil	277	115	216	280	290	665
Fuel Oil	3520	4100	13050	16690	17130	12770
Lub. Oil	183	755	970	1020	3490	2030
Asphalt	815	1405	1590	1760	2160	1560

IMPORT OF PETROLEUM PRODUCTS FIRST SIX MONTHS 1950

(Unit: Barrels except as indicated)

	Jan.	Feb.	March	April	May	June
Gasoline	53678	108,332	90965	170,547	--	--
Kerosene	13592	29443	6239	--	--	--
Diesel Oil	353428	177767	107659	29896	--	77121
N.S.F.O.	388967	429266	193304	517830	115949	344069
Fuel Oil C	--	--	--	--	45004	--
Lube Oil	96035	93205	19184	54075	20725	14963
				(tons)	(tons)	(tons)
Paraffin	211 tons	--	--	1624	136	568
Grease	907 "	--	--	--	--	--
Sub Total	905700	829013	417351	772348	181678	436153
	1118 "			1624	136	568
Crude Oil	309354	192813	702190	1045693	939732	105760
Total	1215054	1021826	1119541	1818041	1121410	541913
	1118 tons			1624 tons	156 tons	568 tons

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The production listed when added to that of the indigenous refineries, meets the minimum requirements of the Japanese economy with the exception of gas oil and lubricating oil. The gas oil shortage should be covered in the near future, as earlier described, if refinery prices are rationally revised. The lubricating oil deficiency, as also described earlier, will exist for a longer time.

The refineries, after being seriously damaged during the war, were idle and neglected for the following four years. During their reconstruction period other elements of Japanese industry were being reconstructed, and materials, workmanship and deliveries were not usually those desired. Considering all of these handicaps it is felt that the recovery of the petroleum refining industry is commensurate with that of other industires.

RECOMMENDATIONS

There is still a great deal of work to be done before the Japanese refineries will be operating on an efficient basis which will permit maximum recovery of product from the crudes charged. The present time is particularly critical as, starting 1 October, each refinery is to specify the crudes or charging stocks they wish to process.

It is probable that the resulting crudes imported will not be those necessary for a balaneed program unless the procurement is supervised. There is also much rehabilitation work to be done including the construction of additional lubricating oil production facilities.

In the past the refineries have produced only distillate type lubricating oils and all rehabilitation plans have been prepared for the production of this type only. There is a substantial demand for residual type oils which heretofore have been imported and in order to reduce finished product imports to a minimum, provision should be made for producing this type of product. The gas oil deficiency and fuel oil excess mentioned earlier may also be repeated if the crudes are not properly selected.

The writer regrets that this phase of the program occurs after his departure and strongly recommends that a man thoroughly experienced in refining be obtained to advise on these critical points as quickly as possible and to be available until all operations are turned over to the refineries.

To achieve maximum benefit from the program it is recommended that the following be carried out:

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1. That one or more refineries substitute contact filtration for contact rerun plants. This would relieve some of the quality shortage in heavier grades of lubes and increase efficiency.

2. That refineries be urged to install more equipment to recover crystalline wax and petrolatums from their crude. The present crystalline wax production and that planned for the future is far below the demand. As petrolatums are a by-product of the processing of residual stocks there are now no plans for its manufacture.

3. That the refineries develop and initiate a personnel training program. Much of the difficulty experienced to date has been rightly attributed to loss of competent personnel during the long period of refinery inactivity; however, this can be overcome by proper training of technicians by competent officials and engineers. Information and data on this matter secured by Japanese technicians during their recent visits to the United States and guidance by representatives of affiliated foreign oil companies should be made available to the refineries to assist in initiating such a program.

Joseph K Kelsey

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A P P E N D I X A

Report on Refinery Inspection
Trip in February

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Report on Refinery Inspection Trip in February

Note - H_2SO_4 needed by oil industry

Nippon Oil Co., Yokohama

That the present crude supply is not adapted to produce satisfactory quantities nor qualities of kerosene and gas oil for diesel fuel use. Yokohama is having to treat their heavy gasoline fraction with 5 pounds of sulfuric acid per barrel to obtain color and gum stability. From a better crude 2 lbs. per barrel should suffice, if any were needed. Kerosene required a treatment of 11 pounds of sulfuric acid per barrel; from a suitable crude 5/6 pounds per barrel should suffice. Lamp chimneys from their kerosene burning test were examined. It was found that at the end of eight hours burning the chimneys were satisfactory, but at sixteen and twenty-four hours burning they were badly charred. The condition of the wicks were bad at 8, 16 and 24 hours burning.

This data substantiated the verbal report received from Shimizu so present specifications for crude purchased were revised upon return to Tokyo. The revised specifications are to ensure that future supplies of crude will be of mix base. The present supply is too asphaltic or napthenic in character and the proper grade of the two products cannot be economically prepared from such crude.

Conversations with refinery personnel were most satisfactory. They were cooperative, well informed on their equipment and technically appeared to be capable. In reply to questions they said they had no present operating problems on which help was needed.

The inspection, though not detailed, revealed that operating equipment is fairly modern and quite well instrumented. A fair degree of automatic control is possible. Equipment not yet in operation appeared well engineered and likely to be completed by the dates established. Fire protection seemed to be given serious consideration and modern extinguishers were in evidence.

A further and complete survey of fire protection equipment and procedures will be made when the repairs to the plant are more nearly completed.

Showa Oil Co., Kawasaki

Conversations with refinery personnel were satisfactory. A great deal of discussion was necessary to determine the actual status of present operation and prospects for future processing. It was finally determined that they can produce no products for

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sale (finished products) other than gasoline, kerosene, diesel fuel and heavy fuel until after 1 April. This is due to their Bari-Sol dewaxing unit not being completed until 1 April. Lube fractions can be prepared and stored for further processing before that date so production of lubes can be then fairly continuous. Solvent refined oils are planned for production starting in May.

The refining facilities rehabilitated and in process of rehabilitation appear adequate for the work to be done. They are not as modern nor as well instrumented as those of the Yokohama refinery.

Due to the amount of construction in progress it is difficult to appraise the protective measures against fire damage. Some old but satisfactory equipment was in evidence on the operating units. Other portable equipment was strategically well located; a further and complete survey of fire protection equipment and procedures will be made when reconstruction is more nearly complete.

An unscheduled discussion of manpower needed to operate a topping still took place. It appears that 5 to 6 men per shift are used. This is more than twice the number used in the United States and the writer finds it impossible to understand how so many could be kept busy. He is aware that United States standards cannot be applied here, but feels that appreciable reductions are desirable. For smooth initial operation of a refinery it is desirable to have extra men on shift. This enables prompt corrective action to be taken when unexpected difficulties arise on new and untried units. For this reason the writer would prefer deferring discussions and proposals for personnel education until the initial operating phase for each refinery has been passed.

Toa Nenryo Co., Shimizu

The high asphalt content of San Joaquin crude is such that present asphalt equipment is sufficient to process only the quantity produced from 2500 bbls. per day of crude. Additional asphalt stills are being reconditioned and by 1 March 1950 should be completed. The refinery can then charge its rated 4000 bbls. of crude per day.

Their earlier verbal report of poor quality and low yield of kerosene and gas oil was verified by examination of laboratory tests and data. Quality of lubricating distillates (unfinished) were satisfactory as was that of gasoline and asphalt production. Acid treatment of lubricating oils should be started by 1 March 1950 and finished oils available for the market shortly thereafter. A thorough survey of fire protection equipment on 17

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February 1950 revealed that only old equipment and their fire truck was in position to be used. New, modern equipment was in their storehouse so instructions were given to place it in required locations and familiarize personnel with its use. On 18 February 1950 the equipment was on site and an instruction of personnel in its proper use was observed. Light product tanks equipped with foam boxes were not connected outside the fire walls. Instructions were given to bring them outside the fire walls so that the portable foam generators they have can be used.

Further discussion on fire fighting personnel and training on 18 February 1950 resulted in the refinery management proposing to establish a special squad for fire protection only. The squad would consist of two groups of 5 men each. Each group would be on duty 12 hours per day and provision made to give days off without reducing squad strength. The proposal was accepted and refinery management agreed to effect the change at once.

Conversations with refinery personnel were most satisfactory. They were cooperative, well informed on their equipment and appeared to be capable technically. In reply to questions they said they had no operating problems on which help was needed. They said they might ask for help when their dewaxing plant is started up in late April or early May, as they have had no experience in benzol-acetone solvent dewaxing.

In conversation about solvent dewaxing, the writer asked if methyl-ethyl-ketone could not be used in place of acetone. He was told that the M. E. K. was not available in Japan. As at least 4 refineries here will be using benzol-acetone dewaxing plants it might be advantageous to interest a Japanese chemical company in the production of methyl-ethyl-ketone. The advantage in the later solvent over acetone is that it permits dewaxing at lower temperatures without a separation of a high V. I. oil layer which is lost with the wax. In other words it permits production of low pour lubricating oils with larger yield of oil, higher viscosity index and a more oil free wax.

Daikyo Oil Co., Yokkaichi

The refinery is operating at its scheduled rate of 1000 B.P.D. but is having difficulty due to excessive wax content of the Navy Special Fuel Oil they are processing. Their laboratory and yield data indicate that the charge stock contains 8/9% of wax whereas, for best operation, it should contain not more than half that amount. With the excessive wax content they find it necessary to leave half of the kerosene content in the bottoms from the atmospheric tower to provide enough carrier to remove sufficient wax from the vacuum tower bottoms to permit them to

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be made into straight and blown asphalt. They also have to recirculate part of the vacuum tower bottoms thru the vacuum heater and back into the vacuum tower for the some purpose.

To obtain a pressable, sweatable wax they have to split their wax distillate in 36% light and 36% on charge of heavy wax distillate. The light wax distillate is being pressed on two plate and frame presses. The slack wax is being accumulated and will be sweated and finished when their sweating oven is completed about the end of March 1950.

The pressed light wax distillate is being redistilled in their contact unit and the products acid treated on 3 Sharples centrifuges. They have 20 centrifuges.

The heavy wax distillate obviously contains microcrystalline wax, and as this cannot be removed by pressing, 36% of their charge stock can be used for little but fuel. A propsed change in processing procedure to reduce this percentage of devalued product is being sent to the Daikyo office. A copy of the procedure is attached but it is at best a make shift and partial solution to the problem. The correct solution is a topped crude charge stock containing less wax.

By the operating procedure given in the first paragraph plus their asphalt convertors they are producing 60/100 and 100/200 penetration asphalts as well as kerosene, gas oil and some acid treated light lubes.

Yokkaichi's contact plant is not in full operation yet as they have been unable to obtain any precoat for their filter. They have now devised a method of preparing their own precoat and expect to have the plant in full operation about 1 April 1950.

Yokkaichi apparently considered fire protection last in their plans to get in operation. Investigation revealed that the fire water distribution loop was not yet completed. The underground piping was installed but not all of the hydrants. The pumps supplying pressure to the loop are one electric and one steam turbine driven which is very desirable here where purchased power failures are common. Insufficient hand extinguishers were available at operating units and one gasoline powered portable pumper is being purchased. If the above recommendations are not carried out promptly this refinery should be compelled to stop operation until equipment and inventory are adequately protected.

Conversations with refinery personnel were very satisfactory. They were cooperative, well informed on their equipment and appeared to be capable technically. Some advice on the acid

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treating of scale wax was given verbally.

Ex-Naval Arsenal Refinery, Yokkaichi

The inspection revealed a considerable quantity of damaged refinery equipment which could be usefully employed, if desirable, in the Pacific Coast refineries. The equipment included furnaces, distillation columns, tubular heat exchange equipment, solvent refining equipment, tankage and pipe. This equipment could be restored to useful service if action on its removal and repair were taken immediately. If left unprotected for another year it is doubtful that its use could be economically justified.

The reconditioned machine tools, pumps, compressors, motors and other miscellaneous electrical equipment now stored in warehouses seemed to be well reconditioned and ready for use. Almost any type and size of pump, motor, or compressor required in refinery operations appeared to be on hand and ready to install.

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APPENDIX B

Report on Refinery Inspection
Trip in March

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Report on Refinery Inspection Trip in March

Ex-Naval Arsenal, Tokuyama

On 7 March 1950 Tokuyama Arsenal Refinery was inspected. In general appearance it was in a much better state of preservation than that at Yokkaichi. Most standing equipment was painted and in good condition. The towers, furnaces and exchangers of most units appeared to be usable as is or with only minor repairs. Particular attention was given to the propane deasphalting and barisol dewaxing plants. These, too, were very complete, nearly intact and appeared to be usable with only very minor repairs.

The Duo-Sol and benzol-ketone dewaxing equipment, other than the towers had been moved to the arsenal warehouse and time did not permit its inspection.

Nippon Oil Co., Kudamatsu

The Kudamatsu refinery of the Nippon Oil Co., was also inspected on 7 March 1950. Rehabilitation was complete except for their vacuum distillation unit and lube refining equipment which is scheduled for July, 1950 completion. They reported difficulty in the manufacture of turbine oil 140. They were getting a pour 5°C. above specification, a demulsibility of 50 sec. and too dark a color. It is the writer's opinion that the high pour is due to poor fractionation, e. g., the cut is too wide and includes waxy elements that should be left in the residuum. The demulsibility difficulty seems to be due to the oil only being acid treated and neutralized. This situation should be improved in the near future when their contact plant is completed. Filtration will also correct the high color. Plant operators were orally advised of the above opinions and agreed to try to improve fractionation pending the completion of their filter plant.

Fire protection was not considered adequate. The fire water distribution loop covered the whole plant and hydrants were frequent and well located. They have an old pumper truck well located and also two portable foam carts strategically well placed. They do not have hand extinguishers located on the operating units and pump houses. Fog nozzles are installed on all inflammable tanks. They have an organized fire fighting squad on all three shifts but the writer does not believe they are sufficiently drilled in their duties. Recommendation was made that hand extinguishers be conveniently located on all operating units and that more frequent fire drills be held.

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This refinery is also subject to two power holidays on different days each month. They advised that they unsually receive twenty-four hours notice prior to having their power cut off.

Koa Oil Co., Marifu

The Marifu refinery of the Koa Oil Co., was visited on 8 March 1950. Their rehabilitation program was well along toward completion. It was noted, however, that although plans call for them to crack topped crude their topping unit was now completed and their cracking unit will not be completed until about 1 June. It was also noted that their boiler in service was burning fuel oil. No work appeared to be done in equipping their boilers for coal firing. Their present tankage does not appear to be adequate for continuous operation.

Koa's fire protection is inadequate. They have a satisfactory water distribution loop with sufficient hydrants completed but no provision for fighting small fires or tank fires. No hand extinguishers nor portable equipment were seen. When this was pointed out to local management they agreed to order an adequate quantity. They also advised that fog nozzles for tank protection had been ordered.

Maruzen Oil Co., Shimotsu

The Maruzen Oil Co. refinery at Shimotsu was visited on 10 March 1950. The progress made in the rehabilitation of this refinery is excellent. The work has been done in an orderly fashion and with modern technique. Due attention has been given to promote safety of personnel and equipment. Instrumentation is good - equal to anything the writer has seen in Japan. This should ensure excellent quality and quantity control during operations.

Their boilers are equipped for burning coal. Fire protection, both fixed and portable is of first class quality, sufficient quantity and correctly located.

From the quality of the work the writer is sure that rehabilitation will be completed on schedule. Laboratory facilities were also first class - adequate to give necessary operational control.

Toa Nenryo Co., Wakayama

The Wakayama refinery of the Toa Nenryo Oil Co. was visited on 10 March 1950. Progress on rehabilitation of equipment was not up to expectations. At present rates of progress the topping unit will not be ready to operate before 1 June 1950 and the cracking unit before 1 July 1950. No preparation for

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lube. Manufacture was in evidence and this was attributed by management to lack of action on the part of the Japanese Government.

Fire protection is receiving consideration. They have a usable pumper truck with 2 dry powder foam generators and a fair supply of powder. Their water loop is complete with an adequate number of hydrants. Portable and hand extinguishers to be located on all operating units recommended and agreed to by management. It was specified that this equipment should be in place before the first crude was received.

Daikyo Oil Co., Yokkaichi

The Yokkaichi refinery of the Daikyo Oil Co. was visited on 12 March 1950. The fire protection measures recommended on the writer's visit of 23/24 February 1950 had been carried out. Their boilers burn coal.

They are still producing 36% of heavy wax distillate from their N. S. F. charge stock. The processing change proposed to reduce this yield was tried and was unsuccessful. A sample of this heavy stock was dewaxed and acid treated in their laboratory and it produced a very good grade of 60/65 V. I. lubricant. As Daikyo equipment cannot dewax this oil and it is a product which should be recovered, an attempt is being made to find unoccupied dewaxing and acid treating facilities in some refinery. If such are found an attempt will be made to have Daikyo sell the distillate to another refinery which will finish and market it. About 225/250 bbls. per day of high grade lube are involved. Toa Nenryo's Shimizu refinery and Nippon's Kudamatsu refinery are investigating this possibility. Maruzen will be asked to investigate as soon as the proper people can be contacted.

Toa Nenryo Co., Shimizu

The Shimizu refinery of Toa Nenryo was visited on 14 March 1950. They have not and are not running at their rated capacity of 4000 BPD. For their first 29 days of operation they averaged 1380 BPD and from 1 March to 12 March 1950, 2000 BPD. This is attributed to asphalt production from crude being beyond their capacity to handle it.

Their rehabilitation program is progressing and B/A dewaxing plant should be completed by 15 May 1950. They were asked to anticipate this date if possible to process Daikyo heavy wax distillate and are now investigating this possibility.

Fire protection recommendations made on an earlier visit have been carried out.

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A P P E N D I X C

Report on Refinery Inspection
Trip in June

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Report on Refinery Inspection Trip in June

Nippon Oil Co., Kudamatsu

The Kudamatsu refinery was visited on 23 June. The operation of their furfural extraction plant seemed to be satisfactory except that the loss was running 50-70% of the charge at a solvent-oil ratio of 2:1. They explained that the high solvent ratio and consequent loss was necessary to meet stability tests on Diesel Engine Oil 450 which is in short supply. They are the only refinery now able to make this grade. It was recommended that they definitely determine if such severe treatment is required and to reduce it if not to increase total lube production. A proposal to shut down their topping tower for removal and cleaning of all trays was discussed and approved. This work will improve fractionation and yields of gasoline and kerosene. It was noted that they use a fuel lighter than grade C so a recommendation to use heavier than grade C was made to increase availability of marketable product. Their supply of fire foam chemicals was checked and found adequate. Their B/A dewaxing unit was operating satisfactorily.

Koa Oil Co., Marifu

The Marifu refinery was visited on 24 June. Their topping unit has been tested with hot gas oil and is satisfactory. The cracking unit has been tested with water only and many leaks were found. The leaks were being repaired and a gas oil test was scheduled for the following week. They reported that all tower trays had been removed and cleaned during rehabilitation. There is every evidence that their topping and cracking equipment will be ready to operate when crude is received. Their fire protection was not adequate but they have a fire engine and 2250 gallons of foam liquid on order and expect delivery before crude is received. There is no fire protection provided for the Arsenal tanks they use but they have agreed to provide the required foam connections. The Arsenal crude tanks had not been tested nor had the 10-inch crude line. Assurance was given that they would test and make necessary repairs to this equipment before crude was received.

Toa Nenryo Co., Wakayama

The Wakayama refinery was visited on 26 June. As they had finished processing their crude allotment for the month, the topping unit was shut down and repairs were being made. Progress was being made on the construction of their cracking unit but materials were not arriving as scheduled further delaying completion. The fuel oil burned is much heavier than C grade

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and so is acceptable. Their fire protection is satisfactory except for their foam powder supply. They have on hand only 2900 kilograms whereas their minimum requirement is 34,000 kilograms. They agreed to order immediately the 31,100 kilograms lacking.

Maruzen Oil Co., Shimotsu

The Shimotsu refinery was visited 27 June. A very efficient job of rehabilitation has been done on this refinery. They have largely met their scheduled completion dates. Their operating results to date are equal to or better than those of the other refineries. However, they have in storage 100,000 barrels of semi products which they estimate can be processed into finished products in the next 100 days. If that goal is reached, they should receive consideration as a candidate for a larger crude allocation. They burn a fuel much heavier than the C grade. Their fire protection for the refinery including supply of foam chemicals is adequate. All members of the party were very favorably impressed with the work done and in progress here.

Daikyo Oil Co., Yokkaichi

The Yokkaichi refinery was visited 29 June. The operation of this refinery is very satisfactory. Their original rehabilitation plans have been completed including wax sweating ovens. Good progress is being made on the construction of their new B/A plant now scheduled for completion 31 August. The completion of this new dewaxing unit will augment their lube oil production by 250 to 300 barrels per day and provide greater flexibility in future operations. They are burning a fuel lighter than C grade and were requested to use heavier than C grade to increase availability of saleable products. The Arsenal tanks and lines they are using have been tested and found suitable for service. No foam, steam or water lines are now installed on these tanks but they assured us these facilities would be installed by the end of August. As they handle no product lighter than kerosene their fire risk is much less than that of other refineries. The fire protection of the refinery proper is satisfactory except they have only a 1200 kilogram inventory of foam powder. They should have a minimum of 14,000 kilograms and have assured us it will be pruchased promptly. To alleviate the present shortage of motor oils Daikyo is blending motor oils from bright stock and SAE 10 motor oil (supplied by others) with their heavy wax distillate to which 0.5% of pour depressant has been added. They supplied 500 kiloliters of the blend in May and anticipated doing equally as well in June and July.

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Toa Nenryo Co., Shimizu

The Shimizu refinery was visited 30 June. The operation of this refinery is satisfactory. Although they have not been able to consistently surpass their crude rate they process their crude to finished products and do not accumulate an abnormal inventory of semi-product. Their refinery fuel is heavier than C grade as it should be. Their fire protection system is acceptable except that their present supply of foam powder is 4800 kilograms whereas the minimum supply on hand should be 34,200 kilograms. They have agreed to make up the deficiency at once. They started their B/A dewaxing plant on 19 June. Many mechanical difficulties were encountered and had to be corrected so no production had been realized to the date of visit. A Mr. Rich of Standard Oil Development Co. was at Shimizu assisting in the work and they expect to have this unit operating successfully by 15 July.