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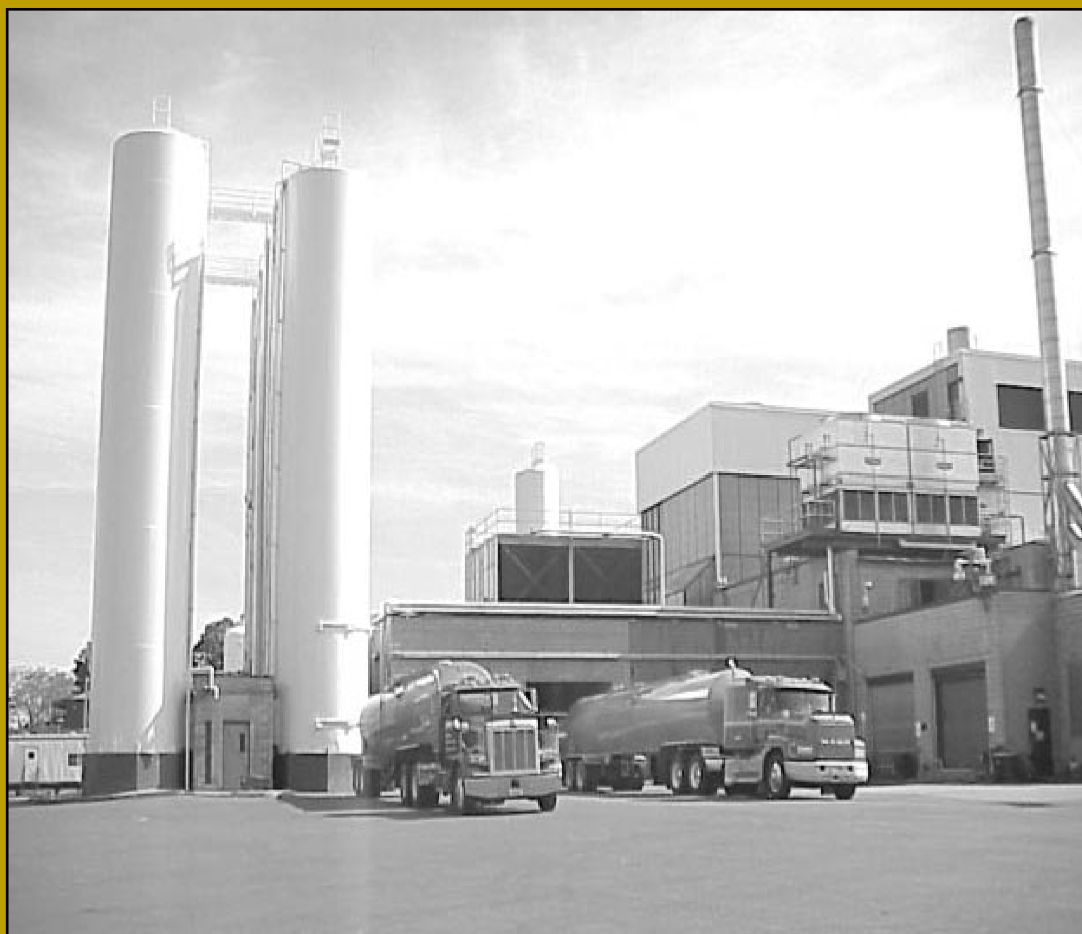
Cost of Balancing Milk Supplies: Northeast Regional Market



Abstract

The seasonal nature of milk production and fluid consumption necessitates maintaining seasonal and operating reserves to ensure fluid demand is satisfied. Operating reserves are maintained at a certain percentage of fluid milk needs to satisfy day-to-day fluctuation in demand. Seasonal reserves vary month to month depending on production and consumption level. Manufacturing plants incur higher costs because of the fluctuating reserve milk volume. The costs of balancing reserve milk supplies are estimated using two scenarios. One assumes the volume of operating reserves is 10 percent of fluid demand, and the other, 20 percent.

Keywords: Milk, operating reserves, seasonal reserves, reserve-balancing cost.

Cost of Balancing Milk Supplies:Northeast Regional Market

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Preface

This is an update of A Reserve-Balancing Pool for Services by Dairy Cooperatives, ACS Research Report 51, published in August 1985 (1) .This report clarifies the methodology and uses actual milk volumes and utilizations of the Northeast market to estimate the costs incurred by manufacturing plants in balancing reserve milk supplies. This update was requested by the Association of Dairy Cooperatives in the Northeast, which consists of Agri-Mark, Inc., Dairy Farmers of America, Inc., Dairylea Cooperative, Inc., Land O'Lakes, Inc., Maryland & Virginia Milk Producers Cooperative Association, Inc., St. Albans Cooperative Creamery, Inc. and Upstate Farms Cooperative, Inc.

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Based on 1995-99 Northeast market information, monthly milk deliveries are higher than the annual average during January through June and peak in May. Milk deliveries decline sharply from June to July and stay relatively low throughout summer and fall, and bottom out in November. The seasonality index indicates that May deliveries are 11 percentage points higher than November.

The seasonal pattern of fluid demand is quite different. It peaks in September and maintains a higher than average level through fall and winter until March. The lowest fluid consumption month is June. The seasonality index shows that fluid demand in June is 11 percentage points lower than it is in September. Beside this annual cycle of fluid uses, processing plants have a weekly cycle of fluid demand.

Two categories of milk reserves, operating and seasonal, are required to meet fluctuating fluid needs. Operating reserves satisfy fluid demand of the peak day and week, while seasonal reserves are necessary because of the nature of milk production and fluid milk demand. If producers supplying the market raise a sufficient number of cows to produce enough milk in the lowest milk producing months in the fall to fully satisfy the highest fluid demand and operating reserves in that same season, then more milk will be produced than is needed in other seasons. The extra volume produced in these other seasons constitutes seasonal reserves.

The sum of operating and seasonal reserves represents the necessary reserves--the minimum standby milk volume needed to satisfy fluid demand year-round. Assuming that the operating reserve is 10 percent of fluid demand, then the volume of necessary reserves ranges from 2.9 million pounds per day in October to 8.6 million pounds in June. Necessary reserves in June are equivalent to 33 percent of the fluid demand for that month. In September and October, those reserves are 10 percent of fluid demand, representing the required operating reserves only.

To process the peak daily volume of necessary reserves of 8.6 million pounds of milk requires three butter-powder plants, each with a daily capacity of 3 million pounds of milk. A butter-powder plant with this capacity would cost an estimated $28 million. The annual total capital cost of land, building, machinery and equipment, and the estimated overhead of taxes, licenses, insurance and administrative cost, are estimated at $3 million a year, or $9 million for the three plants. Prorating the cost to the milk volume represented by the unused capacity because of the fluctuating necessary reserves, the allocated annual fixed and overhead cost for reserve balancing is $2,991,166.

Increased butter and powder manufacturing plant costs due to under-capacity use caused by fluctuating necessary reserves are also calculated. They range from 4 cents per hundredweight of milk manufactured in May to 83 cents per hundredweight in October. Expanding these extra costs by the total volume of necessary reserves, monthly total increase in the manufacturing costs due to reserve balancing is estimated to be zero in June and ranges from $94,755 in May to $836,460 in December. Total extra manufacturing cost for balancing necessary reserves for the entire year is estimated at $6,745,641.

Fixed and overhead costs prorated to the milk volume of unused capacity and the manufacturing cost increases on the actual processed volume due to under-used plant capacity are combined to constitute total reserve-balancing costs. The three butter-powder plants would incur annual total costs of reserve balancing estimated at $9.7 million to maintain necessary fluid reserves.

Highlights

If operating reserve is 20 percent of fluid demand, the peak daily volume of necessary reserves is estimated at 11.8 million pounds of milk or the equivalent of four butter-powder plants, each with a daily capacity of 3 million pounds of milk. The allocated annual fixed and overhead cost for reserve balancing is $3 million per year. Total extra manufacturing cost due to balancing necessary reserves for the entire year is estimated at slightly less than $8.6 million. The annual total costs of reserve balancing are estimated at $11.6 million.

Given the seasonalities of milk production and fluid demand, the volume of operating reserves needed to satisfy fluid milk demand is the key factor in deciding the volume of seasonal and necessary reserves, and in turn, the total costs of balancing reserve milk supplies.

Cost of Balancing Milk Supplies: Northeast Regional Market

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Seasonal Nature of Milk

The seasonal nature of milk deliveries in the Northeast market is best portrayed by the index of seasonality in table 1. The index is derived from the combined data from 1994-99 of the three Federal Milk Market Orders in the Northeast that preceded the current order. The index expresses a particular month's milk deliveries as a percentage of the 12-month moving average centered on that month, subject to the adjustment to make the annual average index to be 100.

The seasonality index of milk deliveries shows that the first six months of the year reflect the period of higher than average milk deliveries, with May being the peak. The index of 106 indicates that May is 6 percent higher than annual average daily deliveries (average index=100). Milk deliveries decline sharply from June to July and stay relatively low throughout summer and fall. Deliveries are usually lowest in November. With an index of 95, November is 5 percent below annual average daily deliveries. Deliveries recover in December and increase steadily through winter and spring until peaking again in May. The drop from May to November is 11 percentage points, based on average daily deliveries. On an actual daily delivery basis, the discrepancy between the peak and trough would have been even greater.

The seasonality index of fluid demand is calculated in the same manner as the index of deliveries. However, the seasonal pattern of fluid demand is quite different (table 1). Fluid demand peaks in September and maintains a higher than average, although declining, level through fall and winter until March. The peak (seasonal index=105) is 5 percent above annual average daily consumption (average index=100). The lowest fluid consumption month is June. The index of 94 is 6 percent below the annual daily average. The June low is 11 percentage points below the September peak.

Besides the annual cycle of fluid uses, processing plants have a weekly cycle of fluid demand. Typically, fluid processing plants operate fewer than 7 days a week and their operating schedules are geared to meet consumers' weekly shopping patterns. They receive milk for fluid processing to fit their weekly operating schedules. Fluid demand fluctuations pose problems for the supply-balancing plants, particularly for their required manufacturing capacity and plant operations.

Table 1—Indices of seasonality of producer milk deliveries and fluid demand, Northeast Orders [1]

Month	Producer milk deliveries	Fluid demand
	Percent	
January	100.1	101.9
February	101.8	100.6
March	103.7	100.9
April	105.4	98.2
May	106.0	98.1
June	103.4	94.0
July	97.8	94.2
August	97.0	98.1
September	96.3	105.2
October	95.4	104.6
November	95.0	102.8
December	98.1	101.4
	— — —	— — —
Simple average	100.0	100.0

[1] Based on pool statistics 1994-1999, calculated using 12-month moving average method.

Reserves To Satisfy Fluid Demand

Two categories of milk reserves, operating and seasonal, arerequired to meet fluctuating fluid needs. Operating reserves satisfy fluid demand of the peak day and week, while seasonal reserves are necessary because of the nature of milk production and fluid milk demand (table 2).

Operating reserves—These include reserves that ensure a sufficient supply for the daily fluctuating fluid demand encountered by processing plants. The reserves also cover shrinkage and returns of packaged products ordinarily experienced by processing plants. The analysis in this section assumes the operating reserves required by the market are 10 percent of fluid demand. (Later, the same analysis assuming 20 percent operating reserves is also presented.)

In table 2, operating reserves are set at 10 percent of fluid demand every month. Both follow the same seasonal pattern. In June, operating reserves drop to 2.6 million pounds per day and peak at almost 3 million pounds in September. The annual average is 2.8 million pounds a day.

Seasonal reserves—Milk deliveries are high in spring and low in the fall, but just the opposite of fluid demand in spring and fall. If producers supplying the market raise sufficient number of cows to produce enough milk in the lowest milk producing months in the fall to fully satisfy the highest fluid demand and operating reserves in that same season, then more milk will be produced than is needed in other seasons. The extra volume produced in these other seasons constitutes seasonal reserves (table 2).

To calculate the seasonal reserves, October is the base month when milk deliveries exactly supply the needs of fluid demand (29.3 million pounds per day) and operating reserves (2.93 million pounds a day). The production base needed in October will create an extra volume in the other months—determined by the ratio of the other months' seasonality indexes for milk deliveries to October. The difference between the resulting volumes and the other months' fluid demands and operating reserves represents the seasonal reserves for the other months.

For example, the ratio of January's seasonality index for milk deliveries to October is 1.0493 (100.1/95.4). So, the production base used to meet the October fluid demand and operating reserves of 32.227 million pounds per day (29.297+2.93) would produce 33.815 million pounds of milk (1.0493 x 32.227) in January. January requires 31.35 million pounds of milk per day for fluid demand and operating reserve (28.5+2.85). Thus, the seasonal reserves for January are 2.464 million pounds per day (33.815 – 31.350). The seasonal reserves for other months can be calculated in the same way, using October as the base.

There is a wide range of seasonal reserves. The volume peaks at 6 million pounds per day in June and drops to 0.1 million pounds a day in September. There are no seasonal reserves for October. (November is seasonally the lowest month for milk deliveries. But, if November production matched fluid demand and operating reserve for that month, a situation would occur where there would not be enough milk to cover relatively higher fluid demand and operating reserves for October—a negative seasonal reserve. Therefore, October, the next lowest milk production month, is used as the benchmark for calculating seasonal reserves.)

Necessary reserves—The sum of operating and seasonal reserves represents the necessary reserves--the minimum standby milk volume needed to ensure sufficient supply for satisfying year-round fluid demand. The volume of necessary reserves ranges from 2.9 million pounds per day in October to 8.6 million pounds in June and averages 5.7 million pounds (table 2). On a daily average basis, necessary reserves are 21 percent of fluid demand. In other words, for every 100 pounds of fluid demand, an average minimum of 21 pounds of milk reserves are needed to satisfy year-round demand. Necessary reserves in June are equivalent to 33 percent of the fluid demand for that month. In September and October, necessary reserves are 10 percent of fluid demand, respectively,representing the required operating reserves but without seasonal reserves because these are the two seasonally lowest milk delivery months.

Total reserves—These are defined as the milk volume in excess of Class I and Class II uses and, in fact, are the manufacturing milk volume currently classified as Class III and Class IV (table 2, column 9). Necessary reserves are a part of total reserves. The other part in excess of necessary reserves is the extra standby milk volume to satisfy fluid demand. This volume may be called excess reserves.

The relationship between milk deliveries, fluid demand, and reserves is depicted in figure 1. In summary

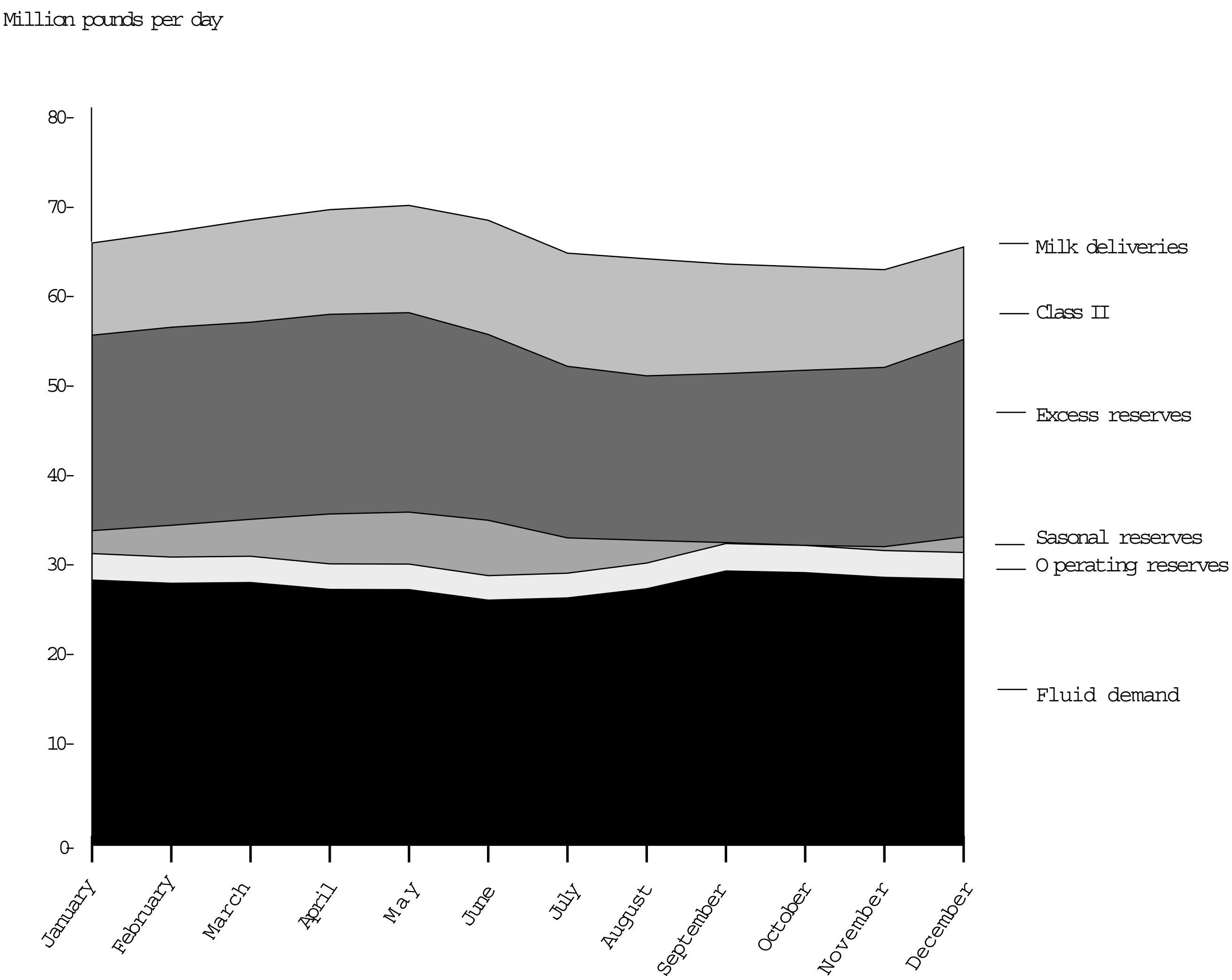
Operating reserves =	A fixed percentage of fluid demand such as 10 percent or 20 percent.

Table 2—Necessary reserves to satisfy fluid demand assuming 10 percent operating reserves, and total reserves, Northeast Orders

Month	Seasonality index						Necessary reserves [2]		Total reserves [3]	
	Producer milk deliveries (1)	Fluid demand (2)	Producer milk deliveries [1] (3)	Fluis demand [1] (4)	Operating recerves (5)	Seasonal reserves (6)	Milk volume (7)	Percent fluid demand (8)	Mlk volume (9)	Percent milk deliveries (10)
	Percent		----------Million pounds per day----------						Mil.lb/day	
January	100.1	101.9	64.735	28.500	2.850	2.464	5.314	19	26.321	41
February	101.8	100.6	65.920	28.156	2.816	3.417	6.233	22	27.523	42
March	103.7	100.9	67.206	28.237	2.824	3.970	6.793	24	27.979	42
April	105.4	98.2	68.317	27.493	2.749	5.362	8.112	30	29.575	43
May	106.0	98.1	68.774	27.471	2.747	5.589	8.336	30	29.772	43
June	103.4	94.0	67.176	26.343	2.634	5.952	8.586	33	28.559	43
July	97.8	94.2	63.643	26.582	2.658	3.797	6.455	24	24.896	39
August	97.0	98.1	63.035	27.572	2.757	2.438	5.195	19	22.882	36
September	96.3	105.2	62.476	29.476	2.948	0.107	3.055	10	21.230	34
October	95.4	104.6	62.163	29.297	2.930	0	2.930	10	21.758	35
November	95.0	102.8	61.866	28.793	2.879	0.419	3.299	11	22.570	36
December	98.1	101.4	64.303	28.605	2.861	1.673	4.534	16	25.757	40
Simple average	100.0	100.0	64.968	28.044	2.804	2.932	5.737	21	25.735	40

[1] Five-year average, 1995-99.
[2] Necessary reserves are the sum of operating and seasonal reserves
[3] Total reserves are the sum of Class III and Class IV milk, or the sum of necessary and excess reserves.

Figure 1—The relationship between milk deliveries, fluid demand, and reserves, Northeast Orders



Seasonal reserves	=	Reserve volume due to seasonality of milk production if fluid demand and operating reserves are to be satisfied year-round.
Necessary reserves	=	Operating plus seasonal reserves.
Total reserves	=	Milk deliveries in excess of Class I and Class II uses.
Excess reserves	=	The difference between total and necessary reserves.

Necessary Reserve Balancing Costs

To process the peak daily volume of necessary reserves of 8.6 million pounds of milk, three butter-powder plants, each with a daily capacity of about 3 million pounds of milk, are required. (The plants could be cheese-whey plants of the same capacity, which may entail a different set of cost estimates.) This capacity allows the plants to operate 7 days a week (3 shifts, 20 machine-hours a day) and exhaust the available milk in June. The 8.6-million-pounds-per-day volume in June is the highest necessary reserves among the 12 months (table 2, column 7). For this study, milk

Table 3—Estimated cost of balancing necessary reserves assuming 10 percent operating reserves, Northeast Orders

Month	Unused capacity caused by fluctuation in necessary reserves (1)	Unused capacity percent of peak necessary reserves (2)	Fixed and overhead costs of reserve balancing (3)	Plant cost increases on the actual processed volume caused by unused capacity [1]: Per pound of butter or powder [1] (4)	Converted to per hundred-weight milk [2] (5)	Per daily necessary reserve volume (6)	Per monthly necessary reserve volume (7)	Total reserve balancing cost (8)=(3)+(7)
	Million lbs/day		$/month	Cents/lb	Cents/cwt	$/day	$/month	$/month
January	3.3	38	291,266	3.8	48	25,536	791,606	1,082,873
February	2.4	27	189,241	2.7	35	21,542	603,190	792,431
March	1.8	21	159,588	2.1	26	17,885	554,446	714,035
April	0.5	6	40,866	0.6	7	5,651	169,529	210,395
May	0.2	3	22,226	0.3	4	3,057	94,755	116,981
June	0	0	0	0	0	0	0	0
July	2.1	25	189,684	2.5	31	20,200	626,212	815,896
August	3.4	39	301,878	3.9	50	25,872	802,045	1,103,923
September	5.5	64	476,550	6.4	81	24,816	744,467	1,221,017
October	5.7	66	503,565	6.6	83	24,338	754,474	1,258,039
November	5.3	62	455,541	6.2	78	25,615	768,457	1,223,997
December	4.1	47	360,761	4.7	60	26,983	836,460	1,197,221
Sum			2,991,166				6,745,641	9,736,807

[1] Estimated to increase by 0.1 cent/lb of product per percentage point of unused plant capacity.

[2] Assuming per cwt milk, 4.48 pounds of butter and 8.13 pounds of nonfat dry milk can be made

volume is split equally between the three plants every day of the year. Each plant experiences the same seasonal fluctuation in reserve milk volume.

The monthly variation of necessary reserves has a major impact on the capacity use of a manufacturing plant. The January necessary reserves are 3.3 million pounds lower than the June peak reserves of 8.6 million pounds a day. The shortfall translates into a 38-percent under-use of the plant capacity (table 3, columns 1 and 2). The February shortfall is 2.4 million pounds a day, a 27-percent under-use of plant capacity. The shortfalls for other months are calculated the same way. The variation ranges from full-capacity operations in June to a shortfall of 5.7 million pounds a day in October. This causes a 66-percent under-use of plant capacity. The degree to which a manufacturing plant is used at less than capacity increases the per-unit cost of products actually made at the plant.

The fluctuating volume of necessary reserves puts the reserve-balancing butter-powder plants at a disadvantage compared with a plant built solely for manufacturing. Milk volume going through the latter type of plant can be maintained relatively constant at full capacity to take advantage of least-cost operations. Balancing necessary reserves, therefore, exacts a substantial cost on the three balancing plants.

Fixed and overhead costs–Based on available information, a butter-powder plant with a capacity of manufacturing 3 million pounds of milk a day is estimated to cost $28 million. At a 9 percent interest rate, annual total capital cost on land, building, machinery, and equipment is $2.52 million. Add to this the estimated overhead of taxes, licenses, insurance, and administration costs, and total annual fixed and overhead costs are estimated at about $3 million. The fixed and overhead costs for the three plants are therefore estimated at $9 million a year. Prorating the cost to the milk volume represented by the unused capacity, the allocated annual fixed and overhead cost for reserve balancing is nearly $3 million (table 3, column 3).

January's unused capacity caused by fluctuation in necessary reserves is 3.3 million pounds of milk per day or about 38 percent of the peak necessary reserves (combined capacity of three plants). The fixed and overhead costs for the three plants are $9 million a year or $24,658 a day. Prorating this cost to the 38 percent unused capacity results in $9,396 per day fixed and overhead cost for reserve balancing, or $291,266 for January. Fixed and overhead costs for reserve balancing for other months are calculated the same way.

Plant manufacturing costs–These are directly associated with manufacturing operations of the plant when milk is moved from the receiving deck through the plant to the product delivery deck. They include labor (direct labor, supervisory/indirect labor, and fringe benefits), electricity, fuel, water and sewage, plant and cleaning supplies, repair and maintenance, depreciation, taxes and insurance, and miscellaneous expenses. Except for depreciation, these items are generally called variable costs. They may be semi-variable or semi-fixed.

Assume that there is no shipment of intermediate product, cream or skim, into or out of the butter-powder plants. A 1-percent decrease in milk volume going through a butter-powder plant will correspondingly decrease plant capacity use. The fluctuating volume of necessary reserves affects under-use of the butter and powder plants by the same percentage. Under-capacity percentages reported in table 3 apply equally to both butter and powder production.

Increases in the costs of manufacturing butter and powder due to under-capacity use caused by fluctuating necessary reserves can be calculated. Based on data available to RBS Cooperative Services, it has been estimated that for every 1-percent decrease in the plant capacity use, product cost will increase one-tenth of a cent per pound (2).

Table 3 lists increases in the in-plant costs of manufacturing butter and powder caused by the fluctuating volume of necessary reserves for the 12 months. June is operated at full capacity and the manufacturing costs are the lowest. When the plant is operating at less than capacity, manufacturing costs increase by 3.8 cents per pound of butter or powder in January, by 2.7 cents in February, etc.

By using standard yield factors of 4.48 pounds of butter and 8.13 pounds of powder per hundredweight of milk at 3.67 percent butterfat test, the above increases in manufacturing costs can be converted to a per-hundredweight-of-milk basis. Column 5 of table 3 shows that increases in manufacturing costs due to under-capacity plant use caused by necessary reserves range from 4 cents per hundredweight of milk manufactured in May to 83 cents in October. Expanding these extra costs by the total volume of necessary reserves (table 2, column 7), monthly total increase in the manufacturing costs due to reserve balancing is zero in June and ranges from $94,755 in May to $836,460 in December (table 3, column 7). Total extra manufacturing cost for balancing necessary reserves for the entire year is estimated to exceed $6.7 million.

Total balancing costs–This combines fixed and overhead costs prorated to the milk volume of unused capacity and the manufacturing cost increases on the actual processed volume due to under-used plant capacity (table 3, column 8). For maintaining milk reserves necessary for the fluid market, the three butter-powder plants incur a total reserve-balancing cost of more than $1 million in January, $792,431 in February, etc. June has no reserve-balancing cost because the plants operate at full capacity during that month. Annual total costs of reserve balancing are estimated at more than $9.7 million.

Doubling Operating Reserves

The calculation in this section is the same as the previous one, except that operating reserves are doubled or 20 percent above fluid demand. This entails a different set of reserve milk volumes and the associated costs of reserve balancing.

Satisfying fluid demand--Operating reserves are set in table 4 at 20 percent of fluid demand every month and follow the same seasonal pattern. The operating reserves range from the low of 5.3 million pounds per day in June to the high of 5.9 million pounds in September. The annual average is 5.6 million pounds a day.

The volume of seasonal reserves is zero in October when milk deliveries exactly supply the need of fluid demand and operating reserves. That volume peaks at 6.5 million pounds per day in June and drops to a low of 0.1 million pounds a day in September. (October is used as the benchmark for calculating seasonal reserves to ensure sufficient minimum volume of milk to cover fluid demand and operating reserves year-round.) While the volume of operating reserves is doubled, the volume of seasonal reserves is only slightly higher than when operating reserves are 10 percent of fluid demand.

Necessary reserves, the sum of operating reserves and seasonal reserves, range from 5.9 million pounds per day in October to 11.8 million pounds in June, with 8.8 million pounds being the daily average (table 4). On a daily average basis, necessary reserves are 32 percent of fluid demand. For every 100 pounds of fluid demand, it is necessary to carry an average minimum of 32 pounds of milk reserves to make sure that fluid demand will be satisfied year-round. Necessary

Table 4—Necessary reserves to satisfy fluid demand assuming 20 percent operating reserves, and total reserves, Northeast Orders

Month	Seasonality index						Necessary reserves [2]		Total reserves [3]	
	Producer milk deliveries (1)	Fluid demand (2)	Producer milk deliveries [1] (3)	Fluid demand [1] (4)	Operating recerves (5)	Seasonal reserves (6)	Milk volume (7)	Percent fluid demand (8)	Mlk volume (9)	Percent milk deliveries (10)
	Percent		———Million pounds per day———						Mil.lb/day	
January	100.1	101.9	64.735	28.500	5.700	2.688	8.388	29	26.321	41
February	101.8	100.6	65.920	28.156	5.631	3.728	9.359	33	27.523	42
March	103.7	100.9	67.206	28.237	5.647	4.331	9.978	35	27.979	42
April	105.4	98.2	68.317	27.493	5.499	5.850	11.349	41	29.575	43
May	106.0	98.1	68.774	27.471	5.494	6.097	11.592	42	29.772	43
June	103.4	94.0	67.176	26.343	5.269	6.493	11.762	45	28.559	43
July	97.8	94.2	63.643	26.582	5.316	4.142	9.459	36	24.896	39
August	97.0	98.1	63.035	27.572	5.514	2.660	8.174	30	22.882	36
September	96.3	105.2	62.476	29.476	5.895	0.117	6.012	20	21.230	34
October	95.4	104.6	62.163	29.297	5.859	0	5.859	20	21.758	35
November	95.0	102.8	61.866	28.793	5.759	0.457	6.216	22	22.570	36
December	98.1	101.4	64.303	28.605	5.721	1.825	7.546	26	25.757	40
Simple average	100.0	100.0	64.968	28.044	5.609	3.199	8.808	32	25.735	40

[1] Five-year average, 1995-99.
[2] Necessary reserves are the sum of operating and seasonal reserves
[3] Total reserves are the sum of Class III and Class IV milk, or the sum of necessary and excess reserves.

reserves in June are equivalent to 45 percent of the fluid demand for that month. In September and October, necessary reserves are 20 percent of fluid demand, representing the required operating reserves but without seasonal reserves because these are the two seasonally lowest milk delivery months.

Total reserves (the milk volume in excess of Class I and Class II uses and classified as Class III and Class IV) remain the same fixed volume as in the previous section. Because of the higher necessary reserves in this section, excess reserves are lower.

Total balancing costs—To process the peak daily volume of necessary reserves of 11.8 million pounds of milk, four butter-powder plants, each with a daily capacity of about 3 million pounds of milk, are required.

The monthly variation of necessary reserves has a major impact on the under-capacity use of a manufacturing plant. January necessary reserves are 3.4 million pounds lower than the June peak reserves of 11.8 million pounds a day. The shortfall translates into a 29-percent under-use of the plant's capacity (table 5, columns 1 and 2). February shortfall was 2.4 million pounds a day, a 20-percent under-use of plant capacity. The shortfalls for other months are calculated the same way. The variation ranges from full-capacity operations in June to a shortfall of 5.9 million pounds a day in October, or a 50-percent under-use. Note that monthly under-capacity volumes caused by fluctuating necessary reserves are almost the same when operating reserves are 20 percent of fluid demand as when operating reserves are 10 percent of fluid demand (column 1 of both tables 3 and 5).

Following the same calculations in the previous section, the fixed and overhead costs for the four plants are estimated at $12 million a year. By prorating the cost to the milk volume of unused capacity, the allocated annual fixed and overhead cost for reserve balancing is more than $3 million (table 5, column 3). Increased plant costs of manufacturing butter and powder caused by the fluctuating volume of necessary reserves for the 12 months are listed in table 5, column 4. June is operated at full capacity and the manufacturing costs are the lowest. When the plant is operating

Table 5—Estimated cost of balancing necessary reserves assuming 20 percent operating reserves, Northeast Orders

Month	Unused capacity caused by fluctuation in necessary reserves (1)	Unused capacity percent of peak necessary reserves (2)	Fixed and overhead costs of reserve balancing (3)	Plant cost increases on the actual processed volume caused by unused capacity [1]: Per pound of butter or powder [1] (4)	Converted to per hundred-weight milk [2] (5)	Per daily necessary reserve volume (6)	Per monthly necessary reserve volume (7)	Total reserve balancing cost (8)=(3)+(7)
	Million lbs/day		$/month	Cents/lb	Cents/cwt	$/day	$/month	$/month
January	3.4	29	292,290	2.9	36	30,336	940,417	1,232,707
February	2.4	20	188,046	2.0	26	24,108	675,020	863,066
March	1.8	15	154,540	1.5	19	19,079	591,445	745,985
April	0.4	4	34,629	0.4	4	5,024	150,732	185,360
May	0.2	1	14,717	0.1	2	2,111	65,431	80,148
June	0	0	0	0	0	0	0	0
July	2.3	20	199,534	2.0	25	23,352	723,906	923,440
August	3.6	31	310,868	3.1	38	31,440	974,628	1,285,496
September	5.7	49	482,139	4.9	62	37,060	1,111,789	1,593,928
October	5.9	50	511,439	5.0	63	37,078	1,149,407	1,660,846
November	5.5	47	465,038	4.7	59	36,958	1,108,729	1,573,767
December	4.2	36	365,255	3.6	45	34,104	1,057,212	1,422,467
Sum			3,018,495				8,548,716	11,567,210

[1] Estimated to increase by 0.1 cent/lb of product per percentage point of unused plant capacity.

[2] Assuming per cwt milk, 4.48 pounds of butter and 8.13 pounds of nonfat dry milk can be made

below capacity, manufacturing costs increase by 2.9 cents per pound of butter or powder in January, by 2 cents in February, etc.

By using standard yield factors, increases in manufacturing costs are converted to a per- hundred-weight-of-milk basis. Column 5 of table 5 shows that increases in manufacturing costs due to below-capacity plant use caused by necessary reserves range from 2 cents per hundredweight of milk manufactured in May to 63 cents per hundredweight in October. Expanding these extra costs by the total volume of necessary reserves, monthly total increase in the manufacturing costs due to reserve balancing is zero in June and ranges from $65,431 in May to over $1.1 million in October (table 5, column 7). Total extra manufacturing cost for balancing necessary reserves for the entire year is estimated at $8.5 million.

Fixed and overhead costs prorated to the milk volume of unused capacity and the manufacturing cost increases on the actual processed volume due to under-utilized plant capacity are combined to constitute total reserve-balancing costs (table 5, column 8). For maintaining milk reserves necessary for the fluid market, the four butter-powder plants incur a total reserve-balancing cost of $1.2 million in January, $863,000 in February, etc. June has no reserve-balancing cost because the plants operate at full capacity during that month. Annual total costs of reserve balancing are estimated at $11.6 million.

Conclusions

Given the seasonalities of milk production and fluid demand, the volume of operating reserves needed to satisfy fluid milk demand is the key factor in deciding the volume of seasonal and necessary reserves, and in turn, the total costs of balancing reserve milk supplies. Therefore, knowing how much operating reserves are needed is pivotal for the cost estimation. This report uses 10 and 20 percent operating reserves above fluid demand for illustration. If operating reserves are 10 percent of fluid demand, the cost of reserve balancing is estimated at $9.7 million a year. The annual cost is estimated at $11.6 million, if operating reserves are 20 percent of fluid demand.

The estimation of the reserve-balancing costs assumes all necessary reserves are balanced in the hypothetical plants. In real life, reserve balancing is carried out among many manufacturing plants. However, no manufacturing plant is known to have kept separate records for calculating the reserve-balancing costs. The methodology used in this report yields cost data that probably represent the best estimates.

References

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Rural Business–Cooperative Service

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