CHAPTER SIXTEEN

# Product Allocation

In a joint-ownership refinery, the participants can use their share of the refinery in any way they wish, provided it is not detrimental to the other participant or refinery as a whole. Therefore, at any given time, the participants will be using different proportions of their capacity entitlement on the crude and downstream units to produce a wide range of finished products, some of which are common to both participants and others produced for one participant only. Also, the inventory of intermediate or process stocks will change constantly.

At some stage, the ownership of various products and intermediate stocks has to be determined. In fact, the allocation of feedstocks and production is an exercise required under the processing agreement. This chapter describes how this is done. Product allocation for an operating period is routinely done at the end of the operating period. For example, if the operating period is a month, say January, product allocation will determine the ownership of products and process stocks at the end of January 31. Also, product allocation requires all operating data for the entire month, which would be available only after January 31. The actual ownership of products and process stocks in the refinery inventory on January 31, may be available only some weeks later, after the completion of the product allocation exercise for the month of January.

Product allocation is carried out in two distinct stages: preliminary allocation and final allocation. Essentially, the preliminary allocation consists of collecting data from all sources, feeding the data into an allocation program, making forecaster changes, and cross-checking the input data. Preliminary allocation allocates only the fixed-product grades and process stocks. Final allocation allocates the refinery production of balancing-grade products to the participants in the ratio of their allocation linear programs (LP) production of balancing grades.

## INPUT DATA

The following input data are required:

1. Each participant's definitive operating plan (DOP) for the month.
2. The participant's opening inventories of finished products and intermediate stocks. The previous month's preliminary and final allocation reports. The previous month closing inventories become the opening inventories for current month.
3. Each participant's product lifting, showing actual product shipped, local sales, pipeline transfers, etc. during the month.
4. Refinery closing inventories and consumption of finished products and intermediate stocks.
5. Actual crude throughput of the refinery for the month.
6. Product equivalencies for all fixed grades and process stocks.

## FORECASTER CHANGES

The actual refinery production during the month of all fixed grades is compared with the production of the fixed grades in the combined or refinery DOP (Table 15-7). The differences between actual production and the DOP for fixed grades and process stocks are allocated to the participants as per a set of rules.

These differences, called *deltas*, between actual production and the combined DOP is allocated to the participants in such a way that the sum of two revised DOPs is made equal to actual production for all fixed grades and process stocks. This allocation of fixed-grade and process-stock deltas to the participants is called *forecaster assigned changes* or simply *forecaster changes*. Note that these changes are made only to fixed grades and process stocks and not to balancing grades. The objective is to revise the participants' DOPs in such a way as to bring all fixed-grade production in the combined DOP equal to the actual production.

## RULES FOR FORECASTER CHANGES

First, the cause of difference between the actual refinery production and combined DOP is investigated and the delta allocated to the participants according to following rules.

## Fixed Grades

1. *For grades where only one participant requests production in its DOP.* The delta is allocated to the participant with the DOP request as shown in following example. Consider a fixed grade I-390. Comparing the combined DOP for I-390 with its actual refinery production shows a delta of 7879 barrels. The entire delta is allocated to participant AOC, as BOC did not request production of this grade in its DOP:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 55300 | 7879 |
| BOC | 0 | 0 |
| TOTAL | 55300 | 7879 |
| ACTUAL PRODUCTION | 63179 | |
| DELTA | 7879 | |

2. *For a grade where both participants request production in their DOP.* Delta is allocated in the ratio of their DOP requests. However, if allocation by this rule causes negative closing inventory to a participant, the delta should be changed:

| PARTICIPANT | DOP | DOP RATIO | DELTA | LIFTING | OPENING INVENTORY | CLOSING INVENTORY |
|---|---|---|---|---|---|---|
| AOC | 69185 | 0.8279 | 20126 | 98000 | 5260 | −3429 |
| BOC | 14384 | 0.1721 | 4184 | 0 | 3400 | 21968 |
| TOTAL | 83569 | 1.0000 | 24310 | | 8660 | 18539 |
| PRODUCTION | 107879 | | | | | |
| DELTA | 24310 | | | | | |

In this case, splitting the delta in the DOP ratio has caused negative closing inventory due to overlifting by one participant. Here, AOC's delta is made equal to (lifting – opening inventory – DOP) to eliminate the negative closing inventory as follows:

| PARTICIPANT | DOP | DELTA | LIFTING | OPENING INVENTORY | CLOSING INVENTORY |
|---|---|---|---|---|---|
| AOC | 69185 | 23555 | 98000 | 5260 | 0 |
| BOC | 14384 | 755 | 0 | 3400 | 18539 |
| TOTAL | 83569 | 24310 | | 8660 | 18539 |
| PRODUCTION | 107879 | | | | |
| DELTA | 24310 | | | | |

3. *No DOP request but there was an actual positive production.* In this case, the delta is allocated in the crude run ratio:

| PARTICIPANT | DOP | CRUDE RATIO | DELTA |
|---|---|---|---|
| AOC | 0 | 0.7112 | 3200 |
| BOC | 0 | 0.2888 | 1300 |
| TOTAL | 0 | 1.0000 | 4500 |
| PRODUCTION | 4500 | | |
| DELTA | 4500 | | |

4. *No DOP request but there was an actual negative production due to reblending of a product grade.* In this case, the delta is allocated to participants in the ratio of their opening inventories:

| PARTICIPANT | DOP | OPENING INVENTORY | DELTA |
|---|---|---|---|
| AOC | 0 | 8290 | −990 |
| BOC | 0 | 4350 | −520 |
| TOTAL | 0 | 12640 | −1510 |
| PRODUCTION | −1510 | | |
| DELTA | −1510 | | |

## Process and Intermediate Stocks

1. *One participant requests a buildup and there actually is a buildup close to the request.* In this case, the delta is allocated to the requesting participant as follows:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 25000 | 2230 |
| BOC | 0 | 0 |
| TOTAL | 25000 | 2230 |
| ACTUAL PRODUCTION | 27230 | |
| DELTA | 2230 | |

2. *One participant requests a buildup and there actually is a buildup but much larger than the request.* In this case, the delta is allocated in the ratio of crude run of the participants:

| PARTICIPANT | DOP, bbl | CRUDE RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | 19000 | 0.6250 | 14896 |
| BOC | 0 | 0.3750 | 8937 |
| TOTAL | 19000 | 1.0000 | 23833 |
| ACTUAL PRODUCTION | 42833 | | |
| DELTA | 23833 | | |

3. *One participant requests a buildup and there actually is a buildup but much smaller than the request.* In this case, the delta is allocated in the ratio of DOP of the participants:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 40000 | −30000 |
| BOC | 0 | 0 |
| TOTAL | 40000 | −30000 |
| ACTUAL PRODUCTION | 10000 | |
| DELTA | −30000 | |

4. *One participant requests a buildup and there actually is a drawdown that is small.* In this case, all drawdown (not delta) is allocated to the nonrequesting participant:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 25000 | −25000 |
| BOC | 0 | −1580 |
| TOTAL | 25000 | −26580 |
| ACTUAL PRODUCTION | −1580 | |
| DELTA | −26580 | |

5. *One participant requests a buildup, and there actually is a drawdown that is large.* In this case, all the drawdown (not delta) is allocated in the ratio of the opening inventories of the participants:

| PARTICIPANT | DOP, bbl | OPENING INV RATIO | DRAWDOWN, bbl | DELTA, bbl |
|---|---|---|---|---|
| AOC | 20000 | 0.3342 | −6528 | −26528 |
| BOC | 0 | 0.6658 | −13005 | −13005 |
| TOTAL | 20000 | 1.0000 | −19533 | −39533 |
| ACTUAL PRODUCTION | −19533 | | | |
| DELTA | −39533 | | | |

6. *Both participants request a buildup and there actually is a buildup.* In this case, the delta is allocated in the ratio of DOP of the participants as follows:

| PARTICIPANT | DOP, bbl | DOP RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | 21333 | 0.3983 | −6033 |
| BOC | 32230 | 0.6017 | −9114 |
| TOTAL | 53563 | 1.0000 | −15147 |
| ACTUAL PRODUCTION | 38416 | | |
| DELTA | −15147 | | |

7. *Both participants request a buildup and there actually is a drawdown.* In this case, the drawdown (not delta) is allocated in the ratio of opening inventories of the participants:

| PARTICIPANT | DOP, bbl | OP. INV RATIO | DRAWDOWN, bbl | DELTA, bbl |
|---|---|---|---|---|
| AOC | 20000 | 0.3341 | −8353 | −28353 |
| BOC | 41000 | 0.6659 | −16647 | −57647 |
| TOTAL | 61000 | 1.0000 | −25000 | −86000 |
| ACTUAL PRODUCTION | −25000 | | | |
| DELTA | −86000 | | | |

8. *Only one participant requests a drawdown and there actually is a drawdown close to that request.* In this case, the delta is allocated to the requesting participant as follows:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 0 | 0 |
| BOC | −36000 | −3610 |
| TOTAL | −36000 | −3610 |
| ACTUAL PRODUCTION | −39610 | |
| DELTA | −3610 | |

9. *Only one participant requests a drawdown and there actually is a drawdown much larger than the request.* In this case, the delta is allocated to participants in the ratio of opening inventories, as follows:

| PARTICIPANT | DOP, bbl | OPENING INV RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | 0 | 0.4355 | −12126 |
| BOC | −19480 | 0.5645 | −15717 |
| TOTAL | −19480 | 1.0000 | −27843 |
| ACTUAL PRODUCTION | −47323 | | |
| DELTA | −27843 | | |

10. *Only one participant requests a drawdown and there actually is a drawdown much smaller than the request.* In this case, the delta is allocated to participants in the ratio of DOPs, as follows:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 0 | 0 |
| BOC | −20788 | 19212 |
| TOTAL | −20788 | 19212 |
| ACTUAL PRODUCTION | −1576 | |
| DELTA | 19212 | |

11. *No DOP request but there actually is a drawdown.* In this case, the delta is allocated to participants in the ratio of opening inventories, as follows:

| PARTICIPANT | DOP, bbl | OPENING INV RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | 0 | 0.6814 | −2418 |
| BOC | 0 | 0.3185 | −1130 |
| TOTAL | 0 | 1.0000 | −3548 |
| ACTUAL PRODUCTION | −3548 | | |
| DELTA | −3548 | | |

12. *One participant requests a buildup, the other asks for a drawdown; there actually is a buildup that is small.* In this case, protect the participant who asks for a drawdown:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | −20000 | 20000 |
| BOC | 15000 | −10345 |
| TOTAL | −5000 | 9655 |
| ACTUAL PRODUCTION | 4655 | |
| DELTA | 9655 | |

13. *One participant requests a buildup, the other asks for a drawdown; there actually is a buildup that is large.* In this case, protect the participant who asks for a drawdown (delta 1), then split the remaining delta (delta 2) in the ratio of crude run of the participants:

| PARTICIPANT | DOP | CRUDE RATIO | DELTA 1, bbl | DELTA 2, bbl | TOTAL DELTA, bbl |
|---|---|---|---|---|---|
| AOC | −6500 | 0.3971 | 6500 | 10376 | 16876 |
| BOC | 9230 | 0.6029 | | 15754 | 15754 |
| TOTAL | 2730 | 1.0000 | 6500 | 26130 | 32630 |
| ACTUAL PRODUCTION | 35360 | | | | |
| DELTA | 32630 | | | | |

14. *One participant requests a buildup, the other asks for a drawdown; there actually is a drawdown that is small.* In this case, protect the participant who asks for a buildup, then allocate the remaining delta to the other participant:

| PARTICIPANT | DOP, bbl | DELTA, bbl |
|---|---|---|
| AOC | −21740 | 18600 |
| BOC | 15000 | −15000 |
| TOTAL | −6740 | 3600 |
| ACTUAL PRODUCTION | −3140 | |
| DELTA | 3600 | |

15. *One participant requests a buildup, the other asks for a drawdown; there actualy is a drawdown that is large.* In this case, protect the participant who asks for a buildup (delta 1), then split the remaining delta in the ratio of opening inventories:

| PARTICIPANT | DOP, bbl | OPENING INV RATIO | DELTA 1, bbl | DELTA 2, bbl | TOTAL DELTA, bbl |
|---|---|---|---|---|---|
| AOC | 12681 | 0.3189 | −12681 | −7019 | −19700 |
| BOC | −6730 | 0.6811 | | −14992 | −14992 |
| TOTAL | 5951 | 1.0000 | −12681 | −22011 | −34692 |
| ACTUAL PRODUCTION | −28741 | | | | |
| DELTA | −34692 | | | | |

16. *Only one participant requests a drawdown; there actually is a buildup that is small.* In this case, allocate the buildup (not delta) to the nonrequesting participant:

| PARTICIPANT | DOP, bbl | ALLOCATION, bbl | DELTA, bbl |
|---|---|---|---|
| AOC | 0 | 1499 | 1499 |
| BOC | −27471 | 0 | 27471 |
| TOTAL | −27471 | 1499 | 28970 |
| ACTUAL PRODUCTION | 1499 | | |
| DELTA | 28970 | | |

17. *Only one participant requests a drawdown; there actually is a buildup that is large.* In this case, allocate the buildup (not delta) on a crude run ratio basis. Use this ratio to allocate the delta:

| PARTICIPANT | DOP, bbl | CRUDE RATIO | ALLOCATION, bbl | DELTA, bbl |
|---|---|---|---|---|
| AOC | 0 | 0.3972 | 10777 | 10777 |
| BOC | −29491 | 0.6028 | 16356 | 45847 |
| TOTAL | −29491 | 1.0000 | 27133 | 56624 |
| ACTUAL PRODUCTION | 27133 | | | |
| DELTA | 56624 | | | |

18. *Both participants request a drawdown; there actually is a drawdown.* In this case, allocate delta in the ratio of DOP:

| PARTICIPANT | DOP, bbl | DOP RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | −17320 | 0.4471 | 4578 |
| BOC | −21417 | 0.5529 | 5662 |
| TOTAL | −38737 | 1.0000 | 10240 |
| ACTUAL PRODUCTION | −28497 | | |
| DELTA | 10240 | | |

19. *Both participants request a drawdown; there actually is a buildup.* In this case, allocate the buildup (not delta) in the ratio of crude run. Use this ratio to allocate the delta:

| PARTICIPANT | DOP, bbl | CRUDE RATIO | ALLOCATION, bbl | DELTA, bbl |
|---|---|---|---|---|
| AOC | −17600 | 0.6032 | 12215 | 29815 |
| BOC | −10100 | 0.3968 | 8035 | 18135 |
| TOTAL | −27700 | 1.0000 | 20250 | 47950 |
| ACTUAL PRODUCTION | 20250 | | | |
| DELTA | 47950 | | | |

20. *No DOP request but there actually is a buildup.* In this case, the delta is allocated to participants in the ratio of their crude run ratio, as follows:

| PARTICIPANT | DOP, bbl | CRUDE RUN RATIO | DELTA, bbl |
|---|---|---|---|
| AOC | 0 | 0.6032 | 11530 |
| BOC | 0 | 0.3968 | 7585 |
| TOTAL | 0 | 1.0000 | 19115 |
| ACTUAL PRODUCTION | 19115 | | |
| DELTA | 19115 | | |

We see that the allocation of deltas between DOP requests and actual production involves considerable judgment. However, if a wrong decision is made, compensating changes to the balancing grade, which is equal in magnitude but opposite in sign, ensure that the participants' fixed grade is merely exchanged with equal barrels of balancing-grade products.

## Allocation of Cat Reformate

Allocation of cat reformate, of different octane numbers, from the catalytic reformer unit is done using a different procedure. The actual cat reformer production during the month is split in the ratio of the DOP request of the participants. The reformate used by a participant in blending its gasoline cargoes is deducted from it. The remaining reformate is its allocation. A more-detailed procedure follows:

1. From the refinery records, for the reference month, determine the total reformer feed and the split for each mode of (severity) operation.
2. Split the estimated reformate production in the ratio of the DOPs.
3. Make an estimate of reformate usage of either severity in the blending of gasoline shipments during the month by each participant and use this ratio to split the actual reformate used in blending gasoline grades.
4. Deduct the reformate used from the reformate production of each participant to estimate its allocation.

The following example make the procedure clear.

## EXAMPLE 16-1

During a given month, the cat reformer ran for 16 days at 8000 barrels per calendar day and processed 128,000 bpcd of feed. The split of the feed into different operation modes was as follows:

| SEVERITY | FEED | REFORMATE YIELD | REFORMATE PRODUCTION |
|---|---|---|---|
| RON 90 | 48000 | 0.8200 | 39000 |
| RON 95 | 80000 | 0.7700 | 62000 |
| TOTAL | 108000 | | 101000 |

1. Split the estimated production of reformate, in the ratio of the DOP of the participants, as follows:

| PARTICIPANT | DOP | DOP RATIO | 90R REFORMATE | 95R REFORMATE |
|---|---|---|---|---|
| AOC | 65296 | 0.7167 | 27951 | 44435 |
| BOC | 25816 | 0.2833 | 11049 | 17565 |
| TOTAL | 91112 | 1.0000 | 39000 | 62000 |

2. Estimates of actual reformate usage in different shipments by both the participants are next prepared:

| GRADE | AOC 90R, bbl | AOC 95R, bbl | BOC 90R, bbl | BOC 95R, bbl |
|---|---|---|---|---|
| I-393 | 0 | 2500 | 0 | 0 |
| I-395 | 9400 | 4350 | 4600 | 2150 |
| I-397 | 11500 | 500 | 0 | 0 |
| I-397M | 18000 | 36900 | 0 | 0 |
| I-398 | 4000 | 0 | 0 | 0 |
| TOTAL | 42900 | 49250 | 4600 | 2150 |

3. Actual reformate usage in gasoline blending during the month from the refinery records, follows. This is split between the participants

in the ratio of their actual usage. The reformate actually used in gasoline blending is

Reformate 90R = 54635 bbls

Reformate 95R = 47298 bbls

4. Split this actual refinery usage of reformate, in the ratio of participants' 90R and 95R usage in their shipments. Allocation is remaining production of a participant; that is (production – usage) as follows. For reformate 90R,

| PARTICIPANT | SHIPMENT RECORD, bbl | SHIPMENT RATIO, bbl | ACTUAL USAGE, bbl | REFORMER PRODUCTION, bbl | ALLOCATION, bbl |
|---|---|---|---|---|---|
| AOC | 42900 | 0.9032 | 49344 | 27951 | −21393 |
| BOC | 4600 | 0.0968 | 5291 | 11049 | 5758 |
| TOTAL | 47500 | 1.0000 | 54635 | 39000 | −15635 |

For reformate 95R,

| PARTICIPANT | SHIPMENT RECORD, bbl | SHIPMENT RATIO, bbl | ACTUAL USAGE, bbl | REFORMER PRODUCTION, bbl | ALLOCATION, bbl |
|---|---|---|---|---|---|
| AOC | 49250 | 0.9582 | 45320 | 44435 | −885 |
| BOC | 2150 | 0.0418 | 1978 | 17565 | 15587 |
| TOTAL | 51400 | 1.0000 | 47298 | 62000 | 14702 |

## FORECASTER COMPENSATING CHANGES

Every forecaster change results in an equal and opposite change to the balancing grades, depending on the product equivalency of that grade. Thus, any production of fixed grade by a participant over and above what was indicated in the participant's DOP has to come at the expense of balancing grade from a given crude run.

## EXAMPLE 16-2

Suppose forecaster change for I-1138 (bulk asphalt) for participant AOC is −9604 bbl and the equivalency for asphalt is as follows:

$$\text{I-1138} = 1.0000$$
$$\text{I-888} = -0.7287$$
$$\text{I-961} = 1.7287$$

or one barrel of asphalt is equivalent to 1.7287 bbl I-961 (fuel oil) minus 0.7287 barrels of I-888 (diesel).

As such, −9604 bbl asphalt (I-1138) would be equivalent to

$$\text{I-961} = 1.7287 \times (-9604)$$
$$= -16602 \text{ bbl}$$
$$\text{I-888} = -0.7287 \times (-9604)$$
$$= 6998 \text{ bbl}$$

Thus, a fixed-grade I-1138 (asphalt) production decrease of 9604 barrels results in a balancing-grade fuel oil (I-961) production increase of 16,602 barrels and a balancing-grade diesel (I-888) production decrease of 6998 barrels. So, participant AOC is compensated for 9604 bbl asphalt loss with +16602 bbl I-961 (fuel oil) and −6998 bbl I-888 (diesel), as follows:

| FIXED GRADE | FORECASTER CHANGE, bbl | FORECASTER COMPENSATING CHANGES, bbl | | TOTAL FORECASTER COMPENSATING CHANGE, bbl |
|---|---|---|---|---|
| | | I-961 | I-888 | |
| I-1138 | −9604 | −6998 | 16602 | 9604 |

Compensating changes to the balancing grade are equal in magnitude but opposite in sign to forecaster change.

The forecaster compensating changes are added algebraically to the balancing grade production of the participant.

## CRUDE OIL CHANGES

The actual crude run during a month cannot be exactly the same as the participants' DOP estimates, even though the joint-operating company (JOC) tries to keep the crude run as close as possible to the participants' DOP.

Any delta between the actual crude run of a participant and its DOP rude run is reflected as forecaster change The crude oil delta is converted into balancing grade products by means of crude oil equivalency. The crude oil equivalency is the yields of balancing-grade products from the incremental crude run, generally determined by actual test runs on the refinery at various levels of crude throughput (Table 15-12).

## EXAMPLE 16-3

The actual crude run of the refinery during a month was 125,526 barrels more than the combined DOP of the participants as follows:

| CRUDE RUN | DOP, bbl | ACTUAL, bbl | DELTA, bbl |
|---|---|---|---|
| AOC | 6,090,000 | 6,215,526 | 125,526 |
| BOC | 1,200,000 | 1,200,000 | 0 |
| TOTAL REFINERY | 7,290,000 | 7,415,526 | 125,526 |

Any change in the crude run is reflected in the production of balancing grades by means of crude oil equivalency. Here refinery crude run is 243 mbpcd therefore from table 15-12, crude oil equivalency for crude run 200–259 mbpcd is used.

Thus, additional processing of 125,526 bbl crude oil results in following balancing-grade production for participant AOC:

I-201 = −126 bbl
I-210 = 22,971 bbl
I-440 = 12,553 bbl
I-888 = 41,047 bbl
I-961 = 46,947 bbl
Loss = 2,134 bbl
Total = 125,526 bbl

## DOP "LOSS" ADJUSTMENT

During processing in the conversion units of the refinery (FCCU, hydrocracker, etc.) the stocks expand in volume due to reduction in density, resulting in volume gain or negative loss. A situation can arise in which the DOP of one participant shows volume gain (negative loss) while the other participant's DOP shows a positive loss. The allocation of actual refinery "losses" on the basis of retrospective DOPs becomes unrealistic, as the following example shows:

Retrospective DOP loss, AOC = −5,000
Retrospective DOP loss, BOC = 9,600
Total refinery retrospective losses = 4,600
Actual refinery losses = 30,000
Loss delta = 25,400

Splitting the loss delta in the ratio of retrospective DOP losses yields the following results:

AOC delta = −27,607 bbl
BOC delta = 53,007 bbl
Total retrospective delta = 25,400 bbl
AOC allocated losses = −32,607 bbl
BOC allocated losses = 62,607 bbl
Total refinery losses = 30,000 bbl

This allocation is unrealistic. Therefore, to make the losses positive in both retrospective DOPs, the balancing-grade production of each is reduced by 0.6 vol%. The actual refinery losses are next allocated in the ratio of the revised retrospective DOPs, after deducting 0.6% from balancing-grade production volumes.

The figure of 0.6%, which roughly represents unaccounted losses of the refinery during crude processing, is chosen to make the losses positive in both retrospective DOPs or, in other words, a little more than the volume gain encountered in the retrospective DOPs.

## RETROSPECTIVE DOP

By applying forecaster changes, forecaster compensating changes, and crude changes, the original DOP of the participants has been amended to bring their fixed grades, process stock, and crude run equal to the actual production of fixed grades, process stocks, and crude. These amended DOPs of the participants are called *retrospective DOPs*, or *retro DOPs*, which are combined to make a refinery retro DOP.

Note that, in the refinery retro DOP,

- All fixed grade and process stock production equals their actual refinery production.
- The total crude run in the retro DOP equals the actual crude run.
- The delta between the actual production and retro DOP of the refinery remains on balancing grades.
- The delta between the actual production and retro DOP of the refinery remains on losses.

The retrospective DOP is used for the allocation of balancing grades and actual refinery losses.

## ALLOCATION OF BALANCING GRADES

We see that, in the retrospective DOP, all deltas on fixed grades, intermediate stocks, and crude run have been eliminated. The deltas between actual production and retro DOP remain only in balancing grades and refinery loss (actual refinery losses minus retro DOP losses). In the allocation procedure, loss is treated as a balancing-grade product.

The balancing-grade deltas (actual production minus retro production) are allocated by following procedure:

1. The retro DOP of the participants is expressed in balancing-grade equivalents using product equivalencies.
2. The total delta (actual production minus retro DOP) for each balancing grade and loss is determined. The sum of these deltas must equal zero.
3. Next, the deltas are allocated to participants in proportion to their respective shares of production of that product in the combined retro DOP (expressed in balancing grades).
4. By the nature of this calculation, the sum of each participant's delta allocation will not be balanced between the participants but equal in amount and of opposite plus and minus signs, since the sum of such imbalances must equal zero. Accordingly, a further step is required to eliminate these imbalances. This is done by reverse allocation, as described next.

## REVERSE ALLOCATION

5. The absolute values of all balancing-grade (including loss) deltas are added to obtain the absolute value of combined total deltas (AVCTD).
6. The ratio of the absolute value of delta for each product and AVCTD is multiplied by the total imbalance (sum of delta allocations) to obtain the reverse allocation of that product for the other participant. The sum of such reverse allocation for each participant is equal to and of opposite sign to that participant's total imbalance (sum of delta allocations), accordingly eliminating the imbalance.
7. The total allocation of each participant is the sum of the retrospective DOP plus the sum of allocations for such product made under steps 3 and 4.

The preliminary product allocation is now complete.

## EXAMPLE 16-4, PRELIMINARY ALLOCATION

Two participants, AOC and BOC, run a 250 mbpd oil refinery. Participant AOC has a 210 mbpd refinery capacity and participant BOC has

a 40 mbpd refinery capacity. The refinery is operated as a joint-ownership refinery as per their processing agreement (see the Appendix). The entire product allocation procedure for effecting their preliminary allocation is shown in Tables 16-1 to 16-8.

Table 16-1 shows the DOP of participants AOC and BOC for a given month. The combined production of two DOPs make up the refinery DOP. Tables 16-2 and 16-3 present procedure for adjusting the balancing grade for refinery losses, by participant. The total adjustment is 0.6% (LV) of the crude run. This is spread over the balancing grades in proportion to the participant's production, as shown in these tables.

Table 16-4 compares the actual refinery production of every fixed grade and process stock with that in the combined DOP. The delta between these is the total "forecaster" change. The total forecaster change is allocated to the participants as per the rules for allocation of fixed grades and process stocks explained earlier. Table 16-5 shows data for the actual refinery crude run and that, in the combined DOP, allocated to the participants as per the crude distillation unit capacity available to each.

Tables 16-6 and 16-7 show calculation of the forecaster compensating changes for each participant. The forecaster compensating changes for a fixed product grade or process stock are calculated by converting every forecaster change to its balancing-grades equivalent by means of a product equivalency and multiplying it by $-1$. The forecaster compensating change for crude is also calculated by converting to balancing-grades equivalent by means of a crude oil equivalency. However, unlike the fixed grades, the forecaster compensating changes for crude are of the same sign as the forecaster change for crude oil.

Table 16-8 shows the retrospective DOP of the participants (columns 6 and 11) and the overall refinery retrospective DOP (column 12). We see that

1. The fixed grade production in the participant's retrospective DOP is, in fact, its allocation. The sum of the participants' retrospective DOPs for any fixed grade or process stock equals the actual refinery production for that grade. Thus, in the retrospective DOP, the actual refinery production of all fixed grades and process stocks has been split or "allocated" to the participants.
2. The delta between the actual refinery production and the total retro DOP (column 12) remains only on balancing grades and losses.

**Table 16-1**
**Refinery DOP (All Figures in Barrels)**

| PRODUCT | AOC | BOC | TOTAL |
|---|---|---|---|
| 1138B | 60000 | 46590 | 106590 |
| 1149B | 0 | 0 | 0 |
| 150 | 17839 | 0 | 17839 |
| 201 | 0 | 864 | 864 |
| 210 | 946831 | 227578 | 1174409 |
| 220 | 0 | 0 | 0 |
| 383 | 0 | 0 | 0 |
| 390 | 76800 | 0 | 76800 |
| 395 | 0 | 0 | 0 |
| 397 | 512647 | 80716 | 593363 |
| 397E | 0 | 0 | 0 |
| 398 | 44100 | 0 | 44100 |
| 411 | 0 | 0 | 0 |
| 419 | 420000 | 0 | 420000 |
| 434 | 240000 | 0 | 240000 |
| 440 | 517375 | 205589 | 722964 |
| 711 | 0 | 0 | 0 |
| 725 | 0 | 0 | 0 |
| 800 | 420000 | 0 | 420000 |
| 876 | 300000 | 0 | 300000 |
| 876ZP | 240000 | 0 | 240000 |
| 888 | 991519 | 409686 | 1401205 |
| 892 | 0 | 0 | 0 |
| 928 | 360000 | 0 | 360000 |
| 961 | 1074918 | 219295 | 1294213 |
| PBFUEL | 0 | 0 | 0 |
| PCTTR | 0 | 0 | 0 |
| PDSDSL | 0 | 0 | 0 |
| PDSL | 0 | 0 | 0 |
| PFCOO | 0 | 0 | 0 |
| PFDISO | 0 | 0 | 0 |
| PKERO | 0 | 0 | 0 |
| PLCGAS | −60000 | 0 | −60000 |
| PLLCN | 0 | 0 | 0 |
| PLTISO | 0 | 0 | 0 |
| PMEISO | 0 | 0 | 0 |
| PMIDSL | 0 | 0 | 0 |
| PMSR | 0 | 0 | 0 |
| PPOLY | −30000 | 0 | −30000 |
| PP90R | −18000 | 0 | −18000 |
| PP95R | −60000 | 0 | −60000 |
| PRESID | 0 | 0 | 0 |
| PSKERO | 0 | 0 | 0 |
| PSLOPD | 0 | 0 | 0 |
| PSLOPO | 0 | 0 | 0 |
| PSMCN | 0 | 0 | 0 |
| PSWMSR | 0 | 0 | 0 |
| PUFCHG | 0 | 0 | 0 |
| PWCN | 0 | 0 | 0 |
| PROD + STOCK | 6054029 | 1190318 | 7244347 |
| LOSSES | 35971 | 9682 | 45653 |
| CRUDE | 6090000 | 1200000 | 7290000 |

**Table 16-2**
**Adjustment of Losses, Participant AOC**

| BALANCING GRADES | DOP, bbls | PERCENT | ADJUSTMENT, bbls | ADJUSTED DOP, bbls |
|---|---|---|---|---|
| I-150 | 18000 | 0.4 | 161 | 17839 |
| I-201 | 0 | 0.0 | 0 | 0 |
| I-210 | 955350 | 23.3 | 8519 | 946831 |
| I-397 | 517260 | 12.6 | 4613 | 512647 |
| I-440 | 522030 | 12.7 | 4655 | 517375 |
| I-888 | 1000440 | 24.4 | 8921 | 991519 |
| I-961 | 1084590 | 26.5 | 9672 | 1074918 |
| | 4097670 | 100.0 | 36541 | 4061129 |

NOTES:
TOTAL CRUDE RUN DURING THE MONTH = 6090000 bbls
DEDUCT 0.6% FOR UNACCOUNTED LOSSES = 36540 bbls

Table 16-9 shows the retro DOP of the participants converted to balancing grade equivalents. This is used to allocate balancing grades and losses (loss is considered as balancing grade).

Table 16-10 shows the allocation of balancing grade deltas to participants as per procedure described earlier. Table 16-11 shows the complete preliminary product allocation, in which the actual refinery production of all fixed and balancing grades has been split (allocated) to the participants, AOC and BOC.

**Table 16-3**
**Adjustment of Losses, Participant BOC**

| BALANCING GRADE | DOP, bbls | PERCENT | ADJUSTMENT, bbls | ADJUSTED DOP, bbls |
|---|---|---|---|---|
| I-150 | 0 | 0 | 0 | 0 |
| I-201 | 870 | 0.1 | 6 | 864 |
| I-210 | 229140 | 19.9 | 1562 | 227578 |
| I-397 | 81270 | 7.1 | 554 | 80716 |
| I-440 | 207000 | 18 | 1411 | 205589 |
| I-888 | 412500 | 35.7 | 2811 | 409689 |
| I-961 | 220800 | 19.2 | 1505 | 219295 |
| | 1151580 | 100.0 | 7849 | 1143731 |

NOTES:
CRUDE RUN FOR BOC = 1308000 bbl
DEDUCT 0.6% FOR UNACCOUNTED LOSSES = 7848 bbl

**Table 16-4**
**Forecaster Changes for Fixed Grades and Process Stocks**
**(All Figures in Barrels)**

| PRODUCTS | ACTUAL PRODUCTION | COMBINED DOP | TOTAL FORCASTER CHANGE | FORECASTER CHANGE, AOC | FORECASTER CHANGE, BOC |
|---|---|---|---|---|---|
| GRADES | | | | | |
| 1138B | 85638 | 106590 | −20952 | −9604 | −11348 |
| 1149B | 25568 | 0 | 25568 | 13451 | 12117 |
| 150 | 19553 | 17839 | BG | | |
| 201 | 0 | 864 | BG | | |
| 210 | 1029704 | 1174409 | BG | | |
| 220 | 575 | 0 | 575 | 0 | 575 |
| 383 | 17686 | 0 | 17686 | 17686 | 0 |
| 390 | 88039 | 76800 | 11239 | 11239 | 0 |
| 395 | 104597 | 0 | 104597 | 87671 | 16926 |
| 397 | 289195 | 593363 | BG | | |
| 397E | 3384 | 0 | 3384 | 0 | 3384 |
| 398 | 67508 | 44100 | 23408 | 23408 | 0 |
| 411 | 100 | 0 | 100 | 100 | 0 |
| 419 | 220278 | 420000 | −199722 | −199722 | 0 |
| 434 | 309908 | 240000 | 69908 | 69908 | 0 |
| 440 | 944758 | 722964 | BG | | |
| 711 | −28374 | 0 | −28374 | 0 | −28374 |
| 725 | 100752 | 0 | 100752 | 100752 | 0 |
| 800 | 378169 | 420000 | −41831 | −41831 | 0 |
| 876 | −130601 | 300000 | −430601 | −430601 | 0 |
| 876ZP | 232098 | 240000 | −7902 | −7902 | 0 |
| 888 | 2002599 | 1401205 | BG | | |
| 892 | −66 | 0 | −66 | −38 | −28 |
| 928 | 403652 | 360000 | 43652 | 43652 | 0 |
| 961 | 1345430 | 1294213 | BG | | |
| PROCESS STOCKS | | | | | |
| PBFUEL | −1301 | 0 | −1301 | −657 | −644 |
| PCTTR | −8731 | 0 | −8731 | −7294 | −1437 |
| PDDSL | 1470 | 0 | 1470 | 1232 | 238 |
| PDSL | 33564 | 0 | 33564 | 28133 | 5431 |
| PFCOO | −25764 | 0 | −25764 | −17798 | −7966 |
| PFDISO | −196533 | 0 | −196533 | −188993 | −7540 |
| PKERO | −19637 | 0 | −19637 | −14004 | −5633 |
| PLCGAS | −18227 | −60000 | 41773 | 41773 | 0 |
| PLLCN | 2674 | 0 | 2674 | 2241 | 433 |
| PLTISO | 10800 | 0 | 10800 | 9052 | 1748 |
| PMEISO | 35309 | 0 | 35309 | 29595 | 5714 |
| PMIDSL | −26688 | 0 | −26688 | −20269 | −6419 |
| PMSR | 19029 | 0 | 19029 | 15950 | 3079 |

**Table 16-4**
**Continued**

| | | | | | |
|---|---|---|---|---|---|
| PPOLY | 3652 | −30000 | 33652 | 30000 | 3652 |
| PP90R | 1363 | −18000 | 19363 | 18000 | 1363 |
| PP95R | 36857 | −60000 | 96857 | 90893 | 5964 |
| PRESID | 793 | 0 | 793 | 665 | 128 |
| PSKERO | 13473 | 0 | 13473 | 11293 | 2180 |
| PSLOPD | −4861 | 0 | −4861 | −4045 | −816 |
| PSLOPO | −4719 | 0 | −4719 | −3874 | −845 |
| PSMCN | 9387 | 0 | 9387 | 7867 | 1520 |
| PSWMSR | 8909 | 0 | 8909 | 7467 | 1442 |
| PUFCHG | −3099 | 0 | −3099 | −2590 | −509 |
| PWCN | −547 | 0 | −547 | −451 | −96 |
| TOTAL | 7377323 | 7244347 | −292859 | −287645 | −5761 |
| LOSSES | 38204 | 45650 | | | |
| CRUDE | 7415526 | 7290000 | 125526 | 125526 | 0 |

NOTE: BG = BALANCING GRADE

## FINAL ALLOCATION

In the preliminary allocation, the allocation of balancing grades is unsatisfactory because it is based on the participants' DOPs. A participant DOP is prepared from the refinery LP model using its share of processing unit capacity. The DOPs are prepared before the start of the reference month. At that time, the exact refinery unit capacity available for sharing between the participants, during the month, is not known. Also, the average balancing-grade product prices prevailing during the month, which are used to drive the LP, are not known. Participants may be using approximate data on processing unit capacity available to them and balancing-grade product prices in their refinery LP model. The result is that the optimization of balancing-grades production is not on the same basis in the two participants' LPs.

**Table 16-5**
**Crude Changes (All Figures in Barrels)**

| | ACTUAL CRUDE | COMBINED DOP | DELTA | FORECASTER, AOC | FORECASTER, BOC |
|---|---|---|---|---|---|
| CRUDE RUN | 7415526 | 729000 | 125526 | 125526 | 0 |

## Table 16-6
## Forecaster Compensating Changes, AOC (All Figures in Barrels)

| GRADE | FORECASTER CHANGE | FORECASTER COMPENSATING AOC | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I-150 | I-201 | I-210 | I-397 | I-440 | I-888 | I-961 | LOSS | CHECK |
| 1138B | −9604 | 0 | 0 | 0 | 0 | 0 | −6998 | 16602 | | 9604 |
| 1149B | 13451 | 0 | 0 | 0 | 0 | 0 | 9802 | −23253 | | −13451 |
| 150 | | | | | | | | | | |
| 201 | | | | | | | | | | |
| 210 | | | | | | | | | | |
| 220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 383 | 17686 | 478 | −14738 | 0 | −3426 | 0 | 0 | 0 | | −17686 |
| 390 | 11239 | 76 | −5106 | 0 | −6210 | 0 | 0 | 0 | | −11239 |
| 395 | 87671 | −1043 | −16079 | 0 | −70549 | 0 | 0 | 0 | | −87671 |
| 397 | | | | | | | | | | |
| 397E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 398 | 23408 | 7 | −506 | 0 | −22909 | 0 | 0 | 0 | | −23408 |
| 411 | 100 | 0 | 0 | 0 | 0 | −100 | 0 | 0 | | −100 |
| 419 | −199722 | 0 | 0 | 0 | 0 | 199722 | 0 | 0 | | 199722 |
| 434 | 69908 | 2447 | 0 | −36562 | 0 | −35793 | 0 | 0 | | −69908 |
| 440 | | | | | | | | | | |
| 711 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 725 | 100752 | 0 | 0 | 0 | 0 | 0 | −34941 | −65811 | | −100752 |
| 800 | −41831 | 0 | 0 | 0 | 0 | −23764 | 65595 | 0 | | 41831 |
| 876 | −430601 | 0 | 0 | 0 | 0 | 63643 | 366958 | 0 | | 430601 |
| 876ZP | −7902 | 0 | 0 | 0 | 0 | 4558 | 3344 | 0 | | 7902 |
| 888 | | | | | | | | | | |
| 892 | −38 | 0 | 0 | 0 | 0 | 0 | 28 | 10 | | 38 |
| 928 | 43652 | 0 | 0 | 0 | 0 | 0 | 891 | −44543 | | −43652 |
| 961 | | | | | | | | | | |
| Process Stocks | | | | | | | | | | |
| PBFUEL | −657 | 0 | 0 | 0 | 0 | 0 | 0 | 657 | | 657 |
| PCTTR | −7294 | 0 | 0 | 0 | 0 | 0 | 4696 | 2598 | | 7294 |
| PDDSL | 1232 | 0 | 0 | 0 | 0 | 0 | −1232 | 0 | | −1232 |
| PDSL | 28133 | 0 | 0 | 0 | 0 | 0 | −28133 | 0 | | −28133 |
| PFCOO | −17798 | 0 | 0 | 0 | 0 | 0 | 4800 | 12998 | | 17798 |
| PFDISO | −188993 | 0 | 0 | 0 | 0 | 0 | 45472 | 143521 | | 188993 |
| PKERO | −14004 | 0 | 0 | 0 | 0 | 14004 | 0 | 0 | | 14004 |
| PLCGAS | 41773 | 313 | −1366 | 0 | −40720 | 0 | 0 | 0 | | −41773 |
| PLLCN | 2241 | 17 | −73 | 0 | −2185 | 0 | 0 | 0 | | −2241 |
| PLTISO | 9052 | 0 | 0 | 0 | 0 | 0 | −9052 | 0 | | −9052 |
| PMEISO | 29595 | 0 | 0 | 0 | 0 | 0 | −9944 | −19651 | | −29595 |
| PMIDSL | −20269 | 0 | 0 | 0 | 0 | −9224 | 29493 | 0 | | 20269 |
| PMSR | 15950 | 1818 | 7481 | −25249 | 0 | 0 | 0 | 0 | | −15950 |
| PPOLY | 30000 | 462 | 3228 | 0 | −33690 | 0 | 0 | 0 | | −30000 |
| PP90R | 18000 | 409 | 473 | 0 | −18882 | 0 | 0 | 0 | | −18000 |
| PP95R | 90893 | 1872 | 14679 | 0 | −107445 | 0 | 0 | 0 | | −90893 |
| PRESID | 665 | 0 | 0 | 0 | 0 | 0 | −147 | −518 | | −665 |
| PSKERO | 11293 | 0 | 0 | 0 | 0 | −11293 | 0 | 0 | | −11293 |
| PSLOPD | −4045 | 0 | 405 | 405 | 566 | 769 | 1497 | 405 | | 4045 |
| PSLOPO | −3874 | 0 | 387 | 387 | 542 | 736 | 1433 | 387 | | 3874 |
| PSMCN | 7867 | 1370 | −2851 | 0 | −6386 | 0 | 0 | 0 | | −7867 |
| PSWMSR | 7467 | 851 | 3502 | −11820 | 0 | 0 | 0 | 0 | | −7467 |
| PUFCHG | −2590 | −295 | −1215 | 4100 | 0 | 0 | 0 | 0 | | 2590 |
| PWCN | −451 | −79 | 163 | 0 | 366 | 0 | 0 | 0 | | 451 |
| TOTAL | −287645 | 8704 | −11615 | −68739 | −310927 | 203257 | 443561 | 23404 | | 287645 |
| CRUDE | 125526 | 0 | −1255 | 22595 | 0 | 12553 | 38913 | 50587 | 2134 | 125526 |

## Table 16-7
## Forecaster Compensating Changes, BOC (All Figures in Barrels)

| GRADE | FORECASTER CHANGE | FORECASTER COMPENSATING CHANGES TO BALANCING GRADES | | | | | | | LOSS | CHECK |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I-150 | I-201 | I-210 | I-397 | I-440 | I-888 | I-961 | | |
| 1138B | −11348 | 0 | 0 | 0 | 0 | 0 | −8269 | 19617 | | 11348 |
| 1149B | 12117 | 0 | 0 | 0 | 0 | 0 | 8830 | −20947 | | −12117 |
| 150 | | | | | | | | | | |
| 201 | | | | | | | | | | |
| 210 | | | | | | | | | | |
| 220 | 575 | 0 | −575 | 0 | 0 | 0 | 0 | 0 | | −575 |
| 383 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 390 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 395 | 16926 | −201 | −3104 | 0 | −13620 | 0 | 0 | 0 | | −16926 |
| 397 | | | | | | | | | | |
| 397E | 3384 | 0 | 0 | 0 | −3384 | 0 | 0 | 0 | | −3384 |
| 398 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 411 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 419 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 434 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 440 | | | | | | | | | | |
| 711 | −28374 | 0 | 0 | 0 | 0 | 0 | 7094 | 21281 | | 28374 |
| 725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 876 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 876ZP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 888 | | | | | | | | | | |
| 892 | −28 | 0 | 0 | 0 | 0 | 0 | 20 | 8 | | 28 |
| 928 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 961 | | | | | | | | | | |
| Process | | | | | | | | | | |
| Stocks | | | | | | | | | | |
| PBFUEL | −644 | 0 | 0 | 0 | 0 | 0 | 0 | 644 | | 644 |
| PCTTR | −1437 | 0 | 0 | 0 | 0 | 0 | 925 | 512 | | 1437 |
| PDDSL | 238 | 0 | 0 | 0 | 0 | 0 | −238 | 0 | | −238 |
| PDSL | 5431 | 0 | 0 | 0 | 0 | 0 | −5431 | 0 | | −5431 |
| PFCOO | −7966 | 0 | 0 | 0 | 0 | 0 | 2148 | 5818 | | 7966 |
| PFDISO | −7540 | 0 | 0 | 0 | 0 | 0 | 1814 | 5726 | | 7540 |
| PKERO | −5633 | 0 | 0 | 0 | 0 | 5633 | 0 | 0 | | 5633 |
| PLCGAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PLLCN | 433 | 3 | −14 | 0 | −422 | 0 | 0 | 0 | | −433 |
| PLTISO | 1748 | 0 | 0 | 0 | 0 | 0 | −1748 | 0 | | −1748 |
| PMEISO | 5714 | 0 | 0 | 0 | 0 | 0 | −1920 | −3794 | | −5714 |
| PMIDSL | −6419 | 0 | 0 | 0 | 0 | −2921 | 9340 | 0 | | 6419 |
| PMSR | 3079 | 351 | 1444 | −4874 | 0 | 0 | 0 | 0 | | −3079 |
| PPOLY | 3652 | 56 | 393 | 0 | −4101 | 0 | 0 | 0 | | −3652 |
| PP90R | 1363 | 31 | 36 | 0 | −1430 | 0 | 0 | 0 | | −1363 |
| PP95R | 5964 | 123 | 963 | 0 | −7050 | 0 | 0 | 0 | | −5964 |
| PRESID | 128 | 0 | 0 | 0 | 0 | 0 | −28 | −100 | | −128 |
| PSKERO | 2180 | 0 | 0 | 0 | 0 | −2180 | 0 | 0 | | −2180 |
| PSLOPD | −816 | 0 | 82 | 82 | 114 | 155 | 302 | 82 | | 816 |
| PSLOPO | −845 | 0 | 85 | 85 | 118 | 161 | 313 | 85 | | 845 |
| PSMCN | 1520 | 265 | −551 | 0 | −1234 | 0 | 0 | 0 | | −1520 |
| PSWMSR | 1442 | 164 | 676 | −2283 | 0 | 0 | 0 | 0 | | −1442 |
| PUFCHG | −509 | −58 | −239 | 806 | 0 | 0 | 0 | 0 | | 509 |
| PWCN | −96 | −17 | 35 | 0 | 78 | 0 | 0 | 0 | | 96 |
| TOTAL | −5761 | 717 | −770 | −6185 | −30931 | 847 | 13152 | 28930 | | 5761 |
| CRUDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The final allocation is done after the end of the reference month. At that time, the monthly average unit capacity of each processing unit available to participants is known with certainty. Also, the monthly average balancing grade products published prices are known. Therefore, modeling the refinery unit capacities available to each participant can be accurate. Both models are driven by an average "Mean of Platt" or other published product price quotes prevailing during the month. Crude run, fixed grade productions, and process stocks drawdown or buildup are entered in the LP models from the preliminary allocation of the participants.

The final product allocation process has two main parts to it: running the allocation LPs, then rerunning the allocation procedure.

## ALLOCATION LPs

Allocation LPs are the most important part of the allocation procedure. Two refinery LP models are prepared, modeling AOC's and BOC's shares of the refinery for the reference month. For example, if the joint refinery had available crude distillation capacity of 200,000 barrels per day and the equity of the two participants is 60% and 40%, then AOC will have 120,000 bpd and BOC will have 80,000 bpd crude distillation capacity. Capacity of the downstream units will be similarly split up. The unit capacities used in the LP models are the available unit capacities during the month (not the actually used capacities, which could be less than that available for certain units). All unit yields, stream properties, blending, and product specifications are accurately modeled as per actual refinery operations during the reference month.

## PROCESS UNIT CAPACITIES

Data on the unit capacity available on each day of its operation during the month is maintained for every refinery unit and an average available unit capacity is determined at the end of the month (Table 16-12). These available capacities for every unit are split in the ratio of equity to model AOC's and BOC's shares of refinery capacity.

## Table 16-8
## Retrospective DOP (All Figures in Barrels)

| PRODUCT GRADE (1) | AOC DOP (2) | AOC FORECASTER (3) | AOC FC COMPENS. (4) | AOC CRUDE (5) | AOC RETRO DOP (6) | BOC DOP (7) | BOC FORE-CASTER (8) | BOC FC COMPENS (9) | BOC CRUDE (10) | BOC RETRO DOP (11) | TOTAL RETRO (12) | ACTUAL PROD-UCTION (13) | DELTA (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1138B | 60000 | −9604 | | | 50396 | 46590 | −11348 | | | 35242 | 85638 | 85638 | 0 |
| 1149B | 0 | 13451 | | | 13451 | 0 | 12117 | | | 12117 | 25568 | 25568 | 0 |
| 150 | 17839 | | 8704 | 0 | 26543 | 0 | | 717 | 0 | 717 | 27260 | 19553 | −7707 |
| 201 | 0 | | −11615 | −1255 | −12870 | 864 | | −770 | 0 | 94 | −12776 | 0 | 12776 |
| 210 | 946831 | | −68739 | 22595 | 900687 | 227578 | | −6185 | 0 | 221393 | 1122080 | 1029704 | −92376 |
| 220 | 0 | 0 | | | 0 | 0 | 575 | | | 575 | 575 | 575 | 0 |
| 383 | 0 | 17686 | | | 17686 | 0 | 0 | | | 0 | 17686 | 17686 | 0 |
| 390 | 76800 | 11239 | | | 88039 | 0 | 0 | | | 0 | 88039 | 88039 | 0 |
| 395 | 0 | 87671 | | | 87671 | 0 | 16926 | | | 16926 | 104597 | 104597 | 0 |
| 397 | 512647 | | −310927 | 0 | 201720 | 80716 | | −30931 | 0 | 49785 | 251505 | 289195 | 37690 |
| 397E | 0 | 0 | | | 0 | 0 | 3384 | | | 3384 | 3384 | 3384 | 0 |
| 398 | 44100 | 23408 | | | 67508 | 0 | 0 | | | 0 | 67508 | 67508 | 0 |
| 411 | 0 | 100 | | | 100 | 0 | 0 | | | 0 | 100 | 100 | 0 |
| 419 | 420000 | −199722 | | | 220278 | 0 | 0 | | | 0 | 220278 | 220278 | 0 |
| 434 | 240000 | 69908 | | | 309908 | 0 | 0 | | | 0 | 309908 | 309908 | 0 |
| 440 | 517375 | | 203257 | 12553 | 733184 | 205589 | | 847 | 0 | 206436 | 939621 | 944758 | 5137 |
| 711 | 0 | 0 | | | 0 | 0 | −28374 | | | −28374 | −28374 | −28374 | 0 |
| 725 | 0 | 100752 | | | 100752 | 0 | 0 | | | 0 | 100752 | 100752 | 0 |
| 800 | 420000 | −41831 | | | 378169 | 0 | 0 | | | 0 | 378169 | 378169 | 0 |
| 876 | 300000 | −430601 | | | −130601 | 0 | 0 | | | 0 | −130601 | −130601 | 0 |
| 876ZP | 240000 | −7902 | | | 232098 | 0 | 0 | | | 0 | 232098 | 232098 | 0 |
| 888 | 991519 | | 443561 | 38913 | 1473993 | 409686 | | 13152 | 0 | 422838 | 1896831 | 2002599 | 105768 |
| 892 | 0 | −38 | | | −38 | 0 | −28 | | | −28 | −66 | −66 | 0 |
| 928 | 360000 | 43652 | | | 403652 | 0 | 0 | | | 0 | 403652 | 403652 | 0 |
| 961 | 1074918 | | 23404 | 50587 | 1148909 | 219295 | | 28930 | 0 | 248225 | 1397134 | 1345430 | −51704 |
| PBFUEL | 0 | −657 | | | −657 | 0 | −644 | | | −644 | −1301 | −1301 | 0 |

## Table 16-8
## Continued

| PRODUCT GRADE (1) | AOC DOP (2) | AOC FORECASTER (3) | AOC FC COMPENS. (4) | AOC CRUDE (5) | AOC RETRO DOP (6) | BOC DOP (7) | BOC FORE-CASTER (8) | BOC FC COMPENS (9) | BOC CRUDE (10) | BOC RETRO DOP (11) | TOTAL RETRO (12) | ACTUAL PROD-UCTION (13) | DELTA (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCTTR | 0 | −7294 | | | −7294 | 0 | −1437 | | | −1437 | −8731 | −8731 | 0 |
| PDDSL | 0 | 1232 | | | 1232 | 0 | 238 | | | 238 | 1470 | 1470 | 0 |
| PDSL | 0 | 28133 | | | 28133 | 0 | 5431 | | | 5431 | 33564 | 33564 | 0 |
| PFCOO | 0 | −17798 | | | −17798 | 0 | −7966 | | | −7966 | −25764 | −25764 | 0 |
| PFDISO | 0 | −188993 | | | −188993 | 0 | −7540 | | | −7540 | −196533 | −196533 | 0 |
| PKERO | 0 | −14004 | | | −14004 | 0 | −5633 | | | −5633 | −19637 | −19637 | 0 |
| PLCGAS | −60000 | 41773 | | | −18227 | 0 | 0 | | | 0 | −18227 | −18227 | 0 |
| PLLCN | 0 | 2241 | | | 2241 | 0 | 433 | | | 433 | 2674 | 2674 | 0 |
| PLTISO | 0 | 9052 | | | 9052 | 0 | 1748 | | | 1748 | 10800 | 10800 | 0 |
| PMEISO | 0 | 29595 | | | 29595 | 0 | 5714 | | | 5714 | 35309 | 35309 | 0 |
| PMIDSL | 0 | −20269 | | | −20269 | 0 | −6419 | | | −6419 | −26688 | −26688 | 0 |
| PMSR | 0 | 15950 | | | 15950 | 0 | 3079 | | | 3079 | 19029 | 19029 | 0 |
| PPOLY | −30000 | 30000 | | | 0 | 0 | 3652 | | | 3652 | 3652 | 3652 | 0 |
| PP90R | −18000 | 18000 | | | 0 | 0 | 1363 | | | 1363 | 1363 | 1363 | 0 |
| PP95R | −60000 | 90893 | | | 30893 | 0 | 5964 | | | 5964 | 36857 | 36857 | 0 |
| PRESID | 0 | 665 | | | 665 | 0 | 128 | | | 128 | 793 | 793 | 0 |
| PSKERO | 0 | 11293 | | | 11293 | 0 | 2180 | | | 2180 | 13473 | 13473 | 0 |
| PSLOPD | 0 | −4045 | | | −4045 | 0 | −816 | | | −816 | −4861 | −4861 | 0 |
| PSLOPO | 0 | −3874 | | | −3874 | 0 | −845 | | | −845 | −4719 | −4719 | 0 |
| PSMCN | 0 | 7867 | | | 7867 | 0 | 1520 | | | 1520 | 9387 | 9387 | 0 |
| PSWMSR | 0 | 7467 | | | 7467 | 0 | 1442 | | | 1442 | 8909 | 8909 | 0 |
| PUFCHG | 0 | −2590 | | | −2590 | 0 | −509 | | | −509 | −3099 | −3099 | 0 |
| PWCN | 0 | −451 | | | −451 | 0 | −96 | | | −96 | −547 | −547 | 0 |
| LOSSES | 35971 | | | 2133.9 | 38104.94 | 9682 | | | | 9682 | 47786.94 | 38204 | −9582.9 |
| CRUDE | 6090000 | 125526 | | | 6215526 | 1200000 | 0 | | | 1200000 | 7415526 | 7415526 | 0 |
| COL TOT | 6054029 | −287645 | 287645 | | | | −5761 | 5761 | 0 | | | | 0 |

NOTE: COLUMNS 4 AND 9 ARE FORECASTER COMPENSATING CHANGES TO BALANCING GRADES.

**Table 16-9**
**Retrospective DOP in Terms of Balancing Grades**

| BALANCING GRADES | AOC | | BOC | | TOTAL, bbl |
|---|---|---|---|---|---|
| | % | bbl | % | bbl | |
| I-150 | 11460 | 100.00 | 0 | 0.00 | 11460 |
| I-201 | 46017 | 98.16 | 864 | 1.84 | 46881 |
| I-210 | 1094946 | 82.79 | 227578 | 17.21 | 1322524 |
| I-397 | 416254 | 83.76 | 80716 | 16.24 | 496970 |
| I-440 | 1016978 | 83.18 | 205589 | 16.82 | 1222567 |
| I-888 | 1995196 | 84.15 | 375736 | 15.85 | 2370932 |
| I-961 | 1596571 | 84.19 | 299835 | 15.81 | 1896406 |
| LOSS | 38105 | 79.74 | 9682 | 20.26 | 47787 |
| TOTAL | 6215526 | 83.82 | 1200000 | 16.18 | 7415526 |

## FEED AND PRODUCTS

1. Crude run in the LPs is per the participant's retrospective DOPs.
2. In the LP, the fixed grade products to be made are the allocated production for the fixed grades per the preliminary allocation. Negative production of any fixed grade is not entered into the LP and has to be taken care of by a forecaster change in the allocation program.
3. Negative allocation of process stock in the preliminary allocation is reflected as drawdown and positive allocation is reflected as a buildup in the LP models.
4. Allocation of slop (drawdown or buildup) is not modeled in the LPs. This is reflected as a forecaster change in the final allocation.

## PRODUCT PRICES

The product prices driving the LPs are the agreed-on prices for balancing-grade products (Table 16-13). Normally, these are the average mean of Platts (MOP) published prices for the month in question. The location of the joint refinery dictates which market price quotes are to be used. Similarly, energy prices for refinery fuel and the like are based on MOP published data for the month. The LP models optimize the production of balancing-grade products based on balancing-grade prices in the two LPs.

## Table 16-10
## Allocation of Balancing-Grade Deltas (All Figures in Barrels)

| PRODUCTS | TOTAL DELTA (1) | AOC, IN TERMS OF BG (2) | BOC, IN TERMS OF BG (3) | TOTAL (4) | % AOC (5) | % BOC (6) | FIRST STEP AOC DELTA (7) | FIRST STEP BOC DELTA (8) | REVERSE ALLOCATION AOC (9) | REVERSE ALLOCATION BOC (10) | SUM OF DELTAS ALLOCTION AOC TOTAL DELTA (11) | SUM OF DELTAS ALLOCTION BOC TOTAL DELTA (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I-150 | −7707 | 11460 | 0 | 11460 | 1.0000 | 0.0000 | −7707 | 0 | −48 | 49 | −7756 | 49 |
| I-201 | 12776 | 46017 | 864 | 46881 | 0.9816 | 0.0184 | 12540 | 235 | −80 | 80 | 12460 | 316 |
| I-210 | −92376 | 1094946 | 227578 | 1322524 | 0.8279 | 0.1721 | −76480 | −15896 | −581 | 581 | −77061 | −15315 |
| I-397 | 37690 | 416254 | 80716 | 496970 | 0.8376 | 0.1624 | 31568 | 6121 | −237 | 237 | 31331 | 6359 |
| I-440 | 5137 | 1016978 | 205589 | 1222567 | 0.8318 | 0.1682 | 4273 | 864 | −32 | 32 | 4241 | 896 |
| I-888 | 105768 | 1995196 | 375736 | 2370932 | 0.8415 | 0.1585 | 89007 | 16762 | −666 | 666 | 88341 | 17427 |
| I-961 | −51704 | 1596571 | 299835 | 1896406 | 0.8419 | 0.1581 | −43529 | −8175 | −325 | 325 | −43855 | −7849 |
| LOSS | −9583 | 38105 | 9682 | 47787 | 0.7974 | 0.2026 | −7641 | −1942 | −60 | 60 | −7702 | −1881 |
| TOTAL | 0 | | | | | | 2031 | −2031 | −2031 | 2031 | 0 | 0 |

NOTES:
COLUMN 1 BALANCING-GRADE DELTAS BETWEEN ACTUAL PRODUCTION AND COMBINED RETROSPECTIVE DOP.
COLUMNS 2 AND 3 RETRO DOP OF AOC AND BOC EXPRESSED IN TERMS OF BALANCING GRADES.
COLUMNS 7 AND 8 TOTAL DELTA IN COLUMN 1 SPLIT IN THE RATIO OF RETRO DOP EXPRESSED IN TERMS OF BALANCING GRADES.
AVCTD THE ABSOLUTE VALUES OF COMBINED TOTAL DELTAS IN COLUMN 1, =322,740.
COLUMNS 9 AND 10 REVERSE ALLOCATION OF DELTAS TO MAKE THE SUM OF AOC AND BOC DELTAS INDIVIDUALLY EQUAL TO ZERO.
COLUMN 11 = COLUMN 7 + COLUMN 9.

## Table 16-11
## Preliminary Product Allocation (All Figures in Barrels)

| PRODUCT | AOC RETRO | BOC RETRO | AOC BG DELTA | BOC BG DELTA | AOC ALLOCATION | BOC ALLOCATION | ACTUAL PRODUCTION |
|---|---|---|---|---|---|---|---|
| 1138B | 50396 | 35242 | | | 50396 | 35242 | 85638 |
| 1149B | 13451 | 12117 | | | 13451 | 12117 | 25568 |
| 150 | 26543 | 717 | −7756 | 49 | 18787 | 766 | 19553 |
| 201 | −12870 | 94 | 12460 | 316 | −410 | 410 | 0 |
| 210 | 900687 | 221393 | −77061 | −15315 | 823626 | 206079 | 1029704 |
| 220 | 0 | 575 | | | 0 | 575 | 575 |
| 383 | 17686 | 0 | | | 17686 | 0 | 17686 |
| 390 | 88039 | 0 | | | 88039 | 0 | 88039 |
| 395 | 87671 | 16926 | | | 87671 | 16926 | 104597 |
| 397 | 201720 | 49785 | 31331 | 6359 | 233051 | 56144 | 289195 |
| 397E | 0 | 3384 | | | 0 | 3384 | 3384 |
| 398 | 67508 | 0 | | | 67508 | 0 | 67508 |
| 411 | 100 | 0 | | | 100 | 0 | 100 |
| 419 | 220278 | 0 | | | 220278 | 0 | 220278 |
| 434 | 309908 | 0 | | | 309908 | 0 | 309908 |
| 440 | 733184 | 206436 | 4241 | 896 | 737425 | 207333 | 944758 |
| 711 | 0 | −28374 | | | 0 | −28374 | −28374 |
| 725 | 100752 | 0 | | | 100752 | 0 | 100752 |
| 800 | 378169 | 0 | | | 378169 | 0 | 378169 |
| 876 | −130601 | 0 | | | −130601 | 0 | −130601 |
| 876ZP | 232098 | 0 | | | 232098 | 0 | 232098 |
| 888 | 1473993 | 422838 | 88341 | 17427 | 1562334 | 440265 | 2002599 |
| 892 | −38 | −28 | | | −38 | −28 | −66 |
| 928 | 403652 | 0 | | | 403652 | 0 | 403652 |
| 961 | 1148909 | 248225 | −43855 | −7849 | 1105054 | 240376 | 1345430 |
| PBFUEL | −657 | −644 | | | −657 | −644 | −1301 |
| PCTTR | −7294 | −1437 | | | −7294 | −1437 | −8731 |
| PDDSL | 1232 | 238 | | | 1232 | 238 | 1470 |
| PDSL | 28133 | 5431 | | | 28133 | 5431 | 33564 |
| PFCOO | −17798 | −7966 | | | −17798 | −7966 | −25764 |
| PFDISO | −188993 | −7540 | | | −188993 | −7540 | −196533 |
| PKERO | −14004 | −5633 | | | −14004 | −5633 | −19637 |
| PLCGAS | −18227 | 0 | | | −18227 | 0 | −18227 |
| PLLCN | 2241 | 433 | | | 2241 | 433 | 2674 |
| PLTISO | 9052 | 1748 | | | 9052 | 1748 | 10800 |
| PMEISO | 29595 | 5714 | | | 29595 | 5714 | 35309 |
| PMIDSL | −20269 | −6419 | | | −20269 | −6419 | −26688 |
| PMSR | 15950 | 3079 | | | 15950 | 3079 | 19029 |
| PPOLY | 0 | 3652 | | | 0 | 3652 | 3652 |
| PP90R | 0 | 1363 | | | 0 | 1363 | 1363 |
| PP95R | 30893 | 5964 | | | 30893 | 5964 | 36857 |
| PRESID | 665 | 128 | | | 665 | 128 | 793 |
| PSKERO | 11293 | 2180 | | | 11293 | 2180 | 13473 |
| PSLOPD | −4045 | −816 | | | −4045 | −816 | −4861 |
| PSLOPO | −3874 | −845 | | | −3874 | −845 | −4719 |
| PSMCN | 7867 | 1520 | | | 7867 | 1520 | 9387 |
| PSWMSR | 7467 | 1442 | | | 7467 | 1442 | 8909 |
| PUFCHG | −2590 | −509 | | | −2590 | −509 | −3099 |
| PWCN | −451 | −96 | | | −451 | −96 | −547 |
| LOSSES | 38105 | 9682 | −7702 | −1881 | 30403 | 7801 | 38204 |
| COL TOTAL | | | | | 6215526 | 1200001 | 7415527 |
| CRUDE | 6215526 | 1200000 | | | 6215526 | 1200000 | 7415526 |

## SUMMARY OF PRIMARY DATA INPUT FOR LPs

1. Balancing-grade product prices.
2. Available capacity of units during the month.
3. Actual crude run of each participant.
4. Fixed-grade product requirements as per preliminary allocation of that participant (negative allocations of fixed grades and slop allocation, positive or negative, are not put in the LPs).
5. Intermediate stocks drawdown and buildup as per the preliminary allocation data.

## EXAMINATION OF LP RESULTS

The two LPs are run and the results examined for the following points:

1. The solution should be optimum and converged.
2. A data check should be conducted to ensure that the crude run, fixed grade, and process stock production are entered in the LP as per the preliminary allocation report.
3. The utilization of key units (crude distillation, FCCU, hydrocracker, and other conversion units) should be close to maximum or to the actual refinery performance during the month. If any key conversion unit is grossly under utilized, the cause should be investigated.
4. LP product blending should be examined to ensure there is no unnecessary giveaway and no dumping of distillate streams in fuel oils. For example,
   - If the FCCU is running full in one participant's LP but not in the other, adjustment would be made to the buildup or drawdown of process stock HVGO (FCCU feed) in an attempt to get the FCCU to run full in both LPs or at the same percentage of their capacity utilization.
   - If the price differential between naphtha and gasoline is such that the catalytic reformer is running at unrealistically high rates, then limit the unit to what it actually ran during the month.
   - From time to time, a situation arises where there is no production of a balancing grade, usually gasoline. If adjusting the inventory

## Table 16-12
## Calculation of Available Processing Unit Capacities for Allocation LPS

| PROCESS UNITS DAY | NOMINAL CAPACITY | AVAILABLE PROCESSING UNITS CAPACITIES DURING THE MONTH, MBPSD | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
| 1CDU | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| 2CDU | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| 3CDU | 64 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| 4CDU | 93 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 |
| 5CDU | 46 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| TOTAL CDU | 243 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 |
| 1VDU | 9.6 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 |
| 5VDU | 20 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| 6VDU | 52.63 | 67 | 67 | 67 | 50 | 50 | 50 | 50 | 50 | 67 | 67 | 67 | 67 | 67 | 67 | 67 |
| TOTAL VDU | 82.23 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 |
| DIESEL HDS | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| HYDROCRACKER | 50 | 52 | 52 | 52 | 42 | 42 | 42 | 42 | 52 | 47 | 52 | 52 | 52 | 52 | 52 | 52 |
| VISBREAKER | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| FCCU | 39 | 45 | 45 | 45 | 45 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 45 | 45 | 45 |
| CAT REFORMER | 18 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 |
| KERO TREATER | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 |
| SULFUR PLANT | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 |
| H2 PLANT | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |

| PROCESS UNITS DAY | NOMINAL CAPACITY | AVAILABLE PROCESSING UNITS CAPACITIES DURING THE MONTH, MBPSD | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | AVERAGE |
| 1CDU | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22.0 |
| 2CDU | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22.0 |
| 3CDU | 64 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69.0 |
| 4CDU | 93 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 0 | 0 | 0 | 0 | 90.1 |
| 5CDU | 46 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50.0 |
| TOTAL CDU | 243 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 267 | 163 | 163 | 163 | 163 | 253.1 |
| 1VDU | 9.6 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 |
| 5VDU | 20 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33.0 |
| 6VDU | 52.63 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 64.2 |
| TOTAL VDU | 82.23 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 |
| DIESEL HDS | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22.0 |
| HYDROCRACKER | 50 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 50.5 |
| VISBREAKER | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22.0 |
| FCCU | 39 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 36.0 |
| CAT REFORMER | 18 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 |
| KERO TREATER | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42.0 |
| SULFUR PLANT | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.165 | 0.2 |
| H2 PLANT | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |

NOTES:
SULFUR PLANT CAPACITY IN M TONS/DAY SULFUR.
H2 PLANT CAPACITY IN MMSCF H2/DAY.
ALL OTHER CAPACITIES IN M BPSD.
CAPACITIES USED IN ALLOCATION LPS ARE THE AVERAGE OF AVAILABLE UNIT CAPACITIES FOR THE MONTH.

changes of the blendstocks does not rectify the situation, then the balancing grade should be changed.

- The hydrogen balance listed in the LPs sometimes is not accurate. If a hydrogen consuming unit, such as a desulfurizer or hydrocracker, is constrained by the hydrogen supply, verify that the constraint is real or increase the hydrogen plant capacity by, say, 10% to allow conversion unit to run at full capacity.

Other points to look for are

- Are the specifications of all products correct?
- Which specifications are limiting? Are they reasonable? For example, if the flash point is the only limiting specs on diesel, there could be a problem elsewhere.
- For specifications that are not limiting, how much giveaway is there?
- Is the way the LP has chosen to run reasonable? Has it picked up an acceptable mode of operation of a particular unit?
- Are there any streams in the refinery fuel pool that should not be there?

These examples do not cover all the problems that could be encountered. It may be necessary to make additional LP runs until the programmer is satisfied with the results of both LPs for use in the allocation program.

## INFEASIBILITIES

Sometimes, the LP cannot meet all the fixed grade product demand as per the preliminary allocation report and it returns an infeasible solution. In this case, the product or feedstock causing the infeasibility should be identified and its production in the DOP reduced to make the solution feasible. The delta between the actual production and the DOP for this product is entered as a forecaster change in the final allocation.

Gross underutilization of any conversion unit capacity can be handled similarly. For example, if an FCCU is grossly underutilized because of a buildup of VGO feed in the LP model, the VGO buildup could be appropriately reduced to allow fuller utilization of the FCCU and the rest of VGO buildup reflected as a forecaster change in the final allocation.

## Table 16-13
## Calculation of LP Driving Prices (Example)

| DAY | AG LPG, $/ton | AG NAPHTHA, $/ton | AG KEROSENE, $/bbl | AG DIESEL, $/bbl | AG FUEL OIL, $/Month | MED. NAPHTHA, $/ton | MED. PREM., $/ton GAS |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | 111.50 | 120.50 | 13.90 | 13.20 | 47.00 | 112.00 | 171.00 |
| 3 | 111.50 | 112.00 | 13.80 | 13.00 | 46.50 | 112.00 | 168.00 |
| 4 | 111.50 | 106.50 | 13.80 | 13.00 | 46.50 | 105.00 | 160.00 |
| 5 | 111.50 | 105.50 | 13.80 | 12.40 | 46.00 | 106.00 | 158.00 |
| 6 | 111.50 | 105.50 | 13.35 | 12.40 | 45.00 | 106.00 | 155.00 |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | 111.50 | 105.50 | 13.35 | 12.40 | 45.00 | 104.00 | 150.50 |
| 10 | 111.50 | 105.50 | 13.35 | 12.40 | 44.00 | 103.50 | 150.00 |
| 11 | 111.50 | 105.50 | 13.35 | 11.95 | 43.00 | 103.50 | 150.00 |
| 12 | 111.50 | 105.50 | 13.35 | 11.95 | 43.00 | 103.50 | 150.00 |
| 13 | 111.50 | 105.50 | 13.35 | 11.95 | 42.00 | 103.50 | 150.00 |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | 111.50 | 105.50 | 13.35 | 11.95 | 42.00 | 103.50 | 150.00 |
| 17 | 101.00 | 105.50 | 12.35 | 11.95 | 42.00 | 103.50 | 150.50 |
| 18 | 101.00 | 107.00 | 12.25 | 11.95 | 42.00 | 102.00 | 150.50 |
| 19 | 101.00 | 107.00 | 12.25 | 11.95 | 42.00 | 102.00 | 150.50 |
| 20 | 101.00 | 106.50 | 12.25 | 11.85 | 42.00 | 100.50 | 150.50 |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | 101.00 | 105.50 | 12.25 | 11.75 | 42.00 | 100.50 | 150.50 |
| 24 | 101.00 | 100.50 | 12.15 | 11.65 | 42.50 | 100.50 | 147.00 |
| 25 | 101.00 | 100.50 | 12.05 | 11.35 | 42.50 | 100.50 | 146.00 |
| 26 | 101.00 | 95.50 | 12.05 | 11.25 | 42.50 | 100.50 | 143.50 |
| 27 | 101.00 | 93.50 | 12.05 | 11.25 | 42.50 | 100.50 | 143.00 |
| 28 | | | | | | | |
| 29 | | | | | | | |
| 30 | 101.00 | 92.50 | 12.05 | 11.25 | 43.00 | 95.50 | 140.50 |
| 31 | | | | | | | |
| MONTH AVERAGE | 106.50 | 104.62 | 12.88 | 12.04 | 43.48 | 103.26 | 151.67 |

NOTES:
AG = ARABIAN GULF MARKET QUOTE (MEAN OF PLATT).
MED = MEDITERRANEAN MARKET QUOTES (MEAN OF PLATT).
*GASOLINE AG MARKET PRICE IS EXTIMATED AS FOLLOWS, AS THERE ARE NO AG GASOLINE PRICES.*

AVERAGE MEAN OF PLATT FOR MED PREM GASOLINE = 151.69 $/Ton
AVERAGE MEAN OF PLATT FOR MED NAPHTHA = 103.26 $/Ton
RATIO OF MED MOGAS /MED NAPHTHA = 1.4690
AVERAGE MEAN OF PLATT FOR AG GASOLINE = 103.36*; 1.4690
= 153.68 $/Ton

# FINAL ALLOCATION CYCLE

## INITIAL DOP (FINAL ALLOCATION)

After the two allocation LPs are satisfactorily run, the LP productions of fixed grades and process stocks are entered as the initial DOP of the final allocation cycle (Tables 16-14 to 16-16). Balancing-grade production from the LP results are reduced by 0.6% to account for unaccounted losses, as was done in the case of preliminary allocation, before entering in the initial DOP.

## FORECASTER CHANGES

Forecaster changes are next applied. There should be almost no forecaster change for most fixed grade and process stocks

All productions are entered in the LP in units of thousand barrels per day. Actual LP production in thousand barrels per day are reconverted into barrels per month before entering this data in the initial DOP of the final allocation. These conversions can cause small rounding errors between the preliminary allocation figures and those entered in the initial DOP of final allocation as shown next.

Consider for example the preliminary allocation of fixed grade I-390. The allocation for participant AOC is 88,039 bbls. This is entered in the AOC allocation LP as 88,039/(1000*30), or 2.934 thousand bbl/day.

In the initial DOP of the final allocation, this figure is again converted into barrels/month as 2.934*1000*30 or 88,020 bbl. To make it equal to the preliminary allocation figure of 88,039, a forecaster change of (88,039 – 88,020) or 19 bbl is introduced for AOC.

Similarly, any rounding error on the crude run is entered in units of thousand barrels/day in the LPs is corrected as a forecaster change, to make it equal to actual crude run of the participant as per preliminary allocation.

For all fixed grades and process stocks that were not modeled in the LPs, the initial DOP (final allocation) would be zero and forecaster changes should be the same as in the preliminary allocation.

A situation can arise in which the allocated production of a process stock in the preliminary allocation, when reflected in the participants' LP, causes serious underutilization of a key conversion unit, such as the hydrocracker or FCCU. In this case, the LP production values are

sufficiently reduced and the remaining allocated production reflected as forecaster changes, as shown by following example.

## EXAMPLE 16-5

The allocated production of a feedstock PFDISO (HVGO feed to hydrocracker) in the preliminary allocation is as follows:

AOC PFDISO = 39,816 bbl
BOC PFDISO = 7839 bbl
Refinery buildup = 47,655 bbl

As this buildup of 39,816 and 7839 bbl in the participants' allocation LPs causes underutilization of the hydrocracker unit (due to lack of feed), the buildup is reduced as follows:

| | BUILDUP, bbl | DELTA, bbl |
|---|---|---|
| AOC | 17,010 | 22,806 |
| BOC | 1,830 | 6,009 |
| TOTAL | 18,840 | 28,815 |

The remaining deltas are applied as forecaster change in the final allocation.

## RETROSPECTIVE DOP (FINAL ALLOCATION)

By applying forecaster changes, forecaster compensating changes, and crude changes, the initial DOP based on allocation LP production is amended to bring fixed grades, process stock and crude run equal to the actual production of the participants. These amended participant DOPs are called *retrospective DOPs* or *retro DOPs*. These two retro DOPs of the participants are combined to make a refinery retro DOP. The procedure is identical to that followed for the retro DOP in the preliminary allocation. The retrospective DOP is used for the allocation of balancing grades and actual refinery losses.

## Table 16-14
## Refinery DOP (bbl)

| PRODUCT | AOC | BOC | TOTAL |
|---|---|---|---|
| 1138B | 50396 | 35242 | 85638 |
| 1149B | 13451 | 12117 | 25568 |
| 150 | 19067 | 0 | 19067 |
| 201 | 204504 | 50906 | 255410 |
| 210 | 622971 | 151556 | 774527 |
| 220 | 0 | 570 | 570 |
| 383 | 17700 | 0 | 17700 |
| 390 | 88050 | 0 | 88050 |
| 395 | 87660 | 16920 | 104580 |
| 397 | 215748 | 58918 | 274666 |
| 397E | 0 | 3390 | 3390 |
| 398 | 67500 | 0 | 67500 |
| 411 | 90 | 0 | 90 |
| 419 | 220290 | 0 | 220290 |
| 434 | 310170 | 0 | 310170 |
| 440 | 376971 | 144019 | 520990 |
| 711 | 0 | −28380 | −28380 |
| 725 | 100740 | 0 | 100740 |
| 800 | 378180 | 0 | 378180 |
| 876 | 0 | 0 | 0 |
| 876ZP | 232110 | 0 | 232110 |
| 888 | 1943011 | 450586 | 2393597 |
| 892 | 0 | 0 | 0 |
| 928 | 403650 | 0 | 403650 |
| 961 | 985664 | 242584 | 1228248 |
| PBFUEL | 0 | 0 | 0 |
| PCTTR | −7290 | −1440 | −8730 |
| PDSDSL | 0 | 1470 | 1470 |
| PDSL | 0 | 33570 | 33570 |
| PFCOO | −17790 | −7980 | −25770 |
| PFDISO | −189000 | −7530 | −196530 |
| PKERO | −19637 | 0 | −19637 |
| PLCGAS | −18227 | 0 | −18227 |
| PLLCN | 2237 | 420 | 2657 |
| PLTISO | 10800 | 0 | 10800 |
| PMEISO | 29610 | 5700 | 35310 |
| PMIDSL | −20280 | −6420 | −26700 |
| PMSR | 15950 | 3079 | 19029 |
| PPOLY | 0 | 3660 | 3660 |
| PP90R | 0 | 1350 | 1350 |
| PP95R | 30900 | 5970 | 36870 |
| PRESID | 660 | 120 | 780 |
| PSKERO | −13 | 13470 | 13457 |
| PSLOPD | 0 | 0 | 0 |
| PSLOPO | 0 | 0 | 0 |
| PSMCN | 7860 | 1530 | 9390 |
| PSWMSR | 7467 | 1442 | 8909 |
| PUFCHG | −3107 | 9 | −3098 |
| PWCN | 0 | 0 | 0 |
| PROD + STOCK | 6168063 | 1186848 | 7354911 |
| LOSSES | 47457 | 13152 | 60609 |
| CRUDE | 6215520 | 1200000 | 7415520 |

NOTE:
THE TWO LP PRODUCTIONS ARE COMBINED TO GIVE AN INITIAL DOP. THE BALANCING GRADE PRODUCTION HAS BEEN ADJUSTED FOR UNACCOUNTED LOSSES.

**Table 16-15**
**Adjustment of Losses, Participant AOC**

| BALANCING GRADE | DOP, bbl | PERCENT | ADJUSTMENT, bbl | ADJUSTED PRODUCTION, bbl |
|---|---|---|---|---|
| I-150 | 19230 | 0.44 | 163 | 19067 |
| I-201 | 206250 | 4.68 | 1746 | 204504 |
| I-210 | 628290 | 14.26 | 5319 | 622971 |
| I-397 | 217590 | 4.94 | 1842 | 215748 |
| I-440 | 380190 | 8.63 | 3219 | 376971 |
| I-888 | 1959600 | 44.48 | 16589 | 1943011 |
| I-961 | 994080 | 22.57 | 8416 | 985664 |
| | 4405230 | 100.00 | 37293 | 4367937 |

NOTES:
CRUDE RUN FOR AOC IN THE LP MODEL = 6215520 bbl
DEDUCT 0.6% FOR UNACCOUNTED LOSSES = 37293 bbl

**Table 16-16**
**Adjustment of Losses, Participant BOC**

| BALANCING GRADE | DOP, bbl | PERCENT | ADJUSTMENT, bbl | ADJUSTED PRODUCTION, bbl |
|---|---|---|---|---|
| I-150 | 0 | 0.00 | 0 | 0 |
| I-201 | 51270 | 4.63 | 364 | 50906 |
| I-210 | 152640 | 13.80 | 1084 | 151556 |
| I-397 | 59340 | 5.36 | 422 | 58918 |
| I-440 | 145050 | 13.11 | 1031 | 144019 |
| I-888 | 453810 | 41.02 | 3224 | 450586 |
| I-961 | 244320 | 22.08 | 1736 | 242584 |
| | 1106430 | 100.00 | 7861 | 1098569 |

NOTES:
CRUDE RUN FOR BOC IN THE LP MODEL = 1310160 bbl
DEDUCT 0.6% FOR UNACCOUNTED LOSSES = 7861 bbl

## ALLOCATION OF BALANCING GRADES (FINAL ALLOCATION)

In the retrospective DOP, all deltas on fixed grades, process stocks, and crude run have been eliminated. Deltas between the actual production and retro DOP remain only in balancing grades and refinery loss (actual refinery losses minus retro DOP losses).

The procedure for allocating the balancing grades in the final allocation is identical to that followed for preliminary allocation. The allocation of fixed grades and process stocks also remain unchanged from that in the preliminary allocation. Only the balancing-grade allocations have changed from the preliminary allocation.

## EXAMPLE 16-6 (FINAL ALLOCATION)

Continuing from Example 16-4, the entire final product allocation procedure is shown in Tables 16-12 to 16-24.

It may be recalled that the allocated productions of fixed grades and process stocks from the preliminary product allocation was input in the respective LP models of the participants. The participants' allocation LPs are run, and the LP production of all grades for both participants is entered as the initial DOP for the final allocation. The crude run of the participants is fixed as per the preliminary allocation. The allocation LPs are used to optimize the production of balancing grades for a given fixed grades/process stock slate.

Table 16-14 shows participants' AOC and BOC initial DOP for final allocation. The combined production of the two DOPs make a refinery DOP. Tables 16-15 and 16-16 show the adjustment of balancing grades for unaccounted refinery losses. The adjustment is 0.6% (LV) of the crude run of the participant. These are spread over the balancing grades in proportion to their production as shown in these tables.

Table 16-17 compares the actual refinery production of every fixed grade and process stock with that in the combined refinery DOP. The delta between these is the total "forecaster" change. There should be no forecaster change for fixed grades, process stocks, and crude run for all those grades whose allocated production as per preliminary allocation is reflected in the allocation LPs (except for small rounding error, as explained earlier). For all those grades that were not reflected in the allocation LPs, such as fixed grades with negative production or process stocks such as slop, the forecaster change is exactly as per the preliminary allocation.

Table 16-18 shows data for actual refinery crude run and that in the combined DOP. The small forecaster change is due to rounding error generated by converting LP figures in thousand barrels per day to barrels in the initial DOP of the participants.

Tables 16-19 and 16-20 show the calculation of forecaster compensating changes for the participants. The procedure is identical to that followed in the preliminary allocation.

Table 16-21 shows the retrospective DOP of the participants (columns 6 and 11) and the overall refinery retrospective DOP (column 12). We see that

1. Fixed grade production in each participant's retrospective DOP is, in fact, its allocation. The sum of the participants' retrospective DOPs for any fixed grade or process stock equals the actual refinery production for that grade.
2. The delta between the actual refinery production and the total retro DOP (column 12) remains only on balancing grades and losses.

Table 16-22 shows the retro DOP of the participants converted to balancing-grade equivalents. This is used for allocation of balancing grades and losses (loss is considered as balancing grade). Table 16-23 shows allocation of balancing grade deltas to participants, as per the procedure described earlier.

Table 16-24 shows the complete final product allocation, in which the actual refinery production of all fixed and balancing grades is split, or "allocated," to participants AOC and BOC.

## ALLOCATION SPREADSHEET PROGRAM

The product allocation procedures can be aided by a spreadsheet program. The program is used for both the preliminary and final allocations. An example in the use of the allocation program follows.

### PRELIMINARY ALLOCATION

Data are entered only in the shaded cells shown in the screens.

1. The participants' submitted DOPs, including crude run, is entered on Screen 1 of the program. The participants' DOP balancing-grade production must be reduced by 0.6% of their crude run to account for unaccounted losses.
2. The participants' opening inventories of all product grades, process stocks, product lifting, and local sales are entered on Screens 2 and 3. The source of opening inventory data is the previous month's

final allocation report. The previous month closing inventories become the opening inventories of the current month.

3. The refinery's physical closing inventory of all products, process stocks, and consumption are entered on Screen 4. The source of the data is refinery stock report. The program calculates the production of a product from the following relationship:

$$\text{Production} = \text{closing inventory} - \text{opening inventory} + \text{product lifted} + \text{local sales} + \text{refinery consumption}$$

where the refinery's opening inventory, product lifted, and local sales is the sum of the participants' opening inventories, product lifted, and local sales data entered in Screen 2 and 3.

4. The total forecaster change for any fixed grade is computed by the program as the delta between the total refinery production and the sum of participants' DOPs.
5. The total forecaster change for a fixed grade or process stock is split between the participants as per the rules of allocation of fixed grades and process stocks and entered on Screen 1.
6. The refinery actual (total) crude run during the month is entered on Screen 1.
7. Product equivalencies of all fixed grades, process stocks, and crude are entered on Screen 5. Unless a new grade is introduced or a balancing grade is changed, no data need be entered on this screen.

The program calculates the following:

1. The retrospective DOP of the two participants (Screen 6).
2. The retrospective DOP of the overall refinery by combining the participants' DOPs and the retro DOP expressed in terms of balancing grades (Screens 7 and 8).
3. The delta on the balancing grades between actual refinery production and the combined DOP production of the participants is split between the participants, and allocation of balancing-grade products is done by the program and presented on Screen 9.

## Table 16-17
## Forecaster Changes for Fixed Grades and Process Stocks (bbl)

| PRODUCT | ACTUAL PRODUCTION | REFINERY DOP* | TOTAL FORCASTER CHANGE | FORECASTER AOC | FORECASTER BOC |
|---|---|---|---|---|---|
| 1138B | 85638 | 85638 | 0 | 0 | 0 |
| 1149B | 25568 | 25568 | 0 | 0 | 0 |
| 150 | 19553 | 0 | BG | | |
| 201 | 0 | 50906 | BG | | |
| 210 | 1029704 | 151556 | BG | | |
| 220 | 575 | 570 | 5 | 0 | 5 |
| 383 | 17686 | 0 | 17686 | −14 | 17700 |
| 390 | 88039 | 0 | 88039 | −11 | 88050 |
| 395 | 104597 | 16920 | 87677 | 11 | 87666 |
| 397 | 289195 | 58918 | BG | | |
| 397E | 3384 | 3390 | −6 | 0 | −6 |
| 398 | 67508 | 0 | 67508 | 8 | 67500 |
| 411 | 100 | 0 | 100 | 10 | 90 |
| 419 | 220278 | 0 | 220278 | 0 | 220278 |
| 434 | 309908 | 0 | 309908 | −262 | 310170 |
| 440 | 944758 | 144019 | BG | | |
| 711 | −28374 | −28380 | 6 | 0 | 6 |
| 725 | 100752 | 0 | 100752 | 12 | 100740 |
| 800 | 378169 | 0 | 378169 | −11 | 378180 |
| 876 | −130601 | 0 | −130601 | −130601 | 0 |
| 876ZP | 232098 | 0 | 232098 | −12 | 232110 |
| 888 | 2002599 | 450586 | BG | | |
| 892 | −66 | 0 | −66 | −38 | −28 |
| 928 | 403652 | 0 | 403652 | 2 | 403650 |
| 961 | 1345430 | 242584 | BG | | |
| Process Stocks | | | | | |
| PBFUEL | −1301 | 0 | −1301 | −657 | −644 |
| PCTTR | −8731 | −1440 | −7291 | −4 | −7287 |
| PDDSL | 1470 | 1470 | 0 | 0 | 0 |
| PDSL | 33564 | 33570 | −6 | 0 | −6 |
| PFCOO | −25764 | −7980 | −17784 | 5 | −17789 |
| PFDISO | −196533 | −7530 | −189003 | 7 | −189010 |
| PKERO | −19637 | 0 | −19637 | 0 | −19637 |
| PLCGAS | −18227 | 0 | −18227 | 0 | −18227 |
| PLLCN | 2674 | 420 | 2254 | 4 | 2250 |
| PLTISO | 10800 | 0 | 10800 | 0 | 10800 |
| PMEISO | 35309 | 5700 | 29609 | −15 | 29624 |
| PMIDSL | −26688 | −6420 | −20268 | 11 | −20279 |
| PMSR | 19029 | 3079 | 15950 | 0 | 15950 |
| PPOLY | 3652 | 3660 | −8 | 0 | −8 |
| PP90R | 1363 | 1350 | 13 | 0 | 13 |

**Table 16-17**
**Continued**

| PRODUCT | ACTUAL PRODUCTION | REFINERY DOP* | TOTAL FORCASTER CHANGE | FORECASTER AOC | FORECASTER BOC |
|---|---|---|---|---|---|
| PP95R | 36857 | 5970 | 30887 | −7 | 30894 |
| PRESID | 793 | 120 | 673 | 5 | 668 |
| PSKERO | 13473 | 13470 | 3 | 13 | −10 |
| PSLOPD | −4861 | 0 | −4861 | −4045 | −816 |
| PSLOPO | −4719 | 0 | −4719 | −3874 | −845 |
| PSMCN | 9387 | 1530 | 7857 | −3 | 7860 |
| PSWMSR | 8909 | 1442 | 7467 | 0 | 7467 |
| PUFCHG | −3099 | 9 | −3108 | 8 | −3116 |
| PWCN | −547 | 0 | −547 | −451 | −96 |
| TOTAL | 7377323 | 1250695 | 1593958 | −139909 | 1733867 |
| LOSSES | 38204 | 6164825 | | | |
| CRUDE | 7415526 | 7415520 | 6 | 6 | 0 |

* SUM OF ALLOCATION LPS.

4. A summary of the allocation of all product grades and process stocks is determined by the program and presented on Screen 10.
5. The allocated production of the participants is transmitted to Screens 2 and 3, and the program calculates the closing inventories of the participants.

## FINAL ALLOCATION

In the final allocation cycle, the following data remain unchanged from the preliminary allocation: the allocation of fixed grades and process

**Table 16-18**
**Crude Changes (bbl)**

| | DOP CRUDE | ACTUAL CRUDE | DELTA |
|---|---|---|---|
| AOC | 6215520 | 6215526 | 6 |
| BOC | 1200000 | 1200000 | 0 |
| TOTAL REFINERY | 7415520 | 7415526 | 6 |

## Table 16-19
## Forecaster Compensating Changes, AOC (bbl)

| PRODUCT | FORECASTER CHANGE | FORECASTER COMPENSATING CHANGES TO BALANCING GRADES | | | | | | | | CHECK |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I-150 | I-201 | I-210 | I-397 | I-440 | I-888 | I-961 | LOSS | |
| 1138B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 1149B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 150 | BG | | | | | | | | | |
| 201 | BG | | | | | | | | | |
| 210 | BG | | | | | | | | | |
| 220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 383 | −14 | 0 | 12 | 0 | 3 | 0 | 0 | 0 | | 14 |
| 390 | −11 | 0 | 5 | 0 | 6 | 0 | 0 | 0 | | 11 |
| 395 | 11 | 0 | −2 | 0 | −9 | 0 | 0 | 0 | | −11 |
| 397 | BG | | | | | | | | | |
| 397E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 398 | 8 | 0 | 0 | 0 | −8 | 0 | 0 | 0 | | −8 |
| 411 | 10 | 0 | 0 | 0 | 0 | −10 | 0 | 0 | | −10 |
| 419 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 434 | −262 | −9 | 0 | 137 | 0 | 134 | 0 | 0 | | 262 |
| 440 | BG | | | | | | | | | |
| 711 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 725 | 12 | 0 | 0 | 0 | 0 | 0 | −4 | −8 | | −12 |
| 800 | −11 | 0 | 0 | 0 | 0 | −6 | 17 | 0 | | 11 |
| 876 | −130601 | 0 | 0 | 0 | 0 | 19303 | 111298 | 0 | | 130601 |
| 876ZP | −12 | 0 | 0 | 0 | 0 | 7 | 5 | 0 | | 12 |
| 888 | BG | | | | | | | | | |
| 892 | −38 | 0 | 0 | 0 | 0 | 0 | 28 | 10 | | 38 |
| 928 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | −2 | | −2 |
| 961 | BG | | | | | | | | | |
| Process | | | | | | | | | | |
| Stocks | | | | | | | | | | |
| PBFUEL | −657 | 0 | 0 | 0 | 0 | 0 | 0 | 657 | | 657 |
| PCTTR | −4 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | | 4 |
| PDDSL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PDSL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PFCOO | 5 | 0 | 0 | 0 | 0 | 0 | −1 | −4 | | −5 |
| PFDISO | 7 | 0 | 0 | 0 | 0 | 0 | −2 | −5 | | −7 |
| PKERO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PLCGAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PLLCN | 4 | 0 | 0 | 0 | −4 | 0 | 0 | 0 | | −4 |
| PLTISO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PMEISO | −15 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | | 15 |
| PMIDSL | 11 | 0 | 0 | 0 | 0 | 5 | −16 | 0 | | −11 |
| PMSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PPOLY | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PP90R | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PP95R | −7 | 0 | −1 | 0 | 8 | 0 | 0 | 0 | | 7 |
| PRESID | 5 | 0 | 0 | 0 | 0 | 0 | −1 | −4 | | −5 |
| PSKERO | 13 | 0 | 0 | 0 | 0 | −13 | 0 | 0 | | −13 |
| PSLOPD | −4045 | 0 | 405 | 405 | 566 | 769 | 1497 | 405 | | 4045 |
| PSLOPO | −3874 | 0 | 387 | 387 | 542 | 736 | 1433 | 387 | | 3874 |
| PSMCN | −3 | −1 | 1 | 0 | 2 | 0 | 0 | 0 | | 3 |
| PSWMSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PUFCHG | 8 | 1 | 4 | −13 | 0 | 0 | 0 | 0 | | −8 |
| PWCN | −451 | −79 | 163 | 0 | 366 | 0 | 0 | 0 | | 451 |
| TOTAL | −139909 | −88 | 973 | 916 | 1474 | 20924 | 114262 | 1448 | | 139909 |
| CRUDE | 6 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 6 |

## Table 16-20
## Forecaster Compensating Changes, BOC (bbl)

| PRODUCT | FORECASTER CHANGE | FORECASTER COMPENSATING CHANGES TO BALANCING GRADES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I-150 | I-201 | I-210 | I-397 | I-440 | I-888 | I-961 | LOSS | CHECK |
| 1138B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 1149B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 150 | | | | | | | | | | |
| 201 | | | | | | | | | | |
| 210 | | | | | | | | | | |
| 220 | 5 | 0 | −5 | 0 | 0 | 0 | 0 | 0 | | −5 |
| 383 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 390 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 395 | 6 | 0 | −1 | 0 | −5 | 0 | 0 | 0 | | −6 |
| 397 | | | | | | | | | | |
| 397E | −6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | | 6 |
| 398 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 411 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 419 | −12 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | | 12 |
| 434 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 440 | | | | | | | | | | |
| 711 | 6 | 0 | 0 | 0 | 0 | 0 | −2 | −5 | | −6 |
| 725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 876 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 876ZP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 888 | | | | | | | | | | |
| 892 | −28 | 0 | 0 | 0 | 0 | 0 | 20 | 8 | | 28 |
| 928 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| 961 | | | | | | | | | | |
| PROCESS STOCKS | | | | | | | | | | |
| PBFUEL | −644 | 0 | 0 | 0 | 0 | 0 | 0 | 644 | | 644 |
| PCTTR | 3 | 0 | 0 | 0 | 0 | 0 | −2 | −1 | | −3 |
| PDDSL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PDSL | −6 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | | 6 |
| PFCOO | 1 | 0 | 0 | 0 | 0 | 0 | 0 | −1 | | −1 |
| PFDISO | −10 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | | 10 |
| PKERO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PLCGAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PLLCN | 13 | 0 | 0 | 0 | −13 | 0 | 0 | 0 | | −13 |
| PLTISO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PMEISO | 14 | 0 | 0 | 0 | 0 | 0 | −5 | −9 | | −14 |
| PMIDSL | 1 | 0 | 0 | 0 | 0 | 0 | −1 | 0 | | −1 |
| PMSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PPOLY | −8 | 0 | −1 | 0 | 9 | 0 | 0 | 0 | | 8 |
| PP90R | 13 | 0 | 0 | 0 | −14 | 0 | 0 | 0 | | −13 |
| PP95R | −6 | 0 | −1 | 0 | 7 | 0 | 0 | 0 | | 6 |
| PRESID | 8 | 0 | 0 | 0 | 0 | 0 | −2 | −6 | | −8 |
| PSKERO | 3 | 0 | 0 | 0 | 0 | −3 | 0 | 0 | | −3 |
| PSLOPD | −816 | 0 | 82 | 82 | 114 | 155 | 302 | 82 | | 816 |
| PSLOPO | −845 | 0 | 85 | 85 | 118 | 161 | 313 | 85 | | 845 |
| PSMCN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PSWMSR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| PUFCHG | −9 | −1 | −4 | 14 | 0 | 0 | 0 | 0 | | 9 |
| PWCN | −96 | −17 | 35 | 0 | 78 | 0 | 0 | 0 | | 96 |
| TOTAL | −2413 | −18 | 189 | 180 | 301 | 325 | 632 | 803 | | 2413 |
| CRUDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

stock and all data on opening inventories, refinery closing inventory, product lifted, local sales, and refinery consumption (Screens 2 to 4) remain unchanged.

The preliminary allocation file is saved under a different name and the initial DOP of the participants in Screen 1 is updated. Instead of the participants' submitted DOPs, the production from the allocation LPs of the participants are entered on Screen 1, subject to following exceptions:

- Only positive production of fixed grades as per allocation LPs and process stock buildup or drawdown as reflected in the LPs are entered.
- Actual crude run of the participants as per the allocation LPs is entered in Screen 1.
- Ideally there should be no forecaster changes for all fixed grades and process stocks reflected in the allocation LPs, except for small rounding errors due to conversion of LP figures in thousand barrels per day to DOP figures in barrels per month. The rounding error is the difference between the allocated production as per preliminary allocation of that grade and the DOP figure of the participant entered on Screen 1.
- If process stocks are not modeled in the LPs, the forecaster change for the product or stock is identical to that in the preliminary allocation.
- If any process stock production, positive or negative, cannot be fully reflected in the allocation LP (due to an LP convergence problem or underutilization of a key conversion unit), the difference between the allocated production of the grade and the initial DOP of the participant (Screen 1) is reflected as forecaster change for that participant.

The program calculates the rest of the data, such as allocation of balancing grades, in a manner similar to that for the preliminary allocation.

We see that, in the final allocation, only the allocation of balancing grades and refinery losses change from the preliminary allocation. The rest of the report is identical to the preliminary allocation report.

## PRODUCT ALLOCATION PROBLEMS

### DUMPING OF KEROSENE INTO DIESEL

Due to constraints on the storage capacity or available ullage to sustain the refinery production rate of middle distillates, the refinery is some-