812 DISCUSSION OF SUBJECTS OF SPECIAL INTEREST

Consolidated Functions Approach

A. In connection with the calculation and control of the following annual statement items:

Basic policy life reserves
Term rider reserves
Reserves for dividend additions
Liability for dividends at interest
Liability for premiums paid in advance
Outstanding premiums
Deferred premiums
Insurance in force
Policy loans

- (i) Are these items being developed on an inventory basis from the detailed policy file as it stands on the statement date? If so, by a seriatim or group method? How often is such inventory run made?
- (ii) Are running totals of the items being maintained on a ledger basis? If so, how often are such totals checked by file inventory? What size groups are considered satisfactory for checking purposes?
- (iii) Are these items being developed on a group basis from other items maintained on a running total basis? If so, how often are such intermediate totals checked by a file inventory?
- (iv) What other checks are being developed to assure the consistency of these items?
- B. What new or unusual methods of calculating reserves, net premiums, and expected mortality have been developed through the use of computers?
- MR. JOHN S. FRY opened the discussion by stating that Continental Assurance obtains all of the annual statement items listed in the program by an inventory method. For almost a year they have been processing a detailed policy file of over 350,000 records weekly. This detailed policy file is in valuation order by plan code, age at issue, and year of issue. In defining plan code, both base and rider are considered together, so that the same basic plan with a ten year term rider and a twenty year term rider are considered as two different plans.

Mr. Fry pointed out that with the detailed file in valuation order it is natural to pass the file at year end and apply group factors to individual policies. This file of group factors that is processed against the detailed policy file contains all of the information that is not unique to a policy but is common to the valuation group. Examples are: unit premiums, cash values and reserves, availability of conversion or other options, expiry or maturity of coverage, unit dividend or paid-up additions. The advantage of this device is that the data carried in the detailed record are reduced,

thereby reducing processing time. For valuations, the benefit is immediate.

Mr. Fry then continued by pointing out that a special valuation rate tape used at the year end contains the mean reserve, cost of insurance, and dividend factors. It also contains factors to compute the following items: nondeduction of fractional premium reserve, additional reserve on substandard ordinary life type plans, Schedule Q premium ratios for computing field expense limits, and the death-of-payor claim reserve.

With this background, Mr. Fry summarized how the annual statement items in the question are developed. The basic policy, term rider, and dividend addition reserves are computed by a seriatim method by an annual pass of the detailed file against the rate tape. In a quarterly pass of the detailed file, which performs many nonactuarial and nonstatement duties, an inventory of insurance in force, uncollected, deferred, and advance gross and net premiums is obtained. The ratio of net to gross premiums for the business in force at quarter's end is also obtained and is used to develop interim reserves on a quarterly basis.

Dividends, coupon and advance premium deposits, as well as policy loans, are maintained as ledger accounts. Ins and outs for each week's processing are balanced against a weekly inventory. The file of 350,000 records and 60,000 rate cells is divided into about 150 groups for checking of these capital accounts. This size division has proved satisfactory. In addition, a monthly report identical in form to the statement policy exhibit is prepared by accounting for ins and outs and these totals are balanced against the quarterly inventory of the insurance in force.

Mr. Fry then pointed out that they place a good deal of faith in the ability of the computer to perform its work accurately once the program has been thoroughly checked. Initially, during the testing stages, a voluminous detailed checking job was done and the 1958 valuation was redone on the computer and reconciled with the former method. Also, reserve figures are checked in aggregate each year by an accumulation formula. Finally, Mr. Fry pointed out that since these statement figures are being developed from a detailed record that is being used throughout the year to bill premiums and to provide policy status information to all departments, it is subject to considerable scrutiny and is likely to be very accurate.

In commenting on section B, Mr. Fry felt that an inventory method is direct and conceptually simple and is now made feasible by high speed computers. This, in turn, encourages first-principle, direct approaches. It also enables companies to develop exact reserves in place of those arrived at by approximate methods that were used in the past.

MR. W. JAMES D. LEWIS began his remarks by briefly describing the Confederation Life Association's system for servicing ordinary policies. It is built around the maintenance, on tape, of two files, each in policy number order, and has been in operation since January 1, 1959.

The first of these files, the master file, contains the data necessary for policyowner billing, premium and claim accounting, commission calculation and accounting, loan and dividend maintenance and accounting, as well as scheduled items of policyowner servicing. This file is processed four times per week. The second file, the calculation file, is processed at the end of each month. In this monthly processing it computes unit dividends and cash values for use by the master file in the following month and in addition computes the reserve data for all movement during the month and for all policies with anniversaries in the month just completed.

Mr. Lewis then went on to show how the reserve output from the monthly run of the calculation file is summarized by means of a monthly reserve summary run. He pointed out that the summarization is sufficient to provide total calculated reserves at the month end on the assumption that for each policy the reserve moves from the last medial to the next medial at the month end following the anniversary during the year. The summarization of the reserves is by anniversary month. For processing at the end of September 1960, for instance, the input to the summarization run consists of a 1960 medial, a 1960 and 1961 terminal for each anniversary month, January to August inclusive, and 1959 medials and 1959 and 1960 terminals for policies with anniversaries in September through to December. During the summarization run at the end of September a thirteenth set of totals is developed for those policies with September anniversaries and the input set of totals for September anniversaries is dropped. This set of totals includes the 1960 medial, the 1960 terminal and the 1961 terminal. The second terminal provided by the input for September anniversaries is reconciled within the computer with the first terminal shown for September anniversaries in the output from the summarization.

In addition, reserve changes as a result of new business, write-offs, and policy changes are maintained separately by monthly anniversary and this provides the means whereby the reserve for any monthly anniversary group can be checked through from one month end to the next.

In describing the checks that are imposed on the calculation of reserves in the monthly run of the calculation file, Mr. Lewis said they compute their reserves using a Karup attained age method on a seriatim basis. The individual policy records maintain the necessary net premiums

and t-corrections and the computation is performed by using these policy factors and commutation columns of N_x . In addition, the individual policy records maintain last year's unit medial reserves. At the time the current medial is computed using the Karup attained age method, last year's medial reserve is brought forward by the addition of a premium and interest and by the reduction of a cost of insurance in order to compute an independent check on this year's medial reserve. Failure to reconcile these two computations of the medial reserve triggers an error indication.

In summary, Mr. Lewis said this is the method for the calculation and control of basic policy reserves, term rider reserves, reserves for dividend additions, deferred premiums and insurance in force. Each of these items is maintained on a ledger basis and is corrected by movement. However, at the end of each month new calculations are made on, roughly, 1/12th of the file so that a complete file inventory is effected annually.

As to the other items mentioned under this topic, Mr. Lewis pointed out that their billing procedure is on a completely revenue basis. At the time a premium is billed, accounting entries are made to revenue premiums and to outstanding premiums. Accordingly, a ledger total is available at any time, providing the total outstanding premiums. This is checked back to the detail by means of a monthly file inventory. A parallel procedure is employed for the liability for dividends at interest, the liability for premiums paid in advance and the policy loan asset.

Mr. Lewis' only remark under section B was to mention that all actuarial functions are computed from tables of N_x stored in the memory of the computer. Commutation columns of this type have been developed by his company for those bases with a zero mortality (i.e., pure interest). This permits them to have a uniform technique of reserve calculation for substantially all insurance and savings plans.

MR. RICHARD A. GETMAN opened his discussion of section A by making the point that the development of reserves is usually coordinated with some other activities such as premium billing and accounting or dividend calculation. If it is coordinated with premium billing and accounting, the seriatim method is suggested, but if it is coordinated with dividend calculation, the group method is suggested.

Mr. Getman then made the observation that prior to the advent of electronic computers, most companies developed reserves from summary data rather than from an inventory of a detailed policy file, but now the great speed of electronics has suddenly made detailed policy valuation practicable. However, he felt that each company should and must make a positive decision as to whether such a course is desirable. He felt that

if the use of summary data had been desirable before, its use may still be desirable now.

Mr. Getman said that The Travelers has used a mechanized attained age method of valuation for some thirty years. With the advent of their computer, they were faced with the valuation question, and could see no reason for adopting the inventory approach. They felt that any effort coordinated with billing and accounting (the primary area of their computer operation) would merely complicate and delay these operations. They found that their attained age system could be adapted to the computer with very little time and effort, as a good part of their present system would be salvageable. It could be tossed aside at any time with little loss of investment, or then even be continued as a check on some other method.

Mr. Getman went on to describe their procedure as follows. Travelers has a program for receiving monthly net change messages arising from new business, other issues, and cancellations. These are not skeleton messages but complete messages arising from file maintenance in some other area. (And here Mr. Getman said he felt that the primary value of computers is achieved by coordination of file maintenance and not necessarily by consolidation of files themselves. Files usually have their own characteristic order, the advantage of which is nullified by consolidation.)

These messages are intersorted in order to valuation basis and policy form and are read into the computer together with commutation columns N_x and M_x and a form factor file. For forms providing level insurance and endowment values equal to the amount of insurance or zero, a net premium and θ -factor are calculated from the commutation columns and emitted in a summary form message to be used for attained age valuation. For other forms the net premium and θ -factor are taken from the form factor file and then emitted in a similar manner. In a subsequent program the summary form messages are summarized and attained age multipliers are applied in order to obtain the reserve adjustment.

In order to get started they "issue" the in-force file, summarize it, and calculate the reserve. Thereafter, it is adjusted monthly and recalculated annually, each time on a summary basis. If there is ever occasion to change the valuation basis, which in the past has given rise to one of the major disadvantages of the attained age system, they will "re-issue" the in-force file and recalculate those net premiums and θ -factors which are carried in the form factor file. Mr. Getman granted that this was extra work, but no more so than under the regular inventory approach and far less frequent.

In conclusion, Mr. Getman hoped he had not given the impression that valuation by a seriatim or group method is necessarily inferior to the attained age method. Each company has its own heritage and its own future. On the other hand, he hoped that he had made it clear that the attained age method has not necessarily been rendered out of date by speed alone which the computers have made possible.

MR. PAUL F. KINSEY began with a description of the Northwestern Mutual's consolidated functions approach operating on a daily cycle. When fully converted the system will be operating on a detailed master file of one and two-thirds million policies and will have an average volume of about 30,000 transactions per day.

The first run in the daily cycle simply selects these 30,000 policies with current activity from the master file and places them in a separate magnetic tape file. The second run completely processes all of the transactions, which involves updating the master record and developing all of the raw data for home office records, agency records and policyholder notices. All subsequent runs in the daily cycle are devoted to using the raw data developed to prepare the printed forms and reports.

Mr. Kinsey noted that there were three means of developing annual statement items suggested in the program and they use all three in some respect or other. First, they have an inventory run which is used quarterly to develop most of the items suggested in the program. This is a seriatim method operating on the master file of individual policy records as it stands on the statement date. The totals which they obtain are as follows:

I. Policy Loans

Number and Amount

Interest Due and Accrued

Interest in Advance-Earned and Unearned

II. Premium Loans

Number and Amount

Interest Due and Accrued

Interest in Advance—Earned and Unearned

III. Premiums Deferred and Uncollected—Gross (including W.P. and A.D.B.)

Life Insurance and Retirement Annuity

Deferred-new and renewal

Uncollected-new and renewal

IV. Premiums in Advance

Life Insurance and Retirement Annuity

In Advance—new and renewal

V. Dividend Accumulations

Life Insurance and Retirement Annuity

Number and Amount by Interest Rate

VI. Dividends Due and Unpaid

Life Insurance and Retirement Annuity

VII. Dividends in Advance

Life Insurance and Retirement Annuity

VIII. Amount Held for Premiums on Changed Policies

IX. Insurance in Force

Policy Contracts and Additions

Number of Policies and Amount

X. Retirement Annuities in Force

Premium Paying, Full Paid and Additions

Number of Policies and Annual Income

Mr. Kinsey pointed out that the need to inventory dividends paid in advance is inherent in their practice of recording the application of dividends twenty to thirty days in advance of the dividend due date. This dividend application system is an integral part of the premium billing system. These totals will provide the ability to adjust lines 1–8 of Exhibit 7 from the cash to the incurred basis.

Regarding item (ii) of section A, Mr. Kinsey said they maintain ledger accounts for policy loans, premium loans and dividend accumulations. In the processing run of the daily cycle, debit and credit records are prepared for these accounts as each transaction is processed and they are summarized in a subsequent daily run by account and type of transaction. The total net change in each of these accounts is verified each day by an independent inventory of the 30,000 master records before and after all processing for each policy that day. With this daily verification of the active master records no difficulty is expected in checking with the quarterly inventory of the entire master file.

As for the insurance and retirement annuity in-force figures, the daily processing run produces the detail increase and decrease records necessary for compilation of the policy exhibit and annuity exhibit which is done monthly. The figures from the quarterly inventory run are then obtained as a check of the in-force developed by this monthly run. In conclusion, Mr. Kinsey said they plan to continue the group method of valuation for both dividend addition and policy reserves. The same detail increase and decrease records used for the policy exhibit run will be used as input to the monthly group valuation summary run.

MESSRS. PAUL E. SARNOFF and J. E. BOOHER, in two discussions about the system used at the Prudential, said they have in operation a computer system which performs the valuation and associated statement work of its Ordinary business, using detail records which are distinct from the basic policy records used for premium accounting. Mr. Booher

said the reason for this separation was that the two systems were developed independently and some regional home offices do not yet have tape equipment.

The valuation system develops the insurance in force; the policy reserve for the life insurance and ancillary benefits, including riders and dividend additions; and the deferred premiums. Its built-in control features include the automatically produced Policy Exhibit, which accounts for the change in the in-force in terms of the volume of each type of exhibit transaction, and the Analysis of Increase in Reserves, which accounts for the change in the reserve in terms of its theoretical elements independently computed. Other controls include the usual run-to-run controls of records processed, and a comparison of computer-calculated death, surrender, and maturity benefits with the corresponding amounts actually paid.

Mr. Sarnoff pointed out that the decision to adopt the group method rather than the seriatim method was made because the amount of computer time required to read each individual tape record into memory in order to compute reserves would be greater than the running time of the method they have chosen, and because the computers they are using do not have the storage capacity to contain either the necessary reserve factors or the factors and formulas necessary for their computation.

They said the deferred premium asset is derived from the valuation premiums in force by the application of controlled sample deferred percentages derived from the actual premium accounting files, which are maintained by tape in some offices and by cards in others. In this connection Mr. Booher said that the error introduced by the sample percentages was not greater than $\pm 0.4\%$ (95% level of confidence).

Mr. Sarnoff went on to say the entire valuation system is updated each quarter, at which time its in-forces are reconciled with an independently calculated total of the detail file. The detail file is maintained in groups of ten detail records at the head of which are in-force totals for each group. These in-force totals are recalculated whenever a transaction is applied which affects the in-force status of any policy in the record group; otherwise no change is made in the totals. These header totals are accumulated and it is this grand total which represents the total of the detail file. An actual detail file inventory by valuation cell is not planned, because the nature of the controls ensures that the details and summaries are updated consistently, and because it is not possible for a given transaction to cause a different cell to be updated from that which the policy helped to create at time of conversion to tape, or at issue if later. Their experience has indicated the importance of adequate controls, with emphasis upon completeness.

Messrs. Sarnoff and Booher then went on to say that the outstanding premiums and policy loans are produced from an inventory of the premium billing and accounting system. (At this point Mr. Booher said they considered using a sampling technique, but discarded it for the complete inventory of this file.) This system is used to produce the deferred premium percentages previously referred to. One of the weekly transaction outputs from the premium system is supplied as transaction input to the company's tape valuation system. The premium system also produces issue and in-force totals for each agency for agency management purposes.

MR. JOHN A. BEVAN briefly mentioned that about 90% of their policies at Connecticut General, other than term, are issued with the automatic premium loan provision as the nonforfeiture option. In order to properly advise the agent and policyholder, at the time of billing, of insufficient equity situations, their detailed record must contain cash values and reserves. This makes it convenient for them to inventory the detailed file quarterly for interim and annual statement purposes. Independent gain and loss calculations will be used for control.

MR. MANUEL R. CUETO, after pointing out that he has a very inappropriate first name to be talking on the subject of computers, went on to say that the actuarial department of NYLIC is charged with the responsibility for determining dividends under individual policies and maintaining outstanding dividend balances. In order to calculate dividends by application of a rate tape and for other computational work, detailed policy files are maintained in group valuation order by anniversary month. Initially, as part of the conversion of their records to magnetic tape, they developed, from individual policy records on tape, number of policies and amount of insurance summaries by valuation cell (i.e., year of issue, reserve basis, plan and age), for insurance, disability, double indemnity, child's protection, etc. To these summaries, updated to the end of the year, they have applied reserve factors for each benefit in force to determine the year-end liability by the group method of valuation.

Mr. Cueto said their electronic operating system involves processing once each month accumulated transactions, including new issues, in valuation order, specially coded for policy exhibit purposes. In this run, they maintain control totals by anniversary month of number of policies, amount of insurance and amount of dividend balances, accumulated increase and decrease summaries by valuation cell, and tabulate totals for the various types of increases and decreases for policy exhibit purposes, including separate data by state. The anniversary month control totals are checked in the computer runs that update the current anniversary month's tape file with accumulated transactions and calculate new divi-

dend balances. New increases in dividend balances resulting from this run are subsequently fed back into the policy exhibit to add to the control totals.

At the end of the year, the accumulated increase and decrease summaries are applied against the prior year's in-force summaries to obtain an updated in-force summary. A rate tape is applied against the in-force summaries and also the increase and decrease summaries to obtain for all benefits the reserve liabilities, premiums receivable both gross and net, tabular cost and reserves released. The reserves for dividend additions, the liability for dividends at interest, and the policy exhibit data are obtained at the end of the year as the result of the computer runs that are made monthly against the transaction file.

At certain intervals in the past, in order to establish accurate control totals, they have updated their entire detailed policy file to the year end and prepared inventory summaries to check against those used in their valuation, cell by cell. It is their intention to make a file inventory of this type not oftener than once every three years.

In addressing himself to section B, Mr. Cueto said they have programs prepared which enable them to randomly generate all rates needed in the valuation procedure. These programs enable them to obtain for each inforce benefit, by valuation cell, the reserve liability rate, the terminal reserve rate for reserves released, the net premium and the tabular cost calculated as a balancing item between two terminals. For the dividend declared liability, the dividend rate is obtained from the rate tape used for calculating dividends for individual policies. Gross premium rates are obtained from a special tape maintained for that purpose.

One further control Mr. Cueto said they maintain on their valuation procedures is to balance the reserves by year of issue, reserve basis and plan from one year to the next, by use of the Gain and Loss formula. In this computer operation, they use the prior year's valuation results adjusted for certain shifts in plan, plus reserves released, and the valuation tape results for the current year.

MR. JASPER E. MOORE briefly mentioned that as far as most of Crown Life's items are concerned, they are going to use a library tape look-up procedure, holding two reserves, three cash values and three dividends on the master record. Monthly they will be comparing the master record anniversary cases to this library tape. At this time, for each master record, they look up the single unit reserve per thousand and then, by simple calculation, generate the ledger reserve items.

MR. J. STANLEY HILL said his company used a monthly cycle consolidated functions approach. As the computer analyzes the previous

month's transactions and changes and updates the master record, it punches out a valuation change card which is then used on a separate run to update a valuation file. The valuation file tape will be in conventional group valuation order, but will contain sufficient fields to handle not only the life valuation but the liability for disability and accidental death benefits. The valuation file will be updated and reserves and net premiums will be calculated only when statement information is needed. In his company this is three times a year.

Mr. Hill went on to say that the order of the master records is by policy number within collection office within file day. "Trailer" totals are maintained for each collection office (within file day) on the amount of dividends at interest, the amount of policy loan, the amount of insurance for policy exhibit purposes, and the amount of insurance for valuation purposes. During the consolidated functions run, the fields under control are reinventoried, the net change to these fields is accumulated, and this information is used to establish new trailer totals and to determine that these trailer totals are in agreement with the individual records. A special run will be made to obtain statement figures.

In discussing the size of their control groups, Mr. Hill pointed out that they have approximately sixty-five collection offices. Since these occur within each of the thirty-one file days, the total number of totals produced for each control field is in the neighborhood of 2,000. They have just over 200,000 ordinary policies in force.

Mr. Hill concluded by saying they originally had intended to develop their reserve information on a basis similar to that used for dividends at interest and policy loans. A closer examination of this proposal made it clear that the additional computer expense would be in excess of any values obtained therefrom.

MR. DAVID H. HARRIS restricted his comments to the two dividend items covered by section A and said that, for the valuation of dividend additions, their program computes mean reserves on a seriatim basis as a part of the anniversary processing of policy records. Summaries of these mean reserves are produced at the time of each run. All off-anniversary transactions affecting dividend additions are analyzed to determine whether they occur before or after the policy anniversary in the calendar year; if the latter, their effect on the mean reserve is determined and recorded in a set of run-by-run summaries. The actual reserve for additions at the year end is determined by adding the figures from all of the anniversary-date summaries, and adjusting this total by the sum (positive or negative) of the summaries arising from postanniversary transactions.

Amounts of additions are obtained in the same way as the mean re-

serves, and the whole procedure is kept in balance by checking the amounts so obtained against the amounts shown in an independent, running-book record. However, Mr. Harris felt that the reconciliation procedure has not proven easy, and they are now planning a new method of dealing with this problem. Effective next year, they expect to compute the amount and mean reserve figures policy by policy at anniversary time, as before, and to hold the results on a part of the master file which will pass through the computer four times each month. (That cycle is, of course, determined by other considerations, not by the requirements with respect to statement figures.) As at present, transactions between anniversaries will modify the "amount" fields in all cases, and the "mean reserve" fields where the change occurs after the policy anniversary in the calendar year. Both the total amount and the total mean reserve will be obtained by direct inventory at every run, and the results will be checked automatically by a running-book type of calculation, using the totals from the previous run modified by the total of the current run's plus and minus adjustments.

As to their current procedures for dividends left on deposit at interest, Mr. Harris said they are essentially the same as for dividend additions, again with reconciliation once a year between a buildup of run-by-run summaries on the one hand and the over-all account figures on the other. They are planning the same kind of change as has been described for the additions; starting next year, an inventory total for dividend deposits on all policies will be accumulated in every run, and a reconciliation made directly.

MR. JOHN F. B. AMSDEN stated that the Sun Life of Canada is converting to combined operations, combining all functions, including commissions, but excluding policy issue, underwriting, and expense accounting. They operate four cycles a month and have a master record in currency and policy number order within branch office. The number of policies converted and operating under the new system is 35,000—increasing to 90,000 by the end of the year, and 175,000 by early 1961.

In specific discussion of section B, Mr. Amsden stated that they are using the accumulation method of calculating reserves. Periodic terminals are carried on the individual policy records and for year-end purposes these will be adjusted to periodic medials, a minimum reserve of half the net premium being set up. This means they will not have to carry a deferred premium asset or, in the case of the Canadian Statement, a deferred premium deduction on the liability side. As the net premiums used are the annual net premiums divided by frequency of premium payment, it is still necessary to set up a reserve for nonpayment of deferred premi-

ums in the event of death. Consistent formulas for both the reserve and the amount of insurance have been developed for family income so the accumulation method can be used there also. For checking purposes at conversion a special formula was devised to calculate the terminal reserve from the medial and the cost employed in the group method of valuation used in the past. This formula avoids the use of the amount of insurance as in many cases this differs from the statement amount which was previously the only one carried on their records. Since the tabular medials were taken to the nearest dollar while the seriatim reserves to which they are compared after conversion are taken to four decimal places, the formula is sufficiently accurate (with an error approximately equal to q^2 times the amount of insurance plus, where the amount is increasing, q times the increase).

Returning to section A, Mr. Amsden described their inventory totals carried at the end of each branch office-currency group. These totals include number, all amounts of insurance (basic plus family income and other term benefits plus paid-up additions), reserves (also combined), outstanding premiums, premiums paid in advance, policy loans, and dividend deposits. Suspense items are handled separately. These inventories are automatically reconciled by the computer with accounting summaries which are in greater detail. If they are out of balance, a separate analyzing program examines the movement on each individual policy and if it finds that the previous status of the policy plus current changes does not equal the current status, then the case is written out for further study. Since there are about thirty programs involved in the operating cycle, there have been some programming inconsistencies and this analyzing program has proved valuable in proving the work. The program also locates certain input inconsistencies. It is hoped that it will not have to be used frequently once the "bugs" have been ironed out.

Thus, the amount of insurance and number of policies are available from the inventories and the accounting summaries. As for the other items such as reserves and various liability items, these are adjusted at year end by a special program which accrues interest, converts terminal to medial reserves, and so on.

As the items entering into the increase in reserve (net premium, required interest and expected mortality) are summarized separately, an independent check in the traditional form can be used if desired. Also the year-end procedure provides addresses for annual statement and proxy purposes, as well as agency figures and statistics for management.