TRINIDAD AND TOBAGO

MINISTRY OF PETROLEUM AND MINES

# ANNUAL REPORT

FOR THE YEAR

# 1978

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GOVERNMENT PRINTERY, TRINIDAD, TRINIDAD AND TOBAGO—1981

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# FOREWORD

## ANNUAL ADMINISTRATION REPORT, 1978

A record high crude oil production level was attained in Trinidad and Tobago in 1978 when a total of 83.8 million barrels of crude oil were produced at a daily average rate of 240,333 barrels. This was the highest level attained since the decline in production after 1968 which was the previous peak year with an annual production of 66.9 million barrels.

Amoco recorded the production of its 200 millionth barrel of crude oil in January of this year, some six (6) years after initial production in Trinidad and Tobago.

The Government of Trinidad and Tobago decided to proceed with the project to export natural gas as liquefied natural gas, LNG, and on that basis commissioned the firm Ryder Scott to study and evaluate the natural gas reserves in certain offshore areas.

The completion of the gas line linking Teak B platform, the Poui field and Galeota was achieved during the year. This line formed part of the 24″ transmission system for collecting and transporting natural gas which would otherwise be flared, to shore.

A change in the U.S. programme of self sufficiency in their domestic refinery industry had an adverse effect on the local refining industry and led to a further drop in the refinery throughput.

Plans for the utilisation of natural gas were further crystallised as the site clearing for construction of the Fertrin Ammonia Plant at Pt. Lisas began in the latter part of this year.

The Ministry wishes to take this opportunity to thank all those organisations who contributed data used in the preparation of this report, and to record its appreciation of the co-operation from all members of staff.

## SUMMARY OF HIGHLIGHTS OF PETROLEUM INDUSTRY FOR 1978

Trinidad and Tobago established its highest level of crude oil production in February with an average daily production of 240,334 barrels. This assisted in reaching the largest annual production of 83.8 million of oil for this country.

In January, 1978, Amoco Trinidad Oil Company completed the production of 200 million barrels of crude oil since the company initiated commercial production in January 1972.

The Government of Trinidad and Tobago commissioned the firm of Ryder Scott and Company to study the gas reserves in certain offshore areas. This study formed the basis of the Government decision to proceed with the project to export natural gas as liquified natural gas.

During the year, the National Gas Company completed the construction of 28 miles of 24-inch gas transmission line between Teak B platform and Point Galeota via the Poui field.

Fertrin, a joint venture between the Government of Trinidad and Tobago (51 per cent) and Amoco International Oil Company (49 per cent), started construction of its Ammonia plant during the year. The plant will consists of two 1,000 metric tonnes per day Ammonia units.

In drilling and completions there was a slight drop in the total footage drilled and a small change in the number of wells completed of 215 wells during 1978.

The refining sector registered a decrease of 14 per cent in the refining throughput with a 50 per cent refining utilization. This resulted from the change in U.S. programme of self sufficiency in domestic refining which began in 1974 following the Arab oil embago.

Table 1 summarizes and compares overall production drilling and refining activities for the years 1975-1978.

TABLE I

**Summary of Statistics for the Trinidad and Tobago Petroleum Industry, 1975-1978**

| | Unit | 1975 | 1976 | 1977 | 1978 |
|---|---|---|---|---|---|
| Annual Crude Oil Production | bbls. | 78,620,938 | 77,672,635 | 83,619,077 | 83,777,503 |
| Annual Natural Gas Production | mscf. | 126,434,192 | 137,959,327 | 149,588,976 | 157,919,827 |
| Average G.O.R. | scf./bbl. | 1,608 | 1,776 | 1,789 | 1,885 |
| Annual C.H.P.S. (Natural Gasoline) Production; | bbls. | 60,991 | 50,920 | 61,091 | 60,247 |
| Daily Refinery Capacity | bbls./day | 456,000 | 456,000 | 456,000 | 456,000 |
| Annual Refinery Throughput | bbls. | 85,660,318 | 117,594,982 | 99,536,480 | 85,881,842 |
| Total Wells Completed during the Year | No. | 189 | 207 | 217 | 215 |
| Average Depth of Completed Wells | Feet | 4,442 | 4,443 | 4,250 | 3,868 |
| Total Footage Drilled during the Year | Feet | 839,649 | 919,705 | 922,295 | 895,098 |
| Oil and Gas Wells Completed during Year | No. | 150 | 153 | 170 | 170 |
| Drilling Success Ratio | Percent | 79.4 | 73.9 | 78.3 | 79.1 |
| Average Rigs Running | No. | 14.3 | 14.7 | 14.7 | 15.4 |

## GEOLOGICAL SURVEYS, 1978

All of the geological surveys conducted in Trinidad during 1978 were concerned with exploration for sand and gravel and stone for use in the construction and road building industries.

The search for sand and gravel continued and was confined to the Caroni Basin at the foothills of the Northern Range. In the Northern Range surveys were carried out to define the limestone bodies known to exist there.

In the Southern Range, reconnaissance surveys were carried out in order to locate sandstone bodies suitable for use in the construction and road building industries.

The Ministry of Petroleum and Mines again supervised geology students at the University of the West Indies who carried out geological mapping in Tobago. This is expected to be an annual exercise until the island is completely mapped geologically.

The Ministry continued to provide assistance to other Ministeries and Government bodies in geology and other related fields.

### A Synopsis of the Activities of the Geophysical Section, Ministry of Petroleum and Mines

The following companies caried out seismic surveys, with the necessary Ministry's permission:

TABLE II
Geophysical Surveys

| *Company* | | *Area* | *Miles* |
|---|---|---|---|
| Amoco | ... | East Coast | 180.2 |
| Mobil | ... | East Coast, North Coast, South Coast | 1,145 |
| Tesoro | ... | East Coast, Gulf of Paria | 570.4 shallow |
| | | (Shallow and deep Penetration) | 884.8 deep |
| Texaco | ... | East Coast (three dimentional) | 770 |
| Trinmar | ... | Gulf of Paria | 155 |
| Trintoc | ... | Gulf of Paria | 39.9 |

Mobil Oil Company in a joint venture with the Ministry of Petroleum and Mines surveyed off the East, North and South Coasts of Trinidad. A geophysicist from the Ministry supervised on the Government's behalf the processing of data. The processing of this data has been done in Dallas. A geologist from the Ministry was sent to Dallas for three (3) months training in geophysics.

Local companies, international companies and other country's governments representatives visited the Ministry to view geophysical data. These visits were made in connection with the forth-coming bidding on open marine areas.

The open marine blocks were sub-divided for surrender purposes.

An interpretation of the reversed L-shape block, sub-blocks 4 and 5 was completed by the Geophysical Department of this Ministry.

Several Deminex structure maps of Block 4 were checked, and discussions held with Deminex geophysicist concerning them.

The north-west coast "open" area has been examined and recommended as a good prospect area.

**Drilling, 1978**

In spite of an increase in cumulative rig months from 176.6 in 1977 to 184.4 this year, the total drilled depth fell by 2.9 per cent during the same period to 272,826 metres (895,098 feet) in 1978.

A total of 326 wells were drilled during the year, one (1) more than in the previous year. Of this total fifty one (51) were drilled in marine leases operated by Amoco, TNA, Trinidad Tesoro and Deminex.

Texaco Trinidad and Amoco, with 53 and 15 wells drilled respectively during the year, were the only companies that registered increases in the number of wells drilled over their previous year's total.

Exploratory Drilling

During the year fourteen (14) exploratory wells were drilled, thirteen (13) of which were drilled in marine areas and one (1) in the Point Fortin area by Trintoc. Of the marine wells six (6) were drilled off the East Coast, [three (3) by Amoco, two (2) by Trinidad Tesoro and one (1) by Deminex] while the remaining seven (7) were drilled off the West Coast by TNA.

Deminex abandoned their wildcat well Kingfish 1, as a dry hole after reaching its targeted depth. The well was drilled from the semi-submersible "Pat Rutherford" in the Block 4 area held under joint licence with Mobil Oil Co.

Amoco continued drilling well Offshore Cascadoux-1 from the semi-submersible "Mariner III" at the beginning of the year. The well was abandoned after several bottom hole assemblies failed to reduce a 67° hole angle built during drilling operations. The next rig move was to the North Poui-2 location to investigate deeper horizons in the Poui area. This well was abandoned in May after tests showed the hydrocarbon accumulations to be uneconomical. In June Amoco released the semi-submersible to Trinidad Tesoro and brought in the drillship "Discoverer 511" to drill exploratory well West Seg 1 southeast of the proven SEG gas field. At year end the well was being drill-stem tested.

Trinidad Tesoro, using the semi-submersible "Mariner III" rig drilled a 12,000 feet exploratory well EG 2 which successfully tested oil and gas in the East Galeota field. Another well, EG-3 which was spudded in October, was still being drilled at the end of the year.

Two (2) jackup rigs "Ocean Patriot" and "TG 145" were used by TNA for exploratory drilling. During the year this company drilled three (3) wells for Trinidad Tesoro in their North Marine lease. Well NM-15 was drilled and completed as an oil producer in February, but by June the well watered out and had to be sidetracked as well NM-15ST. This well was being tested at year end. The third North Marine well NM-16, was abandoned dry.

TABLE III

Summary of Wildcat Drilling in 1978

| Operator | Well No. | Location | Basis for Location | Lahee Exploratory Classification | Completion Date | Total Depth (Ft.) | Name and/or Age of Deepest Formation | Result/Remarks |
|---|---|---|---|---|---|---|---|---|
| Deminex ... ... ... ... | Kingfish-1 | — | S. & S. S. G. | C 3 | 29.4.78 | 14,472 | Pleistocene | Abandoned—Dry |
| Amoco (Trinidad) Oil Company ... | Offshore Cascadoux-1 | — | do. | C 3 | 12.3.78 | 9,683 | Miocene | Abandoned—Mechanical |
| | North Poui-2 | — | do. | C 2 | 31.5.78 | 12,183 | Miocene | Abandoned after Testing |
| | West Seg-1 | — | do. | A 2 C | — | 15,236 | Miocene | Testing |
| Trinidad Tesoro ... ... | E.G.—2 | P 3 MM—17 | do. | B 3 | 17.10.78 | 12,191 | Miocene | Abandoned after Testing |
| Petroleum Company Limited | E.G.—3 | P 7 FB—18 | do. | A 3 | — | 11,586 | Miocene | Drilling |
| Trinidad Northern | NM—15 | F—2 LN—7 | do. | B 2 C | 28.2.78 | 8,592 | Manzanilla | Completed—Oil |
| Areas Ltd. | S—423 | F—13 GJ—8 | do. | B 2 B | 23.3.78 | 10,415 | Cruse | Abandoned—Dry |
| | S—431 (ST) | F—13 FJ—13 | do. | C 2 B | 21.7.78 | 9,457 | Cruse | Abandoned—Dry |
| | S—435 | F—11 ID—10 | do. | A 2 B | — | 8,926 | Cruse | Suspended |
| | NM—16 (ST) | F—2 BH—10 | do. | C 2 C | 10.12.78 | 12,874 | Manzanilla | Abandoned—Dry |
| | NM—15x(ST) | F—2 LN—7/LO—9 | do. | A 2 B | — | 8,770 | Manzanilla | Testing |

In the Soldado field, TNA drilled four (4) exploratory wells during the year. Well S-423 was drilled in the East Soldado field west of Platform 20 and completed as an oil producer. Well S-431, drilled West of platform 19, was abandoned dry, while Well S-435 was suspended after failing to free stuck-pipe. In December an exploratory well was spudded-in to evaluate an untested structure North of the Soldado Rock. This well S-441, located near the Venezuelan boundary, was being drilled at year end.

Trintoc, the state owned oil company, commenced drilling one (1) exploratory well in the Point Fortin Central field in December. This well FC-271 programmed to test deep Lower Cruse Sands in untested fault block, was still being drilled at the end of the year.

Development Drilling

A total of 223 development wells were drilled in 1978, twenty (20) more than the previous year's figure. Of this total thirty-eight were drilled in the marine fields operated by Amoco, TNA and Trinidad Tesoro.

Trinidad Tesoro accounted for 106 of the total number of wells drilled. Two (2) locally fabricated platforms, Trintes B and Trintes C, were installed in their Galeota marine field in June, 1978. Drilling from the Trintes B platform commenced in June and by the end of December, 1978, twelve (12) wells were drilled from the platform. Trinidad Tesoro's development drilling activity on land was concentrated in the Palo Seco field where thirty-nine (39) wells, both thermal and non thermal, were drilled. Thermal wells were also drilled in the Central Los Bajos and Guapo steam project areas and a pilot cyclic steam project was commenced in September in the Sewlal Trace area of the Fyzabad field. Seven (7) thermal wells were drilled in this area at the end of the year. Non-thermal drilling activity by this company also covered the McKenzie, Quarry, Barrackpore and Fyzabad fields.

Development drilling activity by Texaco was conducted in the Oropouche, Barackpore, Palo Seco and Forest Reserve fields. With three (3) rigs in operation this company drilled fifty-three (53) wells, of which twenty-one (21) were thermal wells in the Forest Reserve field. Eleven (11) non-thermal wells were drilled in this field in addition to ten (10) in Palo Seco, five (5) in Barrackpore and six (6) in the Oropouche fields.

Trintoc utilized four (4) rigs during the year for drilling thirty seven (37) development wells. Wells CO-124 and CO-125 in the Catshill field were the only wells drilled outside the Point Fortin field. These were water wells drilled for the Catshill waterflood project. Twenty-two (22) wells were completed as producers and six (6) wells, drilled specifically for a pilot steam project in the Parrylands "E" area, were suspended awaiting the installation of steam generating and production facilities.

Amoco's development drilling activity during the year was confined to the Teak and Poui fields. Twelve (12) wells were drilled, of which two (2), on the Teak D platform, were completed as gas wells. Two (2) wells drilled on the Teak E Platform and six (6) on the Poui B platform were completed as oil producers. Two (2) wells, Poui B-13 and Teak E-7, were being drilled at the end of the year.

Fourteen (14) development wells were drilled and completed by TNA in the Soldado field during 1978. One jackup rig, TG-145 successfully drilled and completed a well in the East Soldado field while the other jackup, the "Ocean Patriot", completed two (2) in the North Soldado field. The thrust of the drilling activity however, was in the East Soldado field where drilling continued from platform 20 and commenced on Platform 21 in June with the spudding of well S-434. Eight (8) wells were successfully completed on Platform 20 and three (3) on Platform 21. Apart from (2) wells on Platform 20 that were completed in the Cruse Sands, the wells drilled on platforms 20 and 21 during the year were completed in the Forest Sands.

TABLE IV

**Summary of Development Drilling in 1978 in Trinidad and Tobago**

| | Field, Area, or District | Number of Producers Completed | Number of Abandoned Wells | Total Completions | Total Footage Drilled | Number of Rigs Actively Drilling or Testing Development Wells on December 31, 1978 |
|---|---|---|---|---|---|---|
| *(a)* Includes 18 injections wells Footage drilled—23561 | 1 | 15 | — | 15 | 97,601 | 3 |
| | 2 | 28 | 4 | 32 | 121,402 | 3 |
| *(b)* Includes 5 injection wells Footage drilled—5968 | 3 | — | — | — | — | — |
| *(c)* Includes 1 injection well Footage drilled—953 | 4 | 74[a] | 5[c] | 79[a+c] | 215,503[a+c] | 1 |
| | 5 | 43[b] | 1 | 44[b] | 108,834[b] | 2 |
| | 6 | 8 | 2 | 10 | 42,774 | — |
| | 7 | 6 | — | 6 | 26,357 | — |
| | 8 | 4 | 2 | 6 | 31,425 | — |
| | 9 | 1 | 1 | 2 | 3,661 | — |
| | 10 | — | — | — | — | — |
| | 11 | 12 | 1 | 13 | 128,000 | 4 |
| | 12 | — | — | — | — | — |
| TOTAL | | 191 | 16 | 207 | 77,557 | 13 |

NOTE: This Table covers *development* drilling (in contrast with wildcat or exploratory drilling which is covered in Table III).

For Definition of Areas *See* Table IVA Following.

TABLE IVA

**Key to Area—Numbers on map (Figure II), on Table IV and in Text**

| *Area Number* | *Description* |
|---|---|
| 1 | Soldado, North Marine, Couva Marine |
| 2 | Pt. Ligoure, F.O.S., Area IV and Guapo, Point Fortin West and Central, Parrylands, Cruse |
| 3 | Brighton (Land and Marine) Vessigny, Merrimac |
| 4 | Palo Seco, Los Bajos, Erin |
| 5 | Forest Reserve, Fyzabad, Point Fortin East, New Dome, San Francique |
| 6 | Quarry, Coora, Quinam, Morne Diablo |
| 7 | Oropouche |
| 8 | Penal, Barrackpore, Wilson, Siparia |
| 9 | Moruga North and West, Rock Dome, Inniss, Trinity, Catshill, Balata, Bovallius |
| 10 | Guayaguayare, Moruga East |
| 11 | Galeota, Teak, Samaan, Poui (East Coast) |
| 12 | South Marine (South Coast) |
| 13 | Tabaquite, Pointe-a-Pierre |
| 14 | Icacos |
| 15 | North Coast |

## CRUDE OIL PRODUCTION

Crude Oil production in Trinidad and Tobago reached its highest ever level in February this year, 240,334 barrels per day. This peak in production coincided with Amoco Trinidad Oil Company attaining their maximum production level of 148,590 barrels per day. Production for this year was 83.8 million barrels, that is, an average of 229,527 barrels per day.

Offshore producing fields have again accounted for 80 per cent of the oil produced locally, with Amoco's share of the production amounting to about 60 per cent of the country's production.

Amoco's high level of production in February was mainly due to the reduction in separator and line pressures in their pipeline system which resulted from the commissioning of the National Gas Company's gas pipeline. Since then the company's production has shown a steady decline throughout the year. Production declined by 12.6 per cent between February and December, and the company averaged 137,745 barrels per day this year, or some 1.6 per cent above the 1977 level. The drop in production has been due to natural decline as well as loss in production from wells which were closed in for repairs.

Trinmar, in averaging 44,380 barrels per day for the year has shown a 4.1 per cent drop from the production level of the previous year. Labour unrest in September adversely affected the company's operations and this factor was a major contributor to their decrease in production in the last quarter of this year.

Land production averaged 45,400 barrels per day or 19.8 per cent of the country's total production for 1978. This represents an increase of 2.4 per cent from the 1977 level.

Trinidad-Tesoro Petroleum Company has performed well during the year in averaging 20,406 barrels per day. The 7.2 per cent increase over last year's figures shown by this company, has been a result of the company's continuing vigorous drilling and workover programme as well as their enhanced oil recovery operations.

Texaco Trinidad Inc. has shown a steady decline in production throughout the year and this company averaged 17,952 barrels per day for 1978, that is an 8.9 per cent drop from last year's level. This decline in production can be attributed to a decrease in well drilling and workover activity by the company.

Trintoc has exhibited fairly steady production behaviour throughout the year and averaged about 8,716 barrels per day for 1978. This figure is an increase of 5.4 per cent over last year's level.

Premier Consolidated Oilfields Limited (PCOL), the country's smallest producer, showed a 2.7 per cent drop in production from last year's figure, with a daily average production of 328 barrels per day. This drop may be attributed to natural reservoir decline, but throught the year a fairly steady production rate was maintained.

Figure IV illustrates graphically the contribution of new and recompleted wells to the country's total crude oil production. Table V gives a detailed comparsion by field of production for the years 1977 and 1978.

TABLE V
Crude Oil Production in Trinidad and Tobago, 1978

| Company Field | Discovery Year | Total Wells Drilled | Name of Producing Formation | Annual Production Bbls. | | Cumulative Production through December, 1978 '000 Bbls. |
|---|---|---|---|---|---|---|
| | | | | 1977 | 1978 | |
| *Trinidad and Tobago Oil Company* | | | | | | |
| Balata East and West | 1952 | 49 | Miocene | 21,331 | 15,312 | 2,131 |
| Catshill | 1950 | 129 | do. | 295,738 | 254,810 | 21,571 |
| Inniss | 1956 | 38 | do. | 72,567 | 57,582 | 5,796 |
| Rock Dome | 1962 | 3 | do. | 0 | 0 | 16 |
| Penal | 1936 | 269 | do. | 552,637 | 545,319 | 58,224 |
| New Dome | 1928 | 31 | do. | 19,118 | 9,495 | 3,090 |
| Point Fortin East | 1929 | 147 | do. | 437,089 | 389,698 | 23,466 |
| San Francique | 1929 | 27 | do. | 15,852 | 14,471 | 5,880 |
| Area IV and Guapo | 1963 | 192 | do. | 447,473 | 594,013 | 34,232 |
| Parrylands | 1913—1918 | 382 | do. | 351,249 | 331,287 | 35,263 |
| Point Fortin Central | 1916 | 139 | do. | 550,492 | 732,826 | 14,039 |
| Point Fortin West | 1907 | 308 | do. | 252,949 | 236,491 | 18,822 |
| Los Bajos | 1918 | 29 | do. | 0 | 0 | 546 |
| Erin | 1963 | 4 | do. | 0 | 0 | 710 |
| Company Total | — | 1,747 | — | 3,016,495 | 3,181,304 | 223,786 |
| *Trinidad Tesoro Petroleum Company Limited*[9] | | | | | | |
| Fyzabad | 1920/1938 | 918 | Miocene | 1,507,245 | 1,518,242 | 157,636 |
| Guapo | 1922 | 560 | do. | 785,349 | 861,385 | 38,964 |
| Moruga East | 1953 | 66 | do | 52,299 | 69,297 | 2,194 |
| Moruga North | 1956 | 23 | do. | 20,497 | 17,157 | 958 |
| Moruga West | 1957 | 129 | do. | 98,384 | 78,728 | 8,736 |
| Coora-Quarry | 1936 | 613 | do. | 1,025,100 | 1,188,842 | 83,772 |
| Palo Seco-Erin | 1926 | 1,235 | do. | 2,341,533 | 2,459,887 | 88,074 |
| North Marine | 1956 | 18 | do. | 0 | 30,635 | 1,269 |
| Galeota | 1972 | 50 | do. | 543,979 | 517,507 | 3,297 |
| Central Los Bajos | 1973 | 118 | do. | 510,079 | 657,729 | 2,656 |
| Oropouche | 1975 | 3 | do. | 51,695 | 32,524 | 170 |
| Barrackpore | 1977 | 4 | do. | 8,231 | 16,203 | 24 |
| Company Total | — | 3,737 | — | 6,944,391 | 7,448,136 | 387,750 |
| *Texaco Trinidad Incorporated* | | | | | | |
| Guayaguayare | 1902 | 697 | Miocene | 1,412,034 | 1,251,670 | 79,744 |
| Trinity | 1956 | 95 | do. | 229,435 | 204,955 | 14,012 |
| Barrackpore | 1911 | 328 | do. | 664,949 | 540,293 | 25,827 |
| Oropouche | 1944 | 126 | do. | 253,789 | 244,962 | 5,526 |
| Morne Diablo-Quinam | 1926 | — | do. | 44,709 | 50,933 | 7,424 |
| Forest Reserve | 1913 | 1,990 | do. | 2,323,221 | 2,346,012 | 241,500 |
| Palo Seco | 1929 | — | do. | 1,234,913 | 1,050,161 | 83,819 |
| Brighton | 1903 | 615 | do. | 690,646 | 591,599 | 69,623 |
| Erin | 1963 | 23 | do. | 95,797 | 82,762 | 2,065 |
| Couva Marine | 1963 | 6 | do. | 3,607 | 0 | 301 |
| Cruse | 1913 | 150 | do. | 74,814 | 65,802 | 25,587 |
| Wilson | 1936 | 77 | do. | 141,134 | 97,430 | 19,279 |
| Tabaquite | 1911 | 225 | do. | 26,452 | 25,775 | 1,621 |
| Balata Central | 1949 | 6 | do. | 0 | 0 | 371 |
| Company Total | — | 4,338 | — | 7,195,500 | 6,552,354 | 576,699 |

TABLE V—*Continued*

**Crude Oil Production in Trinidad and Tobago, 1978**

| Company Field | Discovery Year | Total Wells Drilled | Name of Producing Formation | Annual Production Bbls. | | Comulative Production through December, 1978 '000 Bbls. |
|---|---|---|---|---|---|---|
| | | | | 1977 | 1978 | |
| *Premier Consolidated Oilfields Ltd.* | | | | | | |
| Siparia ... ... ... | 1957 | 5 | Miocene | 6,876 | 6,771 | 800 |
| San Francique ... ... | 1929 | 75 | do. | 37,146 | 36,329 | 2,937 |
| Fyzabad ... ... ... | 1918 | 253 | do. | 57,397 | 56,142 | 12,898 |
| Palo Seco ... ... ... | 1915 | 83 | do. | 5,546 | 6,067 | 1,613 |
| Barrackpore ... ... | 1970 | 3 | do. | 9,256 | 7,316 | 108 |
| Icacos ... ... ... | 1955 | 11 | do. | 6,750 | 7,038 | 440 |
| Defunct Fields ... ... | 1954 | 19 | do. | 0 | 0 | 323 |
| Company Totals ... | — | 449 | — | 122,971 | 119,663 | 19,119 |
| *Trinidad Northern Areas* | | | | | | |
| Fos—Ft. ... ... ... | 1954 | 30 | Miocene | 198,501 | 188,111 | 3,740 |
| Soldado ... ... ... | 1955 | 456 | do. | 16,690,015 | 16,010,817 | 339,557 |
| Company Total ... | — | 486 | — | 16,888,516 | 16,198,928 | 343,297 |
| *Amoco Trinidad Oil Company* | | | | | | |
| Teak ... ... ... | 1971 | 61 | Miocene | 13,224,192 | 15,448,399 | 101,284 |
| Samaan ... ... ... | 1971 | 44 | do. | 19,517,196 | 18,233,726 | 94,352 |
| Poui ... ... ... | 1974 | 28 | do. | 16,709,816 | 16,594,993 | 51,973 |
| Company Total ... | — | 133 | — | 49,451,204 | 50,277,118 | 247,609 |
| GRAND TOTALS ... | — | 10,890 | — | 83,619,077 | 83,777,503 | 1,798,257 |

## REVIEW OF FLUID INJECTION OPERATIONS IN TRINIDAD AND TOBAGO DURING, 1978

Fields producing under the influence of fluid injection accounted for 6.6 million barrels of crude oil, or 7.9 per cent of the country's total annual production for 1978. This level of production has been achieved primarily due to the operations of Amoco Trinidad Oil Company's waterflood schemes, which have been the source of 31 per cent of the oil produced in all fluid injection projects. The most significant events in fluid injection during the year have been the continued intensification of steam injection projects on land, and the successful operation of the country's largest marine waterflood project offshore the East Coast.

In Table VI, injection and production statistics are summarised for injection projects which were in operation during the period 1974-1978. Figure V also presents a summary of annual fluid injection activity.

### Water Injection

Fifty-eight per cent, or 3.8 million barrels, of the oil produced by fluid injection operations came from water injection projects. The total number of projects which were active at the end of the year was 18, the same number as in the previous year. The 24.3 million barrels of water injected during the year represented a drop of 8 per cent from the corresponding figure for 1977. Average watercut for the projects was 43 per cent during the year, that is, some 9 per cent less than that of the year before.

Table VII summarizes Water Injection Operations by Company.

Amoco Trinidad Oil Company injected an average of 32,000 bwpd in producing 5,600 bopd from its Teak and Samaan water injection projects. While injection in the MM-01(L) sand was continued during the year, injection in the MM-0/2 sand has been suspended since November, 1977. The MM-0/2 reservoir was being re-evaluated since its performance indicated that the sand was benefitting from natural water influx. Production from the Teak A/C/E waterflood area showed increases which could only be attributed to water injection. Injection in the Samaan FB K/L waterflood was terminated in June.

Waterflooding, the most common secondary recovery mechanism employed by Texaco Trinidad Inc., accounted for 1.3 million barrels, or approximately 20 per cent of the company's production for the year. Texaco injected an average of 27,500 bopd and produced approximately 3600 bopd from the ten schemes which were in operation. Water was also injected at a rate of 1,400 bwpd in two carbon dioxide injection schemes, and one steam flood. The six waterflood schemes operated by the company in the Eastern District-Guayaguayare and Trinity fields— were responsible for 80 per cent of the water injected and 77 per cent of the oil produced in their water injection schemes.

Trinidad-Tesoro injected an average of 2,000 bwpd in the four waterflood projects which they operated during 1978; this represents a 77 per cent increase over the average injection rate for the previous year. Oil production over the period was 50,000 barrels, however, which was a decrease of 40 per cent from the previous year's figure. During the year two cyclic waterflood projects were initiated in the CO/UC/100 and CO/UC/110 reservoirs. Water injection into the CO/UC/314 reservoir continued for the third year running, and at an average rate of 755 bwpd. Due to the slow buildup in observed reservoir pressure, it is now felt that the CO/UC/314 reservoir is much larger than originally calculated. The CO/UC/317 reservoir continued to produce on its second cycle. Daily average producing rate for the year was 48 bopd. No water has been injected into the Fyzabad FM/UF/169 reservoir since November, 1977 because of water breakthrough at the surface.

Trintoc's Catshill waterflood project maintained the level of performance achieved in the previous year. The scheme produced an average of 265 bopd while injection was held at 751 bwpd, the corresponding figures for the previous year were 226 bopd and 734 bwpd, respectively.

Water injection in TNA's Main Field waterflood project averaged 2,864 bwpd while production averaged 908 bopd. Water injection rate fell by 39 per cent when compared with the rate established during 1977.

Table VIII presents a summary of the country's water injection activity by company and projects for 1978.

Steam Injection

Steam injection operations continued to make substantial contributions to oil production in Trinidad and Tobago during 1978, and the 2.6 million barrels of oil produced by these projects was equivalent to 39 per cent of the annual oil production of all fluid injection operations in the country. The volume of steam injected during the year amounted to 5.6 million barrels, a figure which is 29 per cent greater than that of the previous year. There were 12 major projects active at the end of the year—9 operated by Trinidad-Tesoro and 3 by Texaco.

Trinidad-Tesoro's thermal projects accounted for 1.9 million barrels or 26 per cent of the company's production for the year. The company's overall average injection rate of 8,762 bwpd represented an increase of 57 per cent over the 1977 figure. During the year, the expansion of the N.W. Palo Seco steam project was completed, bringing the total number of existing patterns to 22. Steam injection rates in the Palo Seco area increased from 3,950 barrels per day in September, 1977 to over 9,150 barrels per day in September, 1978. Oil production rates also rose during the period from 1,250 bopd to 2,150 bopd. Several wells had to be closed in, the Central Los Bajos area, due to steam eruptions in the field. Newly drilled thermal wells in Guapo were poor producers, this was primarily due to low steam quality. In May, 1978, cyclic steam injection in Fyzabad was terminated after the project was shown to be uneconomic. A cyclic steam stimulation project was initiated in the Sewlal Trace area of Fyzabad where three wells were steamed. One well which was formerly in the Fyzabad FM/UF/169/I waterflood area was subjected to steam injection.

Steam injection by Texaco resulted in the production of an average of 1,800 bopd by the three projects which were active during 1978. This figure compares favourable with the 1,300 bopd average production for the previous year. Steam injection rates increased by

4 per cent in 1978 to attain an average of approximately 6,600 barrels per day during the year. The company continued the operation of their Forest Reserve Project IV Hot Waterflood as well as their Project III Steamflood. In May, injection commenced in Forest Reserve Phase I Extension Steam project; this project has 53 wells in operation, of which 15 are injectors and 38 producers. Some of the company's lowest quality crude is produced by the steamflood.

Steam injection projects are summarized by company and project in Table IX.

**Natural Gas Injection**

The tight gas supply situation on land fields continued to be reflected by the absence of any true gas injection projects in operation in the country. In the decade 1969 to 1978, gas injection has fallen precipitiously from an average of 67,600 mcfd, to 278 mcfd and the number of schemes in operation during the period has declined from 32 to virtually zero.

Texaco injected 66 mmcf of gas in their Zone 5 "007" Gas and Water Injection project. This was the only gas injection operation carried out by the company for the year, gas injection in the Forest Reserve UCWE Middle Field project having been terminated since April, 1977.

Trinidad Tesoro injected 35 mmcf of gas in their CO/UC/100/I Waterflood reservoir in August.

Table X summarizes gas injection activity for the year.

**Carbon Dioxide Injection**

Texaco continued the operation of three carbon dioxide projects during the year, but no gas was injected in the Forest Sands Zone 5 project. An average of 2,100 mmcfd was injected in the Forest Reserve UCRA, and the Forest Sands projects. The three projects produced an average of 192 bopd during the year; this was some 231 bopd less than in 1977, the corresponding injection rate being also lower by 54 per cent.

Carbon dioxide injection activity is summarized in Table X.

TABLE VI

Summary of Fluid Injection Operations in Trinidad and Tobago, 1974—1978

| Year | NUMBER OF PROJECTS IN OPERATION AT END OF YEAR | | | | INJECTION VOLUMES | | | CRUDE OIL PRODUCTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Oil produced by wells under project influence (Bbl) | | | | | Oil expressed as a percentage of Country's Total Production |
| | Gas | Water | Steam | Carbon Dioxide | Natural Gas (mmscf) | Water and other Fluids (Bbl) | Steam (Bbl) | Gas Inject. Projects | Water Inject. Projects | Thermal Recovery Projects | Carbon Dioxide Projects | All Projects | |
| 1974 | 9 | 13 | 6 | 2 | 4,986 | 21,347,585 | 1,867,416 | 603,930 | 1,803,749 | 1,720,680 | 184,805 | 4,313,164 | 6.3 |
| 1975 | 8 | 16 | 6 | 2 | 1,443 | 13,758,293 | 1,530,743 | 352,920 | 1,992,222 | 1,395,432 | 146,105 | 3,386,679 | 4.9 |
| 1976 | 7 | 16 | 8 | 3 | 607<br>1,189* | 18,536,272 | 2,076,772 | 414,364 | 2,001,986 | 1,223,092 | 203,842 | 3,843,284 | 5.0 |
| 1977 | 2 | 18 | 9 | 3 | 204<br>1,686* | 26,455,049 | 4,353,607 | 61,710 | 3,313,246 | 1,923,299 | 154,575 | 5,452,830 | 6.5 |
| 1978 | 2 | 18 | 12 | 3 | 101<br>768* | 24,312,504 | 5,606,776 | — | 3,844,276 | 2,572,602 | 170,379 | 6,587,257 | 7.9 |

*$CO_2$ injected in Forest Reserve projects.

TABLE VII

**Fluid Injection Operations, 1978**

WATER INJECTION

| Company | No. of Active Projects | Water Injected (Bbl.) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | Water Cut (%) |
|---|---|---|---|---|---|---|
| Amoco | 2 | 11,712,228 | 2,050,824 | 8,191 | 3,043,672 | 0.4 |
| Texaco | 10 | 10,549,023* | 1,315,336 | 2,587,436 | 2,418,315 | 66 |
| T.N.A. | 1 | 1,045,410 | 331,435 | 295,244 | 529,182 | 47 |
| T.T.P.C.L. | 4 | 731,638 | 49,988 | 18,840 | 61,663 | 27 |
| T.T.O.C. | 1 | 274,205 | 96,693 | 20,383 | 24,284 | 17 |
| TOTAL | 18 | 24,312,504 | 3,844,276 | 2,930,094 | 6,077,116 | 43 |

*This figure includes water injected in other types of projects.

STEAM INJECTION

| Company | No. of Active Projects | Water Injected (Bbl.) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | Prod'n/ Injected Ratio (Bbl./Bbl.) |
|---|---|---|---|---|---|---|
| T.T.P.C.L. | 9 | 3,198,486 | 1,906,152 | 853,407 | 57,628 | 0.6 |
| Texaco | 3 | 2,408,290 | 666,450 | 915,738 | 238,800 | 0.3 |
| TOTAL | 12 | 5,606,776 | 2,572,602 | 1,769,145 | 296,428 | 0.5 |

CARBON DIOXIDE INJECTION

| Company | No. of Active Projects | $CO_2$ Injected (Mscf) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | GOR (Scf/Bbl.) |
|---|---|---|---|---|---|---|
| Texaco | 3 | 768,506 | 170,379 | 123,456 | 377,758 | 2,217 |
| TOTAL | 3 | 768,506 | 170,379 | 123,456 | 377,758 | 2,217 |

NATURAL GAS INJECTION

| Company | No. of Active Projects | Gas Injected (Mscf) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | GOR (Scf/Bbl.) |
|---|---|---|---|---|---|---|
| Texaco | 1 | 66,346 | — | — | — | — |
| T.T.P.C.L. | 1 | 34,995 | — | — | — | — |
| TOTAL | 2 | 101,341 | — | — | — | — |

*These are both water and Gas injection projects; no production has been attributed to gas injection.

TABLE VIII

Water Injection Summary by Projects, 1978

| Company | Field | Project | Water Injected (Bbl.) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | Water —Cut % |
|---|---|---|---|---|---|---|---|
| T.T.I. | Forest Reserve | (UCRA)* | 494,316 | — | — | — | — |
| | | (Forest Sands Zones)* | 12,148 | — | — | — | — |
| | | UCWE—Middle Field | 459,776 | 53,677 | 46,990 | 82,510 | 47 |
| | | UC '645' | 721,386 | 75,332 | 91,033 | 128,874 | 55 |
| | | Bernstein UM Cruse | 76,530 | 38,648 | 12,753 | 51,862 | 25 |
| | | Forest Sands Zone 4 (Phase I Exp.†) | 6,666 | — | — | — | — |
| | Guaya-guayare | Navette '007' | 764,003 | 217,836 | 316,691 | 1,105,371 | 59 |
| | | Navette '410' | 2,726,203 | 250,548 | 781,300 | 310,648 | 76 |
| | | '307' Waterflood | 1,821,797 | 219,017 | 351,816 | 259,039 | 62 |
| | | '307' Ext. | 554,904 | 35,352 | 29,025 | 41,485 | 45 |
| | | '410' Ext. | 1,519,259 | 83,883 | 176,495 | 98,025 | 68 |
| | Trinity | Shallow Herrera | 1,080,548 | 204,955 | 572,629 | 179,092 | 74 |
| | Palo Seco | LF '234' Sds. | 311,487 | 136,088 | 208,704 | 161,445 | 61 |
| T.T.I. | All Fields | All Projects | 10,549,023 | 1,315,336 | 2,587,436 | 2,418,315 | 66 |
| T.T.P.C.L. | Coora | CO/UC/100/I | 281,800 | 20,844 | 2,048 | 17,408 | 9 |
| | | CO/UC/110/I | 174,344 | 7,090 | 1,576 | 24,480 | 18 |
| | | CO/UC/314/I | 275,494 | — | — | — | — |
| | | CO/UC/317/II | — | 22,054 | 15,216 | 19,775 | 41 |
| | All Fields | All Projects | 731,638 | 49,988 | 18,840 | 61,663 | 27 |
| T.T.O.C. | Catshill | CO—30 Sds. | 274,205 | 96,693 | 20,383 | 24,284 | 17 |
| T.N.A. | Soldado Main | Cruse | 1,045,410 | 331,435 | 295,244 | 529,182 | 47 |
| A.T.O.C. | Teak | MM—O/1(L) FBII a/IIb | 11,522,203 | 1,561,781 | 8,191 | 1,512,340 | 0.5 |
| | Samaan | MM—5 BFB K/L | 190,025 | 489,043 | — | 1,531,332 | — |
| A.T.O.C. | All Fields | All Projects | 11,712,228 | 2,050,824 | 8,191 | 3,043,672 | 0.4 |
| ALL CO. | All Fields | All Projects | 24,312,504 | 3,844,276 | 2,930,094 | 6,077,116 | 43 |

*Carbon Dioxide/Water Injection Projects.
†Steam Flood.

TABLE IX

Steam Injection Summary by Projects, 1978

| Company | Field | Project | Steam Injected (Bbl.) | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (Mscf) | Water —Cut % |
|---|---|---|---|---|---|---|---|
| T.T.I. | Forest Reserve | F.S. Zns. 5/6 | 1,603,494 | 576,860 | 863,157 | 171,166 | 60 |
| | | Upper Cruse | 147,646 | 22,184 | 41,143 | 10,390 | 65 |
| | | Phase I Ext'n. Steam F.S. Zn. 5 ½ | 657,150 | 67,406 | 11,438 | 57,244 | 15 |
| T.T.I. | All Fields | All Projects | 2,408,290 | 666,450 | 915,738 | 238,800 | 58 |
| T.T.P.C.L. | Fyzabad | Pilot Projects | 13,851 | 236,278 | 36,383 | 37 | 13.3 |
| | | FM/UF/169/1 | 5,592 | 3,848 | 514 | 2,964 | 11.8 |
| | Guapo | Exp. Gen. 3 | 168,472 | 211,360 | 33,843 | 13,349 | 13.8 |
| | | Exp. O/than 3 | — | 9,231 | 287 | — | 3.0 |
| | | Exp. Areas 1A—2D | 485,403 | 246,544 | 146,482 | 5,235 | 37.3 |
| | Palo Seco | Main Project | 1,684,492 | 423,535 | 315,859 | 21,388 | 42.7 |
| | | Patterns 1—5 | 676,078 | 223,961 | 159,956 | 2,881 | 41.7 |
| | Central Los Bajos | Main Project | 125,644 | 296,306 | 80,813 | 6,909 | 21.4 |
| | | Patterns 1—5 | 38,954 | 255,089 | 79,270 | 4,865 | 23.7 |
| T.T.P.C.L. | All Fields | All Projects | 3,198,486 | 1,906,152 | 853,407 | 57,628 | 30.9 |
| ALL CO. | All Fields | All Projects | 5,606,776 | 2,572,602 | 1,769,145 | 296,428 | 40.8 |

TABLE X

Natural Gas Injection Summary by Areas, 1978

| Company | Field | Project | Gas Injected (Mscf.) | Oil* Produced (Bbl.) | Gas Produced (Mscf.) | G.O.R. (Scf./Bbl.) |
|---|---|---|---|---|---|---|
| T.T.I. ... | Guayaguayare | '007' Gas + Water | 66,346 | — | — | — |
| T.T.P.C.L. ... | Coora | CO/UC/100/1 | 34,995 | — | — | — |
| ALL CO. | All Fields | All Projects | 101,341 | — | — | — |

*No production attributed to gas injection.

Carbon Dioxide Injection by Areas, 1978

| Company | Field | Project | Fluid Injected | | Oil Produced (Bbl.) | Water Produced (Bbl.) | Gas Produced (mscf.) | G.O.R. (Scf./Bbl.) | Water —Cut % |
|---|---|---|---|---|---|---|---|---|---|
| | | | $CO_2$ (Mscf.) | Water (Bbl.) | | | | | |
| T.T.I. | Forest Reserve | U.C.R.A. | 749,060 | 494,316 | 129,718 | 121,765 | 310,691 | 2,395 | 48 |
| | | Forest Sands | 19,446 | 12,148 | 3,626 | 557 | 3,418 | 943 | 13 |
| | | F.S. Zn. 5 | — | — | 37,035 | 1,134 | 63,649 | 1,719 | 3 |
| T.T.I. | All Fields | All Projects | 768,506 | 506,464 | 170,379 | 123,456 | 377,758 | 2,217 | 42 |

## NATURAL GAS REPORT, 1978

**Production and Utilization**

Natural gas production rose from the level of 1977 of approximately 410 million cubic feet per day to 433 million cubic feet per day in 1978. However, as a result of our efforts to increase gas utilization, natural gas used in Trinidad and Tobago increased from an average of 194 million cubic feet per day in 1977 to more than 231 million cubic feet per day in 1978.

Overall, gas utilized as a percentage of total gas production rose from 54.4 per cent in 1977 to a level of 63.6 per cent in 1978. Increases of 17 per cent, 15 per cent and 97 per cent respectively were achieved in respect of gas used in the producing fields, in non-oil industries and as a process material, while refinery usage dropped by approximately 3 per cent.

New Facilities

In February 1978, the offshore 24" gas line from Teak to Galeota was put into commission and with the completion of the processing facilities at Point Galeota, the Natural Gas Company is presently in possession of a complete gas transmission system from offshore Galeota to Port-of-Spain capable of transporting in excess of 200 million cubic feet per day.

In addition, three (3) miles of undersea pipeline were laid across Guayaguayare Bay and with the completion of this loop to Beach field and another segment from Picton to Point Lisas in 1979, the total capability of the system will be upgraded to over 400 million cubic feet per day.

Government in 1978 commissioned the National Gas Company to undertake the Preliminary design of the additional pipeline system required for the transportation of gas for the LNG plant and these studies are well underway. The Natural Gas Pipeline Company of America was chosen as consultants for this exercise. The NGC and NGPL will also be conducting the detailed engineering design for the gas compressor stations that Government intends to erect, in order to conserve some 100 million cubic feet per day of low pressure associated natural gas that would otherwise be flared.

Gas Reserves

The Gas Reserve study of certain offshore areas in Trinidad and Tobago was completed in 1978. These studies, conducted by two (2) independent consultants, showed that a total estimate of at least 12 TCF of natural gas reserves are available for development, and indicates quite clearly that the role of natural gas in the economy can be expected to grow rapidly as we enter the next decade.

TABLE XI

Annual Statistics for Natural Gas Production and Utilization, 1974—1978

| | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Millions of S.C.F. | % | Millions of S.C.F. | % | Millions of S.C.F. | % | Millions of S.C.F. | % | Millions of S.C.F. | % |
| | PRODUCTION | 128,293 | 100.0 | 126,434 | 100.0 | 137,959 | 100.0 | 149,589 | 100.0 | 157,920 | 100.0 |
| | G.O. R. (SCF/BBL.) | 1,883 | — | 1,608 | — | 1,775 | — | 1,789 | — | 1,885 | — |
| A. | USED AS FUEL:— In Fields | 7,645 | 6.0 | 6,000 | 4.7 | 7,128 | 5.2 | 9,064 | 6.0 | 10,616 | 6.7 |
| | In Refinerise | 20,034 | 15.6 | 15,763 | 12.5 | 18,541 | 13.4 | 19,350 | 12.9 | 18,751 | 11.9 |
| | In other industries | 23,029 | 17.9 | 29,855 | 19.7 | 27,276 | 19.8 | 34,554 | 23.1 | 39,842 | 25.2 |
| | SUB-TOTAL:— | 50,708 | 39.5 | 46,618 | 36.8 | 52,945 | 38.4 | 62,968 | 42.0 | 69,209 | 43.8 |
| B. | OTHER COMPLETE UTILIZATION:— | | | | | | | | | | |
| | Used as process Gas | 8,071 | 6.3 | 6,844 | 5.4 | 7,169 | 5.2 | 7,708 | 5.1 | 15,153 | 9.6 |
| | Injected into formation | 5,705 | 4.4 | 2,018 | 1.6 | 1,699 | 1.2 | 333 | 0.2 | 114 | 0.07 |
| | Converted into C.H.P.S. | 49 | 0.1 | 60 | 0.1 | 50 | 0.1 | 62 | 0.1 | 63 | 0.03 |
| | SUB-TOTAL:— | 13,825 | 10.0 | 8,922 | 7.1 | 8,918 | 6.5 | 8,103 | 5.4 | 15,330 | 9.7 |
| C. | VENTED:— | | | | | | | | | | |
| | After use of Pneumatic Energy | 6,635 | 5.2 | 6,684 | 5.4 | 7,200 | 5.2 | 10,349 | 6.9 | 15,843 | 10.1 |
| | Without use | 57,125 | 44.5 | 64,010 | 50.6 | 68,896 | 49.9 | 68,169 | 45.6 | 57,538 | 36.4 |
| | SUB-TOTAL:— | 63,760 | 49.7 | 70,894 | 56.1 | 76,096 | 55.1 | 78,518 | 52.5 | 73,381 | 46.5 |

**Crude Oil Balance, 1978**

| Availability | Million Bbls. | Disposal | Million Bbls. |
|---|---|---|---|
| Stock at 1st January ... ... | 4.0 | Exports ... ... ... | 54.0 |
| Production ... ... ... | 83.8 | Delivered to Refinery ... ... | 85.9 |
| | | Loss from Production ... | 0.5 |
| Imports ... ... ... | 56.8 | Stock at 31st December ... | 4.2 |
| | 144.6 | | 144.6 |

## Refining and Petrochemical Manufacture, 1978

Refining activity in Trinidad and Tobago continued to decline in 1978. Average refinery throughput this year was 235,264 barrels per day, a drop of 13.7 per cent from the corresponding figure for 1977.

Following the oil embargo in 1973, the U.S. actively promoted development of its domestic refining industry through its entitlements program. The appreciable rise in U.S. fuel oil production resulted in a weakening in demand for locally produced fuel oil. This market suitation coupled with the poor refinery economics of local fuel oil-oriented refineries were the major reasons for the reduction in refinery throughput.

The following table lists daily average throughputs for the Texaco and Trintoc refineries.

**Average Daily Throughput (Barrels Per Day)**

| *Year* | *Trintoc* | *Texaco* | *Total* |
|---|---|---|---|
| 1970 ... ... | 69,870 | 354,368 | 424,238 |
| 1971 ... ... | 67,427 | 331,297 | 398,724 |
| 1972 ... ... | 76,381 | 326,777 | 394,158 |
| 1973 ... ... | 66,492 | 321,648 | 388,140 |
| 1974 ... ... | 56,613 | 301,759 | 358,372 |
| 1975 ... ... | 46,782 | 187,866 | 234,648 |
| 1976 ... ... | 54,994 | 266,274 | 321,268 |
| 1977 ... ... | 55,124 | 217,555 | 269,679 |
| 1978 ... ... | 51,398 | 183,866 | 235,264 |

In 1978 Trintoc, the Government-owned refinery, recorded a cumulative throughput of 18,760,270 barrels or a daily average of 51,398 barrels. This represents a decline of 6.76 per cent from the volume processed in 1977, and was marginally below Trintoc's normal throughput in the post-1973 period.

The refinery was shut down for periods during the months of January and June because of lack of fuel oil ullage. Frequent shutdowns due to operational difficulties resulted in a low monthly throughput figure in September. However, throughput levels during the fourth quarter were normal, as there were no major operational problems.

The average daily throughput at Texaco's refinery was 183,866 barrels in 1978, a decline of 15.5 per cent from the 1977 level. For the year, the total volume of crude oil refined was 67,111,090 barrels. In 1978, Texaco's throughput was adversely affected by Saudi Arabia's declared policy to futher control and limit its export of Arabian light crude oil.

Hence there was an increase in imports of Arabian Heavy which was used to maintain lube oil requirements. The Arabian Heavy crude was received spiked with naptha (about 5-6 per cent, a total of 432,000 bbls in 1978) which was used to meet Texaco's contractual

commitments for naphtha. Texaco, operating at low levels of throughput, utilized their most efficient topping units, viz., Nos. 1, 4 and 8. However, their operations were affected by problems such as:—

*(a)* Unavailability of natural gas to produce hydrogen which Texaco uses in the Desulphurization and other units.

*(b)* Sudden outages on the T&TEC power system which mainly affected down-stream processing units.

*(c)* A fire which affected the Desuiphurization Unit.

The main refinery products were:—

| | *Barrels x $10^6$ 1978* | *Percent difference from previous year* |
|---|---|---|
| Fuel Oils ... ... ... | 45.5 | −19.2 |
| Gasolines ... ... ... | 17.1 | − 8.6 |
| Gas/Diesel Oil ... ... | 10.1 | − 5.6 |
| Aviation Turbine Fuel ... | 2.2 | −12.0 |
| Kerosene ... ... ... | 4.5 | −22.4 |
| Lubes/Greases ... ... | 0.7 | −30.0 |
| Petrochemicals ... ... | 0.8 | −20.0 |

Crude feedstock to the country's refineries, originated from the following sources:—

| Name of Crude | Country | Amount (Bbls.) | Per cent Total |
|---|---|---|---|
| *Texaco Trinidad Incorporated* | | | |
| — | Trinidad | 10,522,659 | 12.25 |
| Minas ... ... ... ... ... | Indonesia | 17,321,638 | 20.17 |
| Arabian Light ... ... ... ... | Saudi Arabia | 19,105,871 | 22.25 |
| Arabian Medium ... ... ... ... | do. | 295,835 | 0.34 |
| Arabian Heavy ... ... ... ... | do. | 12,121,110 | 14.11 |
| Light Naphtha ... ... ... ... | do. | 431,792 | 0.50 |
| Dubai ... ... ... ... ... | United Arab Emirates | 154,099 | 0.18 |
| Iranian Light ... ... ... ... | Iran | 316,957 | 0.37 |
| Iranian Heavy ... ... ... ... | do. | 925,985 | 1.08 |
| Angolan ... ... ... ... ... | Angola | 3,092,715 | 3.60 |
| Basrah ... ... ... ... ... | Iraq | 56,829 | 0.07 |
| Amal Nafoora ... ... ... ... | Lybia | 2,022,280 | 2.35 |
| Santa Rosa ... ... ... ... ... | Venezuela | 746,473 | 0.87 |
| Texaco Sub-Total ... ... ... | — | 62,111,243 | 78.14 |
| *Trintoc:* | | | |
| — | Trinidad | 18,531,602 | 21.58 |
| Lago Medio ... ... ... ... | Venezuela | 204,686 | 0.24 |
| — | Barbados | 23,917 | 0.03 |
| Trintoc Sub-Total ... ... ... | — | 18,760,205 | 21.85 |
| *Trinidad Tesoro Petroleum Company Limited* — | Trinidad | 10,394 | 0.01 |
| GRAND TOTAL ... ... ... | — | 85,881,842 | 100.00 |

**Petrochemicals**

Production of petrochemical intermediates from the Texaco refinery amounted to 854,341 barrels in 1978 as compared to 953,353 barrels in 1977, a decline of 10.4 per cent.

Production of di-isobutylene (DIB) was discontinued in March 1978 because of poor manufacturing economics. A combination of marketing problems and a decline in availability of feedstock caused the cessation in DIB production. The decline in feedstock availability was a result of a change in catalyst in the Fluid Catalytic Cracking Unit (FCCU), which improved conversion levels and led to increased gasoline production but reduced the isobutylene content of the butane-butylene stream—the feed to the DIB unit.

Cyclohexane production declined appreciably in1978. Mainly responsible for this was an extended shutdown (February to June) of No.1 Catalytic Reforming Unit (No.1CRU) which produces benzene feedstock for the cyclohexane unit, as well as benzene, toluene and xylene for export. Other factors affecting cyclohexane manufacture were lack of hydrogen from Federation Chemicals Limited during July when its hydrogen plant was down for Test and Inspection (T&I); shutdown to facilitate repairs to heat exchangers in August-September and a shutdown in November-December to effect repairs to the hydrogen recycle compressor in the cyclohexane unit.

The extended shutdown of No. 1 CRU was to renew welds on chrome alloy piping in both the Unifiner and Platformer Sections, as cracks were discovered in certain welds during pre start-up testing, following the February-March T&I on No. 1 CRU. These weld failures have been attributed to thermal fatigue and the increase in the number of emergency shutdowns of the unit due to T&TEC power outages/interruptions over the last five years. T&TEC power failures/outages affected the operation of all petrochemical units. Both Texaco and Fedchem have suffered from these frequent power failures/outages, which not only disrupt continuous operation of the units but, in extreme cases, also cause damage to plant and equipment.

The production and export of major petrochemical intermediates and the variations from the 1977 levels are presented below:

**Production and Exports of Important Petrochemical Intermediates Trinidad and Tobago, 1978**

*(Quantities in Barrels)*

| | *Year 1978* | | *Year 1977* | |
|---|---|---|---|---|
| | Production | Exports | Production | Exports |
| Normal Paraffins ... ... | 522,237 | 526,507* | 575,835 | 644,893* |
| Di-isobutylene ... ... ... | 2,308 | 6,792 | 13,617 | 9,129 |
| Nonene ... ... ... | 43,563 | 41,911 | 35,639 | 33,486 |
| Tetramer ... ... ... | 21,243 | 14,833 | 27,113 | 23,070 |
| Benzene ... ... ... | 53,288 | 65,280* | 68,269 | 51,953 |
| Toluene ... ... ... | 162,689 | 134,514 | 158,934 | 165,842* |
| Xylene ... ... ... | 21,263 | 17,891 | 21,961 | 29,810* |
| Cyclohexane ... ... ... | 15,539 | 30,702* | 33,399 | 17,002 |
| Unrefined Napthentic Acids ... | 12,271 | 8,298 | 10,297 | 10,950* |

*Excess of Exports over production made up from stocks.

## SUMMARY OF ACCIDENTS OCCURRING IN THE PETROLEUM INDUSTRY, 1978

The total number of accidents reported in the petroleum industry for 1978 was 877. This figure represents an increase of 12.0 per cent over the number reported in 1977 and includes 501 refinery accidents which do not fall under the jurisdiction of the Ministry of Petroleum and Mines.

Accidents which occurred in the producing fields numbered 376 representing a decrease of 4.8 per cent over the previous year's figure. Of this number 13.8 per cent was classified as serious and consisted of head injuries, fractures, crush injuries, amputation of fingers, deep lacerations, severe burns and eye injuries. The non-serious accidents involved those treated for shock, bruises to the body, sprains squeezed limbs and fingers and strained muscles.

There were three (3) fatal accidents recorded during the year. Two (2) occured in Texaco's producing fields while the third occurred in PCOL's.

At Texaco's Forest Reserve Well FR 1498 an engineer was electrocuted when he held onto the rails of a metal dog house with his wet hands. The dog house was energised with electric current due to a defect in a 440V cable which supplied the dog house with electricity.

Another electrocution took place in PCOL's San Francique field when a woman, on going to her garden, came into contact with a live 440V electric line which had fallen to the ground. The line supplied electricity to pumping wells in the field.

Texaco's second fatality occurred in their Palo Seco field during fishing operations on well PS 447. The drumline parted when the travelling block ran into the crown block and fell. On falling the travelling block broke off the derrickman's gallery withthe derrickman, causing him to fall to his death.

TABLE XIII

Accident Statistics, 1978

| Company | Field | Total | Fatalities | Serious | | | | Non-Serious | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | D | P | E | O | D | P | E | O |
| TEXACO ... | Guayaguayare ... | 12 | — | — | 1 | — | — | — | 11 | — | — |
| | Barrackpore ... | 7 | — | — | 1 | — | — | 3 | 3 | — | — |
| | Forest Reserve ... | 32 | 1 | 4 | — | — | — | 11 | 16 | — | — |
| | Palo Seco ... | 26 | 1 | 2 | 1 | — | — | 11 | 11 | — | — |
| | Erin ... ... | 1 | — | — | — | — | — | — | 1 | — | — |
| | Cruse ... ... | 1 | — | — | — | — | — | — | 1 | — | — |
| | Wilson ... | 1 | — | — | 1 | — | — | — | — | — | — |
| | Pointe-a-Pierre ... | 501+ | | | | | | | | | |
| | | 80 | 2 | 6 | 4 | — | — | 25 | 43 | — | — |
| AMOCO | ALL | 177 | — | 12 | 9 | 1 | 1 | 78 | 55 | 17 | 4 |
| TESORO | ALL | 51 | — | 2 | 5 | 1 | — | 6 | 35 | — | 2 |
| TRINMAR | ALL | 30 | — | — | — | 3 | 1 | 9 | 8 | 3 | 6 |
| TRINTOC | ALL | 34 | — | 1 | 3 | — | — | 17 | 12 | 1 | — |
| P.C.O.L. | ALL | 3 | 1 | — | 2 | — | — | — | — | — | — |
| DEMINEX | ALL | 1 | — | 1 | — | — | — | — | — | — | — |
| | | 376 | 3 | 22 | 23 | 5 | 2 | 135 | 153 | 21 | 12 |

*Refinery Accidents under the Jurisdiction of the Factory Inspectorate Division (not included in Totals).

D—Drilling P—Production E—Engineering O—Others

## PETROL FILLING STATIONS—SALES AND MARKETING POSITION, 1978

There were 218 filling stations in operation in Trinidad and Tobago during 1978 and of these 10 were located in Tobago. The stations were all serviced by the Trinidad and Tobago National Petroleum Marketing Company Limited in accordance with Government's decision to acquire all the service stations operating in the country.

The distribution and sales of these petrol filling stations were as follows:

| | *Trinidad* | *Tobago* | *Total* |
|---|---|---|---|
| No. of Stations | 208 | 10 | 218 |
| Volume Mogas (I.G.) | 75,239,334 | 2,431,385 | 77,670,719 |
| Average per Station (I.G.) | 361,727 | 243,139 | 356,288 |
| Per cent of Total Sales | 96.9 | 3.1 | 100.0 |

Throughput increased by 8.3 per cent from 71.74 million imperial gallons in 1977 to 77.67 million imperial gallons in 1978. The average rate of increase in throughput for the period 1974-1978 was 8.5 per cent.

The following table shows the total consumption of gasoline over the period 1974-1978:

| *Years* | *Total Consumption of Mogas (I. G.)* |
|---|---|
| 1974 ... ... ... ... | 56,017,495 |
| 1975 ... ... ... ... | 58,981,220 |
| 1976 ... ... ... ... | 64,279,672 |
| 1977 ... ... ... ... | 71,738,746 |
| 1978 ... ... ... ... | 77,670,719 |

The volume of exciseable products amounted to 4,030,283 barrels with the exciseable sale of gasoline amounting to 2,621,753 barrels. This shows a 24.2 per cent increase from 1977. Total excise duty on these exciseable products amounted to $14,569,531 an increase of 7.6 per cent from 1977.

Details of some of the exerciseable products are as follows:

| *Premium Gas bbls* | *Regular Gas bbls* | *Gas/Diesel Oil bbls* |
|---|---|---|
| 1,193,418 | 708,335 | 1,045,061 |

The excise duty on propane was removed in 1978.

TABLE XIV

**Production and Exports of Nitrogenous Fertilizers, Trinidad and Tobago, 1978**

| Fertilizer Type | Federation Chemicals Limited | | | | Trinidad Nitrogen Company Limited | | | | TOTAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Net Production | | Exports | | Net Production | | Exports | | Net Production | | Exports | |
| | 1978 | 1977 | 1978 | 1977 | 1978 | 1977 | 1978 | 1977 | 1978 | 1977 | 1978 | 1977 |
| Anhydrous Ammonia ... | 160,000 | 156,505 | 156,981 | 163,575* | 302,873 | 19,061 | 286,622 | 14,307 | 462,873 | 175,565 | 433,603 | 177,882* |
| Ammonium Sulphate ... | 83,116 | 64,923 | 51,543 | 47,543 | — | Nil | — | — | 83,116 | 64,923 | 51,543 | 47,543 |
| Urea ... ... ... | 79,074 | 73,381 | 77,465 | 74,549* | — | Nil | — | — | 79,074 | 73,381 | 77,465 | 74,549* |

*Excess of Exports over production taken from stock.

## ROYALTY ASSESSMENT, 1978

Appendix VIII presents a summary of Crude Oil assessed for State Royalty by Company, showing average price per barrel of crude oil produced. An analysis of each company's crude oil into light fractions, gas oils and fuel oil has been shown together with the relevant percentage content. The periods analysed are half yearly—30th June 1979 and 31st December 1979.

Net Royalty crude oil production of 46,006,040 barrels and 47,069,250 barrels for the first half and second half of 1977 compares favourably with 45,794,418 barrels and 47,564,836 barrels for the first half and second half of 1978. The fluctuation in production in each half year is noticeable and can be attributed to rise or fall of production mainly in the Amoco Trinidad Oil Company's fields.

Because of continued rising prices of petroleum products Royalty on crude oil for 1978 rose to $274,391,049 as compared with $266,028,875 for 1977 and $223,563,233 for 1976.

A summary of Royalty assessed for Crude Oil, Natural Gas and Natural Gasolene produced, and Minimum Rents on State Oil Leases/Licences for the half-yearly periods 1976, 1977 and 1978 can be seen at Appendix IX.

Although, as compared with previous years, prices rose generally for petroleum products, the value of which form the basis for Royalty calculations, the high prices of such products particularly in the second half of 1978 accounted for the highest Royalty received to date of $277,570,968 in 1978 as compared with $269,782,849 and $226,363,710 respectively in 1977 and 1976.

## LEGAL DEVELOPMENTS FOR 1978

The Legal Section played an important part in the promotion of the petroleum industry in that year. Its duties embodied the administration of the petroleum legislation, drafting of contracts and agreements, grants of licences and other connected matters.

### Legislation

The Legal Section was involved in the drafting of Government Notices Nos. 63, 73, 85, 115 and 138 of 1978, all of which gave public notice of applications by companies for Pipeline Licences.

### Contracts and Agreements

A Formation Agreement and Partnership Agreement among the Republic of Trinidad and Tobago, Tenneco Trinidad LNG, Inc., and Peoples Overseas Incorporated dated 24th April, 1978 was finalised. This agreement sought to enhance the production of LNG, via:

(i) research into the feasibility of operating an LNG plant in Trinidad and Tobago; and
(ii) research into the feasibility of operating a fleet of cryogenic tankers for the export shipment of the LNG output of the Plant.

An agreement between Gaffney, Cline and Associates (Trinidad) Limited and the Republic of Trinidad and Tobago and signed on the 31st May, 1978 for the establishment of a computerised data bank system.

On the 16th May, 1978 an agreement between Ryder Scott Company and the Republic of Trinidad and Tobago was entered into to facilitate a detailed gas reserve study of certain Offshore areas by the said company.

On 5th August, 1978 a lease was signed by the Republic of Trinidad and Tobago (as Lessor) and Baroid Trinidad Services Limited, (as Lessee) for the grant to the latter of 4.1564 acres of Constadt Island for a term of fifteen years. The Lessee was, under the said Lease, allowed to use the premises for:

(i) the manufacture of Barytes and by-products; and
(ii) the importation and/or storage of machinery related to the oil industry and oil-well products of all kinds.

**Surrender of Licences**

By deed dated 11th August, 1978 and registered as No. 5807 of 1978, Trinidad and Tobago Oil Company Limited, Texaco Trinidad Incorporated and Trinidad-Tesoro Petroleum Company Limited collectively surrendered Blocks 4, 5 and 6 of the "Inverted L-Block" off the East Coast of Trinidad pursuant to an Exploration and Production (Public Petroleum Rights) Licence dated 28th December, 1973 and registered as No. 4434 of 1978.

**Assignments**

By deed dated 11th August, 1978 and registered as No.5808 of 1978 Texaco Trinidad Incorporated and Trinidad-Tesoro Petroleum Company Limited assigned to Trinidad Oil Company Limited a total of 12.5 per cent of their interest in the Exploration and Production (Public Petroleum Rights) Licence dated 28th December, 1973 and registered as No. 4434 of 1978.

**Grant of Exploration and Production (Public Petroleum Rights) Licences**

On 1st May, 1978 Trinidad-Tesoro Petroleum Company Limited was granted an Exploration and Production (Public Petroleum Rights) Licence over approximately 5,983 acres of State and Alienated Lands.

On 28th November, 1978 Amoco Trinidad Oil Company was granted an Exploration and Production (Public Petroleum Rights) Licence under its Exploration Licence No. 9051 of 1970 as a result of commercial discovery in well East Mayaro-2 on 16th March, 1977. This Licence, registered as No. 2075 of 1979, was granted over approximately 146,336 acres off the East Coast of Trinidad.

## STAFF

Nineteen hundred and Seventy Eight continued with expansion of recruitment at the Technical and professional levels. A total of twenty-five (25) new recruits joined the Ministry:

*Professional*

| | | |
|---|---|---|
| Mrs. SITA SOWLEY | — | *State Counsel I* |
| ANTHONY PAUL | — | *Geologist I* |
| ELLISTON WELSH | — | *Geophysicist I* |
| DAVID WILSON | — | *Petroleum Engineer I* |
| GORDON BARTLETT (Jamaican) | — | *Petroleum Engineer I* *[On Contract for three (3) years]* |
| ALLYSON GAJRAJ (Gov't Scholar) | — | *Petroleum Engineer I* |
| VIJAY RAMLAL (Gov't Scholar) | — | *Petroleum Engineer I* |
| TENSING RAMLAKHAN (Gov't Scholar) | — | *Petroleum Engineer I* |
| RORY SIEUCHAND (Gov't Scholar) | — | *Petroleum Chemist* |
| SELWYN LASHLEY (Gov't Scholar) | — | *Chemical Engineer I* |
| DENNIS PATRICK (Gov't Scholar) | — | *Chemical Engineer I* |
| GERARD RICHARDS (Gov't Scholar) | — | *Mechanical Engineer I* |

At the Technical Level eight (8) new Petroleum Inspectors and five (5) Petroleum Engineering Assistants joined the staff of the Ministry.

While the establishment increased the undermentioned seven (7) experienced officers left the Ministry:

| | | | | |
|---|---|---|---|---|
| JOEL BROWN (Gov't Scholar) | — | *Chemical Engineer II* | — | *Resigned* |
| SYLVAN JAWAHIR | — | *Petroleum Inspector I* | — | *Resigned* |
| RUPERT BROWN | — | *Draughtsman II* | — | *Retired* |
| GANESS COOLMAN | — | *Draughtsman III* | — | *Retired* |
| ANDRIAN EMILE | — | *Foreman Auger Crew* | — | *Retired* |
| BENETT DARBEAU | — | *Mining Survey Technician* | | *Resigned* |
| RUSSEL FRONTIN | — | *Petroleum Engineer Assistants* | | *Resigned* |

## Training

The following two (2) Petroleum Inspectors attended the Petroleum Measurement and offshore Technology Schools at the University of Texas, United States of America:

Carl McClashie
Ulric Rogers.

Messrs. Frank Look Kin, Petroleum Engineer III and K. Rodrigues, Geologist I attended a seminar in Computer application sponsored by I.B.M. in the U.S.A. Mr. George Chin, Chemical Engineer I attended a three (3) months course in Project Formulation and Evaluation organized by the O.A.S. and the Personnel Department.

Miss Mona Joseph and Miss R. Seepaul, Petroleum Engineering Assistants also attended a six-week course in Project Formulation and Evaluation for supporting staff. The Ministry's staff also participated in three (3) courses organized by the Central Training Unit for Clerical, Secretarial and Manipulative staff.

## Attendance at Conferences and Seminars

In order to make continuing use of new technology and exchange of experiences at the international level officers of the Ministry participated in a number of Conferences and Meetings. The highlight of this activity was the participation by the Honourable Minister of Petroleum and Mines, Mr. Errol Mahabir at the United Nations Inter-regional Symposium on State Petroleum Enterprises in Developing Countries held in March, 1978. Mr. Basharat Ali, Director of Energy Planning accompanied the Honourable Minister at this Symposium. Other Conferences and meetings attended are detailed hereunder:

OFFICERS ATTENDING CONFERENCES AND SEMINAR, 1978

| *Officer* | *Conferences/Seminar* | *Period* |
|---|---|---|
| RODNEY APPLETON | Seventh Session of the Third UN Conference on the Law of the sea | 28th March—19th May, 1978. |
| RUPERT MENDS<br>TREVOR BOOPSINGH<br>HORACE WILLIAMS | Offshore Technology Conference | 8th May—11th May, 1978. |
| HUGH HINDS | Inter-Governmental Maritime Consultative Organization Pollution Conference | 1st May—5th May, 1978. |
| JOHN SCOTT | First Session of the Working Group on the Future Role and Functions of the Inter-Governmental Oceanographic Commission. | 12th June—17th June, 1978. |
| JOHN SCOTT | Second Session of the Inter-Governmental Oceanographic Commission Association for the Caribbean and Adjacent Region. | 7th August—11th August, 1978. |
| HAYDEN TONEY<br>GEORGE LUM HEE | Symposium on Energy Modelling and Net Energy Analysis | 21st August —25th August, 1978. |
| JOHN SCOTT | Fifth Plenary Meeting of the Consultative Council of Directors of Latin American Geological Services | 20th August—25th August, 1978. |
| CARLTON BRATHWAITE | VIIIth Council of Exports of Latin American Energy Organization (OLADE) | 27th November—29th November, 1978. |
| TREVOR BOOPSINGH | Second Latin American Session on Petroleum Engineering | 27th November—1st December, 1978. |