

MERIT RATING —
THE PROPOSED MULTI-SPLIT EXPERIENCE
RATING PLAN AND THE PRESENT
EXPERIENCE RATING PLAN

BY

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INTRODUCTION

The title of this paper and the paper itself are perhaps longer than they should be. The original purpose was to bring before the Society and those interested in the subject of merit rating the plan generally known as the "Multi-Split Rating Plan"; but as the multi-split plan was designed to replace the present plan and as the final decision as to its adoption is still being considered, both plans must be presented and discussed. In the course of the discussion it will be necessary to criticize the present plan. This procedure may resemble that of setting up a dummy opponent and then knocking him over. If so, there would be only an element of justice for thus far the multi-split plan has been on the receiving end. A proper appraisal of the proposed plan can hardly be made without discussing the plan it is intended to supplant. Simply to explain the proposed plan, showing its logic and operation, does not seem to be sufficient.

As a matter of record and for those not familiar with the subject a brief review may prove helpful. On May 21, 1936, the Rates Committee of the National Council on Compensation Insurance requested "the Actuarial Committee to make a critical review of the present experience rating plan and report its findings to the Rates Committee at the earliest possible date." The Actuarial Committee, utilizing the facilities and affiliations of the National Council completed a thorough study and investigation of the experience rating plan.

NOTE: The membership of the Committee was in the main composed of Messrs. Dorweiler, Barber, Perryman, Ginsburgh and Constable, all members of the Society. Mr. Yount and Mr. Forrest represented the Liberty Mutual Insurance Company. In addition, Messrs. Kormes, Hipp and Sinnott attended many of the meetings. Messrs. Skelding, Marshall, Williams and Smick of

the National Council Staff were present and participated. At one time or another each contributed to the study. As a result of discussion on one of the points Mr. Perryman wrote a paper "Experience Rating Plan Credibilities" which appeared in Volume XXIV. To Mr. Barber goes the credit for the "Multi-Split" treatment of losses.

Meetings were held at frequent intervals, and in the interim studies, exhibits and analyses were made at the National Council, the boards and bureaus, and the home offices of the companies. The amount of work performed was prodigious. Much of it could possibly have been avoided, but the Committee felt that it was desirable to make a complete analysis and left few points uncovered. Punch cards, transcribed from the detailed reports required under the unit statistical plan, made available a wealth of data for the actuary and statistician. With the carte blanche authority given to the Committee by the resolution of the Rates Committee, and the vast accumulation of punch card data available, the Actuarial Committee wallowed in exhibits. It was an actuarial dream of heaven which may possibly never again be repeated.

On January 5, 1939, the Actuarial Committee submitted to the Rates Committee its report entitled "Study and Investigation of the Experience Rating Plan." The Actuarial Committee recommended that a new plan be adopted. The principal features of this plan and comparison with the present plan are shown on Exhibit A. Two meetings of the Rates Committee have been held to consider the subject, but no decision has as yet been reached. The benefits to be derived from it may not be fully appreciated, while the inconvenience of changing has been emphatically stressed.

It has been pointed out that under the present procedure whenever there is a general revision of rates, almost the equivalent of a complete change in the Experience Rating Plan is effected; new modifications are calculated on the basis of the revised rates and rating values. The rating values usually change to a very marked extent; new average values, new modification factors for actual losses and for expected losses and for credibility values are issued. The reluctance to change plans is therefore not an insurmountable obstacle. Consciously or unconsciously, distrust of the new plan and unfamiliarity with its procedure seem to have an undue effect in producing a hesitation either to adopt or reject the plan in its entirety.

A summary view of the essential points of difference between the present plan and the proposed plan is presented in the following table:

TABLE A

COMPARISON OF PROVISIONS OF PRESENT AND PROPOSED
EXPERIENCE RATING PLANS

PRESENT PLAN

MULTI-SPLIT PLAN

ELIGIBILITY REQUIREMENTS

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| <p>(1) An average annual premium of at least \$500 for the last two years of the experience period.</p> | <p>(1) The states are divided into three groups for qualification purposes. For the first group an average annual premium of at least \$300 for the last two years of the experience period is required. For the second group the corresponding requirement is \$400, and for the third group \$500.</p> |
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EXPERIENCE PERIOD

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|---|--|
| <p>(1) Five years with weights of .40, .60, .80, 1.00 and 1.00.</p> | <p>(1) Three years with uniform weights of 1.00, in other words, an unweighted plan.</p> |
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PRESENT PLAN

MULTI-SPLIT PLAN

TREATMENT OF ACTUAL LOSSES

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|---|---|
| (1) Death and permanent total cases used at average value. | (1) Death and permanent total cases used at average value. |
| (2) Other cases limited to death and permanent total average value. | (2) Other cases limited to death and permanent total average value. |
| (3) Indemnity and medical treated separately. | (3) Indemnity and medical combined and treated as a unit. |
| (4) Indemnity losses split into normal and excess at the point 50 times the maximum weekly compensation provided by the Act. Medical split into normal and excess at the \$100 point. | (4) Total losses (indemnity and medical combined) on each claim are discounted by dividing each claim into a series of \$300 units (or \$400 or \$500 units, depending upon the particular group to which the state is assigned) and discounting the successive units in geometrical progression. In practice, the primary value (i.e., the discounted value corresponding to the actual value) will be shown in Table I of the Plan. |
| (5) Actual losses converted to present law and medical cost level by "loss modification factors." | (5) Loss modification factors not applied to actual losses. Effect of amendments taken care of in calculation of expected losses. |

DETERMINATION OF EXPECTED LOSSES

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| (1) Risk payrolls are reverted back to the level of previous policy years by average "payroll factors" and the corresponding expected losses are determined by applying the current manual rates and then unloading for expenses. No recognition of differences by industry group is made. | (1) Current manual rates, unloaded for expenses, are reverted back to the level of previous policy years and the corresponding expected losses are determined by application of the resulting "expected loss rates" (which will be shown in Table II of the Plan). The reversion of the current manual rates recognizes differences by industry groups. |
| (2) Expected losses are split into normal and excess by application of classification excess ratios. | (2) Expected losses are discounted (corresponding to the discount of actual losses) by application of classification discount ratios. |

PRESENT PLAN

DETERMINATION OF RISK CREDIBILITY AND MODIFICATION

- (1) Credibility determined separately for normal and excess portions by the formula

$$Z = \frac{P}{P + K}$$

where K is a constant so determined that the maximum charge resulting from a single claim shall not exceed 20% on an average split premium basis and the maximum charge from a single claim which does not exceed the normal value shall not exceed 15%, both on \$1000 unweighted subject premium.

$$(2) \text{ Mod.} = \frac{A_n Z_n + A_e Z_e + E_n (1 - Z_n) + E_e (1 - Z_e)}{E_n + E_e}$$

Values of Z_n and Z_e are shown in Table E.

- (3) Self rating on the normal side at \$100,000 total subject premium and on the excess side at \$200,000 total subject premium.

MULTI-SPLIT PLAN

- (1) A stabilizing element, or bal- last factor, is added to both the primary actual and expected losses. This value is so calculated that the maximum charge resulting from a single claim shall not exceed 25% for a risk producing a subject premium equal to three times the average annual premium required for eligibility.

$$(2) \text{ Mod.} = \frac{A_p + B + W \cdot A_e}{E_p + B + W \cdot E_e}$$

Values of W and B will be shown in Table III of the Plan. For risks with expected losses less than twice the average D. & P. T. value, $W = 0$ and B is a constant. Therefore, for the great majority of risks

$$\text{Mod.} = \frac{A_p + B}{E_p + B}$$

- (3) Self rating when undiscounted expected losses equal twenty times the state average D. & P. T. values.

GENERAL CONSIDERATIONS

Before considering some of the criticisms of the present plan, and the need for remedying certain weaknesses, it is perhaps wise to review some of the objectives of a well constructed plan and the problems that arise in connection with its application. On the basis of such a review we can more easily see the difficulties and the short-comings of any merit-rating plan as well as gauge the extent to which success has been obtained or has expectation of attainment with a new plan.

In the first place a merit rating plan applies to a great many risks operating under diverse conditions and involving activities

ranging from those in which the hazards of injury are of negligible importance to those in which the hazard is almost uninsurable. Each state has its own compensation law, its own scale of benefits, its own interpretations, and its own rates. The sizes of the risks vary from those with only a few employees to those with thousands of employees. The medical claims range from the mere removal of a cinder from an eye to treatment of an injury requiring permanent attendance of nurse and costing thousands of dollars. The indemnity claims may amount to a few dollars in one case and in another a life pension of \$25 a week. Consequently, it can be seen that there are many difficulties inherent in the problem of devising a plan to fit so many conditions.

When we consider what the plan is intended to do, we run into additional complications. For the risk with little exposure about all that can be expected is to have the rate reflect favorable experience to a slight degree and to impress the fact upon the assured that the occurrence of losses causes a charge, but not a heavy one. For the large risk it is important to have the plan measure the hazards as closely as possible and give prompt and immediate encouragement to all efforts to reduce accidents, either by reduced rates for favorable experience or added charges for bad experience. Thus the plan must provide for small charges and credits for some risks and large ones for others. If the plan is too responsive to the risk's own experience, its insurance features play a decreasing role. If the plan has little responsiveness its merit rating and beneficial effects may be lessened. If for the sake of stability a long period of time is used in the experience period, then the effect of recent experience must have a secondary role. If a short period of time is used, violent fluctuations from year to year may occur. Constantly the proper course must be selected between Scylla and Charybdis.

The present plan to a certain extent accomplishes all of these functions. The importance of the size of the risk is recognized by having increasing credibility assigned on the basis of size of risk. Self rating is recognized at \$100,000 normal and \$200,000 excess premium subject. Eligibility for rating is established at \$500 annual premium. The effect of the size of an individual loss is recognized by splitting losses into normal and excess, a separate normal for indemnity and another one for medical. The effect of

certain infrequent losses is minimized by the use of average values for death and permanent total disability cases. Stability is reached by using the long experience period of five years. Responsiveness is obtained by giving increased weight to the later years. Where then can criticism of the plan be found, and how can the plan be improved? That in essence was the problem facing the men who made the study.

PRESENT PLAN — DEFICIENCIES

Responsiveness

The present plan is generally recognized as not being sufficiently responsive. In 1928 an attempt was made to make it more responsive, by introducing the principle of weighting. This helped the situation somewhat, and in view of the unfavorable experience that developed in the years from 1929 through 1934, there was relatively little pressure from the insuring employers toward making it more responsive. Of course, had the plan been more responsive, the underwriting situation might perhaps have been more favorable. There was little agitation for any change until the favorable experience of more recent years began to appear. To ameliorate the situation a rather drastic change in the rating procedure was advocated and adopted, but only after a bitter partisan conflict between stock and non-stock carriers. I refer to the plan known as the retrospective rating plan,⁽²⁾ advocated by the stock companies. This plan, which is optional with both carrier and assured, applies only to few risks, generally those with at least \$5,000 annual premium, but the group for which there is keen competition. These risks are the larger ones and if they desire can often escape what they consider unfair rating practices by self-insuring.

An increase in responsiveness seems desirable. This must be obtained without introducing elements which may cause severe

NOTE: The retrospective rating plan is an extremely responsive instrument. A full description of it is contained in Mr. Pinney's article "The Retrospective Rating Plan for Workmen's Compensation Risks," Volume XXIV.

variation in rates from year to year. Furthermore, for smaller risks there is need to limit the effect and to achieve if possible some stability. The difficulties presented by the problem undoubtedly led to limiting the application of the retrospective plan to the larger risks. If some modification can be made which will achieve the desired results in the experience rating plan as a whole, then certainly such a change should be adopted.

Another objection that has been raised, and which is to a certain extent tied up with the question of responsiveness, has to do with the length of the experience period. With the five year experience period in the present plan a loss is used in the rating five successive times. Conditions causing unfavorable experience are discovered and often remedied long before the experience ceases to affect the rating. The assured and the carrier are faced with a condition, in which both know that the risk is now greatly improved and yet rates higher than warranted are being paid and may continue to be paid for a number of years. The situation is, of course, equally likely to be reversed, and the earlier years may be the favorable ones. Complaints against the operation of the plan are not as likely to occur in such instances.

Eligibility

An objection to the eligibility standards of the present plan has also been raised. On the basis of higher wages and higher rates an employer with only a few employees may be eligible for experience rating in New York. An employer with the same number of employees may be ineligible in Alabama. It is true that in the smaller premium-size groups experience rating has relatively slight effect; nevertheless the feeling on the part of the public and supervisory authorities is that more risks should be eligible for rating. In this connection it is well to remember that at one time the eligibility requirements were much lower, but were raised, partly in order to reduce the expense of administering the plan, and partly to recognize the effect of higher rate levels. The objection is also pertinent for larger risks where an employer in one state is entitled to self rating while in another state an employer with the same number of employees is not. It is diffi-

cult to defend the eligibility basis used in the present plan and in a number of jurisdictions the authorities have ordered that eligibility requirements be lowered so as to extend the benefits of the plan to a greater number of risks.

Lack of Flexibility

Another criticism of the present plan is the basis on which the values for rating have been established. For example, a normal indemnity loss is defined as 50 times the maximum weekly compensation. This definition allows a normal loss of \$1,250 in a state such as New York and also in a state such as South Carolina. A much larger percentage of losses amount to less than \$1,250 in South Carolina than in New York. Obviously, there is little defense for such a segregation of losses into normal and excess. The same holds true for the use of a medical normal limit of \$100. Certainly the same medical services cannot be obtained for \$100 in all states. In defense of the procedure one can say that values were selected on the basis of practicability.

When the plan was originally adopted, the statistical methods of reporting data were not as detailed as they now are, and the rating elements in the plan had to be selected with these limitations in mind. On the basis of what we now know, it is possible to adjust many values in the interest of theoretical and practical considerations. Unfortunately the rules in many instances are inflexible and do not permit of automatic changes, now known to be desirable on the basis of statistics as well as underwriting judgment. The plan is so constructed that such changes may not be made without actually amending important features.

Simplicity

Almost everyone recognizes that a more simple plan could be evolved. A tabular plan was suggested a few years ago. The present plan is certainly not designed to fit the smaller risks. It requires segregation of actual losses into normal and excess, both

for indemnity and medical, segregation of expected losses into normal and excess, assignment of credibility to actual normal and excess, to expected normal and excess and the combination of all these elements in order to arrive at a final modification. For the majority of risks much of the procedure is merely a useless gesture, theoretically correct but of little practical value. All this detail is of practical value only for the larger risks. Even then it was the fact that the plan did not fit the larger risks as well as might be expected which caused the introduction of the retrospective rating plan and which led the Rates Committee to inaugurate the study now under discussion.

Basis of Reserves

One other point that may be considered is the matter of incurred cost estimates. Often only a small percentage of the total cost of a case has actually been paid at the time the rating is performed. The incurred cost may be a matter of judgment, and controversies continuously arise on case estimates. There is a crying need for rectification of this situation, both to give relief from the reserves established on a judgment basis by the carrier, and to give the carrier relief from complaints on the subject and consequently the tendency to avoid the issue by underestimating reserves. An indeterminate reserve table has often been advocated as a remedy. However, in the absence of such a table, and even with such a table, a procedure should be devised which should eliminate such estimates as a source of argument.

Advisability of Change

The above points are not merely raised for the sake of polemics. They seriously affect the rating procedure and workmen's compensation insurance. The development of the retrospective rating plan was the best evidence of the need to supplement the individual risk rating procedure. Several states in order to allow more risks to be rated have cut in half the minimum premium required for eligibility. Two states have adopted a modification in the use of average values for death and permanent total disability cases. One state has operated satisfactorily under a

weighted four-year plan for many years and would certainly not increase the period to five years. In another state special consideration was given to the desirability of a three-year period and the use of the current policy in rating. Those upon whom the duty of defending the existing procedure devolved have had a tremendous advantage in that attacks are sporadic and not integrated, and also in the fact that those criticizing the plan could suggest no remedial measures.

For many years technical knowledge concerning the operations of experience rating has been held almost solely by the companies. An insuring employer has had little basis for comparing the results and methods now in use with any other methods, unless he has been willing to make a study of the subject in insurance literature. This may soon be changed. The social security program, and in particular the unemployment compensation acts are now part of our industrial structure. Many of these laws include merit rating procedures and plans. I do not believe that any actuary, or at least any casualty actuary, could have been consulted in the formulation of the majority of these plans, for they are clumsy and amateurish efforts, full of loopholes; but they are extremely simple and this very simplicity may make them popular. (None of these plans has yet been tested extensively. When their faults become apparent to employers and those in charge of their administration, they may be amended.)

If the merit rating procedure in the unemployment compensation acts proves acceptable, as it undoubtedly will to most employers, we may well expect unfavorable comparisons and adverse criticism of the cumbersome and complicated procedure now followed in experience rating workmen's compensation risks. It might be wise to anticipate this eventuality, and forestall outside interference, lest such plans as are in effect for the unemployment compensation acts be suggested for workmen's compensation insurance.

The proposed multi-split plan although not going as far toward correcting some of the deficiencies, nevertheless goes a long way toward improving the experience rating procedure. It must be remembered that the plan was constructed by a group of men and that many of the provisions represent a compromise of their views. Some may argue that the present plan could be amended to reach

the same objectives. Those familiar with the plan would hesitate to subscribe to these views. The present plan has done about all that could be expected of it. I do not believe that we could change a part here and there and obtain satisfactory results. The present plan can be amended only in unimportant respects. The various elements are too closely interrelated to allow for much experimentation. If the eligibility requirements are reduced, the amount of work and expense involved in rating small risks under the present procedure is not commensurate with the results produced. If the experience period is reduced and the weights removed, credibility must be increased and even then the results may not prove acceptable. Any change, though trivial, may cause much greater changes elsewhere in the structure of the plan. An attempt to recognize group rate levels under the present plan, though possible, would cause an increase in the work and time required for rating risks.

The proposed plan, in addition to attaining many of the objectives now desired, has the added advantage of being a flexible instrument, much more so than is the present. The plan is constructed so that important features may be modified, without causing great changes elsewhere. The proposed plan is simpler to start with and may be simplified even further. The rating values are calculated much more accurately, industry group rate levels are recognized, and, if desired, group off-balance factors may be injected. A novel and vastly improved technique for treating losses has been devised. These improvements, important as they are, only foreshadow the inherent possibilities of further improvement.

Extensive tests have been made of the proposed plan and the results found to be satisfactory. Risks were rated in Georgia, Massachusetts and New York and the results of the ratings compared with those produced under the present plan. The average effect is not much different from that produced by the present plan. These tests also indicate that in those cases where a marked difference in results is produced as respects individual risks, the results produced by the multi-split plan are more equitable when the individual risk experience was more closely analyzed in order to determine the reasons for the difference. In other words, if the new plan gave higher or lower rates, the character of the losses or

the recent experience easily justified the change. The following table presents the summary of the tests:

TABLE B
COMPARISON OF RESULTS PRODUCED BY MULTI-SPLIT PLAN AND
PRESENT EXPERIENCE RATING PLAN

State	No. of Risks	Expected Losses Multi-Split Plan Three Year Subject Period	Average Modification		Ratio Multi- Split to Present
			Present Plan	Multi- Split Plan	
Georgia	436 ⁽¹⁾	998541	.980	.962	.981
Mass.	1571 ⁽²⁾	4682333	.930	.927	.997
New York . . .	1541 ⁽³⁾	4874073	.964	.975	1.011
N. Y. Special.	133 ⁽⁴⁾	4287996	.903	.918	1.017

Note (1) Ratings becoming effective between April 1, 1937 and March 31, 1938

(2) Ratings becoming effective in January 1938 and July 1938

(3) Ratings becoming effective in July 1937

(4) Special study on large risks only (Expected losses over \$13,500)

A detailed analysis of these tests, showing the results for individual states, is included in Appendix I.

ADVANTAGES OF THE PROPOSED PLAN TO THE UNDERWRITERS

Since the plan was proposed by an Actuarial Committee it is safe to say that it must appeal to the actuary. The underwriter may face somewhat different problems. The plan is, for the reasons about to be given, a much better plan from the underwriting viewpoint.

For the underwriter the proposed plan offers manifold advantages. Once the novelty of the plan has worn off and the terms and processes become familiar, so that the underwriter is certain of his ground, there can be no doubt but that he will like it.

The plan is advantageous in that it gives a better measure of the rate for the risk than does the present plan. The latest three years of the experience period are used and the earlier years are discarded. Under the present plan, a rating effective January 1, 1940, includes the following experience:

Policy Year 1938	Policy Issued Effective Jan. 1, 1938
1937	Jan. 1, 1937
1936	Jan. 1, 1936
1935	Jan. 1, 1935
1934	Jan. 1, 1934

Policy year 1934 first entered the rating effective January 1, 1936. Surely, if the risk was a poor one at that time, safety engineering and inspection work have not required five years to remedy conditions in the plant. Under the present plan the experience of policy year 1934 still affects the rating. With the proposed three year plan, only the more recent experience will affect the rating. A loss will be used in three successive ratings, as compared with five in the present plan.

Secondly, much greater emphasis is given to the frequency of accidents than is possible under the present five year plan. At present up to the normal maximum it matters little as to what type of loss enters the rating. Thus in New York, any case up to \$1,250 has as much effect as 25 cases at \$50 each. Obviously, a risk producing 25 accidents is a much less desirable one, other things being equal, than one producing only a single accident during the period even though the net cost is the same. The underwriter in deciding on the acceptability of the risk may, therefore, not rely entirely on the modification, but has to break down the experience into its component parts. The number and character of the losses has to be reviewed to see whether the losses are composed of a few fortuitous cases or of many minor ones. Furthermore, on many of the smaller risks the excess losses, which in reality have very little meaning, play a significant role in determining the final modification.

The proposed multi-split plan eliminates much of this. The earlier years are eliminated from the rating. For the later years, the emphasis will be on frequency rather than severity. Thus the \$1,250 case will have a primary rating value of \$950 while the 25 cases at \$50 will have a rating value of \$1,250 and will increase the modification appreciably.

The rating will be performed much more quickly and simply. Three years of experience are used in place of five. All of the steps are performed on one face of the rating form, are easily carried out and are almost self-explanatory. The loss modification, expected loss, and payroll factors have been eliminated. Such factors are often a cause of suspicion and distrust to the assured, and are difficult to explain. The values on the proposed plan have been selected so that in less than one out of ten cases will reference be made to the table of primary rating values. The primary

rating value is invariably less than the actual so that even when it is used, there can be no difficulty in justifying the procedure to the assured. Reserves for case estimates may be properly established with less fear of controversy over the amount. For the majority of risks only the "B" value is added to the losses and as this is also added to the expected, an obvious balance is maintained, easily perceived by the assured. All claims are treated as a whole and not subdivided as under the present plan so that explanations as to why medical is treated differently are avoided.

A NON-TECHNICAL EXPLANATION OF THE MULTI-SPLIT PLAN

In explaining the plan I shall borrow freely from a memorandum previously prepared for distribution to underwriters, fieldmen and executives, and designed as a non-technical presentation of the subject. A technical interpretation will be made later. A summary of the principal features is contained in Table A.

The allowable departure, which determines the credit for good experience or the charge for poor experience will be based on a comparison of the individual employer's experience with that indicated by the manual rates. The basic insurance rate will be increased or decreased in accordance with the influence exerted by the insurance record of the employer for the 36 month period preceding the current policy. This means that the rate for the insurance policy about to be obtained will depend upon the record for the latest available three years. The current policy year is not included as it has not been completed and the experience is, therefore, not yet available. Of course, this last year will automatically be included in a subsequent rating. The actual data to be used will be the amount of payroll allocated to the proper classifications of industry under which the employer operated, as disclosed from the results of inspection and payroll audits, and the itemized record of accidents, and their cost, as maintained in the claim files of the insurance carriers. These data will be compiled and reported to the rating organization and from these basic data the appropriate adjustment in rates will be determined. Those familiar with the administration of workmen's compensation insurance know that in rate-regulated states it does not matter whether the

employer has been insured by one or several carriers during this period, as each carrier reports the data for the period and operations for which it extended insurance to the administrative bureau in charge. An employer subject to merit rating can therefore neither escape the penalty for poor experience nor be deprived of the credit for good experience by reason of a change in insurance carriers.

Although the past record of the employer is of considerable importance in determining future insurance rates, sound insurance principles require that the amount of influence exerted by the record must be determined by the relative size of the risk. Thus there are many employers who, during any given year or period of years, do not have a single accident. These are generally employers whose operations are not very extensive in scope, when measured by the number of employees engaged by them. It would be truly phenomenal to have such a situation occur for a large employer with many activities and thousands of employees. Accordingly, the record of the employer will be allowed to play a progressively increasing role as the size of his operations increases and as the law of large numbers permits more and more advantage to be taken of the averages and more reliability to be assigned to the indications. Any employer whose operations are large enough to develop over the period a premium at current manual rates sufficient to pay for the cost of twenty death and permanent total disability cases, at the average cost of such cases, will be allowed to have his rate based entirely on his insurance record. This process is usually called self-rating and the point at which, on the basis of premium size, this procedure takes effect, is called the point of self-rating.

At the self-rating point the employer's operations are considered large enough to have his rate determined entirely on the basis of his own insurance record. Below this point the plan will allow the employer to have the advantage of the stabilizing effect of averaging his record with that of the other employers and so will provide a cushion to lessen the effect of an adverse accident or series of accidents. This cushioning effect will increase as the need for it increases, so that on the smallest employer subject to merit rating, i.e., one developing the minimum annual premium qualifying him for merit rating, in most cases \$300, the effect of a

serious case will be slight. In general the maximum effect of the costliest accident that might occur is limited to a 25% effect, equivalent to the increase of a \$300 premium by \$75. On the other hand, the case will be included at its full effect in the rating of employers who are subject to self-rating. Between these limits the effect of any single case will vary according to the size of the employer's operations, as determined by the premium involved.

The most important factor affecting the final rate will be the occurrence of accidents. The severity of the injury as determined from the cost of compensation and medical treatment will play a secondary role. The claim costs of the accidents will be included exactly as shown in the claim record, except that on any claim on which the total incurred cost was over \$300 the full amount will not be used in the rating, but a lesser amount will be used, called a primary loss. This discount will increase as the cost of any case increases so that the maximum cost case will never exceed \$900 on a discounted basis. This is three times the initial value of \$300. The initial value or point at which the discounting of losses begins was picked so that 90% of all compensable cases, that is cases on which some amount in addition to medical treatment has been paid, will be less than \$300 and so will be used exactly as reported. If, for any state, the distribution of cases is such that less than 90% of the cases are under \$300, then the initial value is raised to \$400 or \$500, as needed, and the maximum discounted value of \$900 is correspondingly increased to \$1,200 or \$1,500. The discounted values will be obtained from tables, prepared in advance, but, as was previously explained, reference to the tables will be made only if the case exceeds the initial value of \$300. This will occur in only one claim out of ten, so that the primary table will not be used to any great extent. Death and permanent total disability cases will be used at state-wide average value; other cases will be used at actual cost, but limited to the average value of death and permanent total disability cases.

This discounting of individual cases is one of the new and important features of the plan and gives rise to the term "Multi-Split Plan." The severity of the accident as measured by the claim cost is also important but the plan is designed to emphasize the relative frequency of accidents rather than their cost. The discounting process achieves this by including the low cost cases

at their actual value and the higher cost cases at only part of their full claim cost. As the cost of the cases increases, the amount of discount increases, and proportionately less of the actual claim cost is included in the rating at the primary value. Thus a case with an incurred cost of \$1,000 will be included at a primary value of \$670, while one of \$2,000 will be included at \$840.

From both the insurer's and the employer's viewpoint it is highly desirable to limit the importance of the monetary cost of a case. In general, it is the number of accidents occurring that determines the characteristic conditions in a plant. Occasionally a fortuitous high-cost case occurs, which may cost more than a score of minor accidents. Nevertheless one case should not be allowed to affect unduly the insurance rate of the employer. It is the purpose of the discounting procedure to minimize the effect of the relatively infrequent but costly claims.

In order to simplify the actual process of rating and the task of recording the data, the indemnity and medical payments are to be combined. As no adjustments on claim costs are to be made, other than that of using primary values when needed, this procedure is feasible.

In order to determine whether the employer's record is better or worse than average, it is necessary to determine an average. Obviously since there are thousands of employers, each with many different operations, it is extremely difficult to find risks comparable in conditions with those of a particular employer and which could be taken as "average." Recourse is therefore had to a simple procedure for establishing an average with which may be compared the record of an individual employer. The data with respect to payrolls and classifications of operations, applying to the risk under consideration, are used, and the total charge for insurance for the period is determined, on the basis of the rates established to be the required average over the period. These rates are known as they are compiled from statistical data reported for the purpose of establishing average manual rates. With these average rates as a base, the total amount required for insurance on the basis of average conditions, for the particular employer under consideration, is easily ascertained.

The procedure outlined in the preceding paragraphs establishes

the total charge for insurance on the basis of the individual employer's operations and average charges. A number of adjustments must be made in order to determine what would be the average amount and distribution of losses. This is known as obtaining "expected losses." In the premium charge are included provisions for expenses as well as payments for compensation and medical services. The provision for expenses should be eliminated since it is desired to compare only claim costs. As the features within the employer's control are the factors causing accidents, and as the cost is to some extent dependent on factors definitely not within his control, as for example, benefit provisions of the compensation acts, adjustments must be made for law amendments and similar features. Furthermore, since in many cases a considerable amount of the cost of the claims is not used in the rating, because of the discounting feature and the use of only the primary portion of the loss, the amount available for claims on the basis of average rates must be similarly discounted and primary expected losses obtained. This is done by means of average discounts determined for the state as a whole for the particular classification of industry. With these adjustments the remaining average charge is truly comparable with the claim cost of the employer as disclosed by the records.

A direct comparison of the actual claim cost with the indications for average conditions may show a tremendous variation and give cause to violent fluctuations in rates. This condition has already been pointed out to some extent under the discussion of partial and complete self-rating and in the explanation of the limitation that not more than a 25% increase in rate or a charge of \$75 may be caused by the inclusion of the most costly case for an employer who just qualifies for rating under the plan. To accomplish this limitation and to cushion the effect of fluctuations, stabilizing elements (designated as B values) are added in such a way as to limit the charge to 25% and at the same time, as the magnitude of the employers' operations increases, allow his record a gradually increasing part in establishing the rate. These stabilizing elements may be considered as a mere artificial enlargement of the scope of an employer's operations. In order to obtain stability in the results, the stabilizing element is added alike to the sum representing the average conditions and to the sum of the

actual claim cost determined and designated as primary losses. The resulting comparison of the actual claim cost, inclusive of the stabilizing element, with the average claim cost, also inclusive of the stabilizing element, represents the amount of departure allowed to the employer.

Although the above procedure applies to the vast majority of employers, the stabilizing effect of the "B" value is not needed for those employers whose premium is sufficient to qualify them for self-rating. Neither is it as necessary to discount the claims for such employers, using only the primary values, since the occurrence of a high cost case does not have so marked an effect upon the rates of such large employers as it does on the rates of smaller ones. Consequently it is possible to eliminate from the rating procedure the discounting process and the addition of the stabilizing element. In order, however, that all employers shall be treated in a manner reasonably uniform, and to avoid sharp transitional points, it is desirable to eliminate these elements, not abruptly, but by degrees. If this is not done, an abrupt change of treatment may occur, and an employer who just qualifies for self-rating will receive treatment materially different from one who fails of qualification by a single dollar. A process is, therefore, introduced into the plan which gradually cuts down the amount of the stabilizing element, and gradually brings in the portion of the claim cost called "excess" loss, previously not used, by reason of the discounting procedure and use of only primary loss values. This modification, as has been pointed out, is entirely sound because as the employer's operations progressively increase in magnitude, his record begins to develop a certain stability of its own, and even the higher-cost cases begin to have a characteristic representative of the employer's operations. At the point where the premium size is 1/10 of that required for self-rating, or just sufficient to pay for the cost of two average death and permanent total disability cases, some of the losses previously not used enter the rating, and, at the point where complete self-rating becomes effective, all of these losses are used. The procedure will be to obtain the stabilizing element (the B value) from a table which will contain the appropriate values for the particular size indicated by the employer's records. These stabilizing elements will ultimately reduce in amount until at the point of complete self-

rating they will drop out of the picture. At the same time that the stabilizing element is obtained from the tables, another factor will be obtained called a "W" value which will allow a percentage of the claim cost, previously unused because of the discounting procedure, to be included in the rating. This percentage or "W" value will increase by 1% intervals until at the point of complete self-rating all of the previously unused claim cost will be included in the rating and the "W" value will be 100% while the "B" value will be zero.

TECHNICAL ASPECTS OF THE PLAN

It is my intention now to present some of the formulæ and mathematical concepts underlying the plan as well as outline the procedure followed in the calculation of the various rating values.

The principal feature of the multi-split plan is the method of treating losses on the so-called multi-split principle. The theory is simple; each loss is divided into a series of intervals and each interval is discounted by the application of factors, obtained from the terms of a geometric progression. Instead of discounting each individual loss a table of rating values is prepared in advance so that by referring to the table the discounted or primary value may be obtained for any given loss. The total incurred cost of a case is used, medical being combined with indemnity. The construction of the table of primary rating values is as follows:

Let s = primary rating value.

a = initial value, also interval used in splitting losses.

r = discount ratio.

L = actual loss.

1. Then $s = a + ar + ar^2 + ar^3 + \dots + ar^{n-1}$.
2. Expressed as the sum of a geometric progression to n terms,

$$s = \frac{a - ar^n}{1 - r} \text{ or } \frac{a(1 - r^n)}{1 - r}.$$

3. Let S = sum when n approaches infinity.

$$S = \frac{a}{1 - r}.$$

4. Substituting in (2) $s = S(1 - r^n)$.

5. Whence $r^n = 1 - \frac{s}{S}$

6. Taking the logarithm, $n \log r = \log\left(1 - \frac{s}{S}\right)$

but $n =$ number of intervals or $\frac{L}{a}$.

7. Therefore $L = \frac{a \log\left(1 - \frac{s}{S}\right)}{\log r}$.

It may be seen from the above formula that, for each primary rating value there is some actual undiscounted loss value. The table is constructed so that the primary values are at even intervals of \$10. The actual loss values are calculated to correspond to the given primary value. By examining the calculation attached (Exhibit II) for the Primary Table based on an initial value of \$300 and a discount ratio of .667 we see that for a primary rating value (Col. 2) of \$405, the undiscounted value is \$443 and for a primary rating value of \$415 the undiscounted value is \$458. Therefore for a tabular rating value (Col. 1) of \$410, (the midpoint between \$405 and \$415) the actual undiscounted loss must be a minimum of \$443 to correspond with the lower point of the interval for which \$410 is the midpoint and \$457 to correspond to the upper point of the interval for which \$410 is the midpoint. The table is built up on this basis.

The use of midpoints causes an obvious practical difficulty in the first few values of the table. For instance it is possible to have the primary rating value greater than the actual undiscounted loss. Thus for a primary rating value of \$315 the actual corresponding undiscounted value is \$319. For a primary rating value of \$325 the actual undiscounted value is \$332. If we now establish a primary rating value of \$320 as the midpoint all actual losses lying between \$319 and \$332 take \$320 as the primary rating value. If the loss is just \$319 the primary rating value is \$320, slightly greater than the actual. To adjust this condition the following values were adopted:

\$300 Table		\$400 Table		\$500 Table	
Actual Loss	Rating Value	Actual Loss	Rating Value	Actual Loss	Rating Value
Up to \$300	Actual	Up to \$400	Actual	Up to \$500	Actual
301 - 305	300	401 - 405	400	501 - 505	500
306 - 310	305	406 - 410	405	506 - 510	505
311 - 315	310	411 - 415	410	511 - 515	510
316 - 320	315	416 - 420	415	516 - 520	515
321 - 331	320	421 - 431	420	521 - 531	520
332 - 344	330	432 - 443	430	532 - 544	530
345 - 357	340	444 - 457	440	545 - 556	540
Etc. as per original table.		Etc. as per original table.		Etc. as per original table.	

Attached as Exhibits I and II are tables of Primary Rating values and the calculations underlying them. The values actually adopted were as follows:

Exhibit I	Initial Value — <i>I</i>	Discount Ratio — <i>r</i>
Table IA	300	.667
Table IB	400	.667
Table IC	500	.667

(1) *The Credibility Values "B" and "W"*

The rating formula adopted was of the form

$$\text{Modification} = \frac{A_p + B + W A_e}{E_p + B + W E_e}$$

where A_p and E_p represent the primary actual and primary expected losses respectively and A_e and E_e represent the excess actual and excess expected losses. B and W are credibility values, obtained from an auxiliary table. For risks with subject premium equal to or exceeding 10% of the premium required for self-rating the above formula holds. By arbitrarily setting $W = 0$ below this point the formula for risks with a lesser subject premium simplifies to

$$\text{Modification} = \frac{A_p + B}{E_p + B}$$

(1) NOTE: The reader is referred to Mr. Perryman's paper "Experience Rating Plan Credibilities," *Proceedings*, Volume XXIV for a detailed discussion of the subject.

the last term of the numerator and denominator dropping out so that excess losses need not be considered.

The W value follows a straight line at 1% intervals and is 100% at the self-rating point. At 10% of the self-rating point the value of W is zero. Furthermore, the " B " value is constant below this point and is calculated so that an accident may not produce more than a 25% effect on a minimum size risk or a risk which over the experience period of three years develops a subject premium equal to three times the initial value. The mathematical formulæ involved are as follows:

Let A_e = Total actual loss minus discounted actual loss.

E_e = Total expected loss minus discounted expected loss.

E = Total expected loss.

M = Maximum discounted loss.

I = Initial value.

L = Expected loss ratio.

D = State average discount value.

S = Self-rating point 20 times average death and permanent total value, rounded to the nearest \$5,000.

Q = Point where W value is greater than zero (in this case $Q = .10 S$.)

$$B = K_e (1 - W). \quad (1)$$

$$W = \frac{E - Q}{S - Q} \quad (2)$$

$$K_e = K + (gS - K)W. \quad (3)$$

g = The maximum value of $\frac{E_e}{E}$. Tests indicate a value

of $g = .4$ would probably be satisfactory for all states.

$$K = 4M - 3ILD \quad (4)$$

M has been used as the sum of the progression when n in the formula $S = a \frac{(1 - r^n)}{1 - r}$ approaches infinity. Since all cases are to be used at the maximum on the basis of the average cost of a Death and Permanent Total Disability Case, a somewhat lower value may be used.

The actual construction of the tables is very simple, if auxiliary values are used. The procedure is as follows:

When $E = S$ $W = 100\%$ and $B = 0$.

When $E = Q$ $W = 0\%$ and $B = K$, a constant.

Therefore for each .01 increase in W , $\Delta E = \frac{S - Q}{99}$

Similarly $K_e = K + (gS - K)W$.

and $\Delta K_e = (gS - K) .01$, $g = .4$

and at $E = Q$ $K_e = K = 4M - 3ILLD$.

From here K_e is built up by successive addition of ΔK_e

E is built up by successive addition of ΔE

W is constant at .01 intervals and

B is obtained by multiplying K_e by $(1 - W)$.

Exhibit III shows the values for Missouri. These were obtained using the above procedure and the following basic values:

Average D and P. T. Value \$3975. $S = 80000$ $Q = 8000$

$I = 400$ $M = 1200$ $L = .60$ "D" = .710

$K = 4300$ $\Delta E = 727.273$ $\Delta K_e = 277$

It is also noted that the average risk credibility (Z) is the same as the credit for clear experience:

Below the Q point Average $Z = 1 - \frac{K}{E_d + K} = \frac{E_d}{E_d + K}$

Above the Q point Average $Z = 1 - \frac{B}{E_d + B + WE_e} =$

$$\frac{E_d + WE_e}{E_d + WE_e + B}$$

Inasmuch as the W and B values vary for each state only one set will be reproduced along with the procedure followed in its calculation. This is shown in Exhibit III.

Expected Primary Losses

The calculation of expected primary losses is based on a separation of the total expected losses into primary and excess by means of a "D" ratio applicable to each classification.

The "D" ratios are obtained in somewhat the same manner as are the primary actual losses. The process involves discounting the individual losses for the state and obtaining average "D" ratios or ratios of discounted to undiscounted losses for serious, non-serious and medical. These individual ratios are then applied to the serious, non-serious and medical pure premiums to obtain the classification "D" ratio.

The calculation of "D" ratios requires a great deal of work on

the part of the rate-making organizations, particularly in view of the fact that statistics are maintained separately for indemnity and medical and the total incurred cost for both combined is nowhere available, either on the detailed original forms or on the punch cards. The ideal situation would be to have the statistical and rate-making procedure conform to the requirements of a multi-split plan.

In order to obtain discounted losses it will be necessary to modify the statistical procedure so that losses will be reported as total incurred, medical and indemnity combined, or to provide mechanical means for cross-footing the data already punched on the cards. It is my belief that the latter method will be inaugurated if the plan is adopted. Subsequently, when the value of having the total incurred cost of each claim for rating purposes becomes apparent to the carriers, the loss reporting cards will probably be changed to provide that total incurred claim costs be reported.

In the meanwhile the present procedure is as follows:

$$\text{"D" ratio for serious losses} = \frac{(\text{Serious Indemnity} + \text{Medical}) \text{ Discounted}}{\text{Serious Indemnity}}$$

$$\text{"D" ratio for non-serious losses} = \frac{(\text{Non-Serious Indemnity} + \text{Medical}) \text{ Discounted}}{\text{Non-Serious Indemnity}}$$

$$\text{"D" ratio for medical losses} = \frac{(\text{Non-Compensable Medical}) \text{ Discounted}}{\text{Total Medical}}$$

For risks written on an ex-medical basis the procedure is modified as follows:

$$D_{ser} = \frac{\text{Serious Indemnity Discounted}}{\text{Serious Indemnity}}$$

$$D_{n-ser} = \frac{\text{Non-Serious Indemnity Discounted}}{\text{Non-Serious Indemnity}}$$

$$D_{med} = .20.$$

An example of the methods used in obtaining state discounted losses for use in the above formulae are shown in Exhibit IV.

Method A outlines a detailed procedure, wherein losses are tabulated in size of loss groups, the average loss in each group determined and the discounted losses obtained by applying the corresponding primary rating value. Method B is an abridged method. The intervals used for grouping losses are larger and the discounted losses are obtained by applying the primary rating values for the midpoint of the group interval. In addition to saving several steps, this method enables the use of a form on which the primary rating values for each group are imprinted. The calculation of the average state "D" ratios is shown in Exhibit V.

The "D" ratios are then weighted by the serious, non-serious and medical partial pure premiums underlying the classification rate and the average classification "D" ratio obtained. The state average "D" ratio is obtained for use in establishing the "B" and "W" values. The calculation of the classification "D" ratio is explained on Exhibit VI.

Calculation of Factors to Derive Expected Loss Rates

The calculation of the policy year Expected Loss Rates contemplates the recognition of industry group projection factors, law amendment factors, development factors and certain other miscellaneous factors generally used to place the raw losses on a ratemaking basis. The need for all of these factors arises from the desire to use the expected loss rate underlying the current policy year rate as the basis for determining expected losses. The actual risk losses are to be used without modifications. Accordingly, the policy year expected losses should be comparable.

On Exhibit VII is shown the derivation of a set of factors for the manufacturing group. The same procedure applies to other groups with the exception that the figures for the Rate Level Projection factors will differ. It can be easily seen that different values for the other elements may be injected for each group, if desired. The factor for the experience rating plan off-balance is constant and is the same as that in the present plan.

The expected loss factors, expressed as reciprocals, are applied to the classification rates, (unloaded for catastrophe) to obtain policy year classification expected loss rates. Exhibit VIII shows the details of this calculation.

In a number of states many risks are written on an ex-medical basis. In these cases the assured assumes the responsibility for paying the medical costs on the claims. Since most of the medical will not be included in the losses a modification in the rating procedure is required. The procedure is as follows:

1. Expected losses will be determined in the usual manner, using full medical rates.
2. Special medical "D" ratios will be applied.
3. (a) Above the Q point a special ex-medical multiplier will be applied to the full expected losses (undiscounted). This multiplier will be $(1.0 - 1.33 \times \text{ex-medical ratio})$ calculated for each classification.
(b) From the summation of the product of classification expected loss and special multiplier of (a) the discounted medical losses as determined in (2) will be subtracted. The remainder will be the expected ex-medical excess loss.
4. Actual losses will be discounted by the use of the regular tables of Primary Values.

EXPLANATION OF RATING PROCEDURE

The rating form and procedure are extremely easy to follow. In addition to the identifying data the rating form is divided into four sections as follows:

Part I — Exhibit of Actual Losses

Part I is arranged so that space is available to post in one column the sum of the losses, for the rating period, that are equal to or less than the initial value and to list the cases costing in excess of the initial value. All of these will be listed in a column headed "Actual Incurred Losses." Another column will allow for the posting of the Primary Rating Value for those cases in excess of the initial value. The Primary Rating Values must be obtained from Table I. Space is provided for obtaining the Total Incurred Losses, the Total Primary Actual Losses and the difference or Actual Excess Losses.

Part II — Exhibit of Expected Losses

Part II provides space for the classification number, for the payroll exposure, for the policy year expected loss rates, for the extension of the payrolls by the rates to obtain expected losses, and for the application of the "D" ratio to obtain Primary Expected Losses. The totals will give Total Primary Expected Losses and the difference or Excess Expected Losses.

Part III — Rating Procedure

The Primary Actual Losses and the Primary Expected Losses are carried down from Parts I and II. The appropriate "B" and "W" values, to correspond to the Total Expected Losses are obtained from a Table of "B" and "W" values and entered. If "W" equals zero the excess losses may be entirely disregarded. If there is a positive "W" then both the Excess Actual and Excess Expected Losses are multiplied by "W" and added in with the other items. The modification is determined by dividing the total thus obtained for Actual by the total for Expected.

Part IV — Adjusted Rates

In a block especially provided therefor are spaces for posting the classifications and manual rates applicable to the risk for the policy about to be issued. The modification is applied to these rates after specific occupational disease and other non-ratable loadings are removed.

General Comments on the Rating Procedure

The rating form is designed so that all operations may be performed on one face of the blank, thus allowing for the use of fanfold typing machines and interleaved carbon paper. Although, usually, only three lines will be needed for posting the three policy years, space is provided to enable the rating department to post in pencil figures for the latest year at the time the risk is rerated and cross off the earliest year. The rating may then be completed and sent to the typing division.

Reference to the Primary Rating Table will only be made in

about 10% of the cases. The "B" value for expected losses below 10% of the self rating point is constant. A clerk can therefore quickly memorize these values and can post them, for the vast majority of risks, without even referring to the Tables.

Sample ratings have been performed for a large risk and a smaller risk. The expected loss rates and "D" ratios are for the classification used to illustrate the calculation of these values as shown on Exhibits VI and VIII. In order to make the illustrations more meaningful, the same classification is used in both risks, and it is assumed that the incurred losses are identical. The large risk is, in exposure, exactly three times the smaller one. For the large risk, the excess losses are used in the rating, and for the smaller one they are not, since the total expected losses are less than 10% of that required for self-rating.

Naturally the small risk having unfavorable experience, received a debit of 23.7%. For the larger risk the same losses may be considered as involving favorable experience and the result is indicated in a credit of 29.2%.

EXHIBIT I

TABLE IA — PRIMARY VALUES

*Table of Rating Values using Multi-Split Principle*Basis: $a = 300$ $r = .667$ Losses up to \$300 to be used without discount

Actual Loss	Primary Value	Actual Loss	Primary Value
Up to \$300	Actual	778 - 800	590
301 - 305	300	801 - 825	600
306 - 310	305	826 - 850	610
311 - 315	310	851 - 876	620
316 - 320	315	877 - 906	630
321 - 331	320	907 - 934	640
332 - 344	330	935 - 963	650
345 - 357	340	964 - 994	660
358 - 370	350	995 - 1026	670
371 - 385	360	1027 - 1059	680
386 - 399	370	1060 - 1094	690
400 - 413	380	1095 - 1131	700
414 - 427	390	1132 - 1169	710
428 - 442	400	1170 - 1214	720
443 - 457	410	1215 - 1257	730
458 - 472	420	1258 - 1303	740
473 - 488	430	1304 - 1352	750
489 - 503	440	1353 - 1404	760
504 - 521	450	1405 - 1461	770
522 - 538	460	1462 - 1522	780
539 - 555	470	1523 - 1588	790
556 - 573	480	1589 - 1661	800
574 - 590	490	1662 - 1750	810
591 - 609	500	1751 - 1842	820
610 - 628	510	1843 - 1948	830
629 - 647	520	1949 - 2071	840
648 - 667	530	2072 - 2218	850
668 - 689	540	2219 - 2402	860
690 - 710	550	2403 - 2647	870
711 - 732	560	2648 - 3017	880
733 - 754	570	3018 - 3788	890
755 - 777	580	3789 & over	900

EXHIBIT I (Continued)

TABLE IB — PRIMARY VALUES

Table of Rating Values using Multi-Split Principle

Basis: $a = 400$ $r = .667$ Losses up to \$400 to be used without discount

Actual Loss	Primary Value	Actual Loss	Primary Value	Actual Loss	Primary Value
Up to \$400	Actual	797 - 814	670	1609 - 1649	970
401 - 405	400	815 - 835	680	1650 - 1698	980
406 - 410	405	836 - 853	690	1699 - 1743	990
411 - 415	410	854 - 872	700	1744 - 1790	1000
416 - 420	415	873 - 894	710	1791 - 1847	1010
421 - 431	420	895 - 914	720	1848 - 1899	1020
432 - 443	430	915 - 934	730	1900 - 1955	1030
444 - 457	440	935 - 957	740	1956 - 2021	1040
458 - 469	450	958 - 978	750	2022 - 2085	1050
470 - 482	460	979 - 1000	760	2086 - 2152	1060
483 - 497	470	1001 - 1025	770	2153 - 2234	1070
498 - 510	480	1026 - 1047	780	2235 - 2313	1080
511 - 523	490	1048 - 1070	790	2314 - 2399	1090
524 - 539	500	1071 - 1097	800	2400 - 2506	1100
540 - 552	510	1098 - 1121	810	2507 - 2611	1110
553 - 566	520	1122 - 1146	820	2612 - 2729	1120
567 - 582	530	1147 - 1175	830	2730 - 2882	1130
583 - 597	540	1176 - 1201	840	2883 - 3040	1140
598 - 611	550	1202 - 1228	850	3041 - 3229	1150
612 - 628	560	1229 - 1260	860	3230 - 3496	1160
629 - 643	570	1261 - 1288	870	3497 - 3814	1170
644 - 658	580	1289 - 1318	880	3815 - 4288	1180
659 - 676	590	1319 - 1352	890	4289 - 5452	1190
677 - 691	600	1353 - 1384	900	5453 & over	1200
692 - 708	610	1385 - 1417	910		
709 - 726	620	1418 - 1455	920		
727 - 743	630	1456 - 1490	930		
744 - 759	640	1491 - 1526	940		
760 - 779	650	1527 - 1569	950		
780 - 796	660	1570 - 1608	960		

EXHIBIT I (Continued)

TABLE IC — PRIMARY VALUES

Table of Rating Values Using Multi-Split Principle

Basis: $a = 500$ $r = .667$ Losses up to \$500 to be used without discount

Actual Loss	Primary Value	Actual Loss	Primary Value	Actual Loss	Primary Value
Up to \$500	Actual	967 - 985	820	1852 - 1885	1170
501 - 505	500	986 - 1004	830	1886 - 1926	1180
506 - 510	505	1005 - 1021	840	1927 - 1967	1190
511 - 515	510	1022 - 1041	850	1968 - 2004	1200
516 - 520	515	1042 - 1061	860	2005 - 2049	1210
521 - 531	520	1062 - 1079	870	2050 - 2095	1220
532 - 544	530	1080 - 1100	880	2096 - 2137	1230
545 - 556	540	1101 - 1121	890	2138 - 2187	1240
557 - 569	550	1122 - 1139	900	2188 - 2238	1250
570 - 583	560	1140 - 1161	910	2239 - 2285	1260
584 - 595	570	1162 - 1184	920	2286 - 2341	1270
596 - 609	580	1185 - 1203	930	2342 - 2400	1280
610 - 624	590	1204 - 1226	940	2401 - 2453	1290
625 - 636	600	1227 - 1250	950	2454 - 2518	1300
637 - 650	610	1251 - 1270	960	2519 - 2586	1310
651 - 665	620	1271 - 1295	970	2587 - 2648	1320
666 - 678	630	1296 - 1320	980	2649 - 2724	1330
679 - 693	640	1321 - 1342	990	2725 - 2805	1340
694 - 708	650	1343 - 1368	1000	2806 - 2879	1350
709 - 721	660	1369 - 1394	1010	2880 - 2972	1360
722 - 737	670	1395 - 1417	1020	2973 - 3071	1370
738 - 753	680	1418 - 1445	1030	3072 - 3164	1380
754 - 766	690	1446 - 1473	1040	3165 - 3282	1390
767 - 783	700	1474 - 1498	1050	3283 - 3412	1400
784 - 799	710	1499 - 1527	1060	3413 - 3535	1410
800 - 813	720	1528 - 1557	1070	3536 - 3697	1420
814 - 830	730	1558 - 1584	1080	3698 - 3883	1430
831 - 847	740	1585 - 1615	1090	3884 - 4069	1440
848 - 862	750	1616 - 1648	1100	4070 - 4328	1450
863 - 880	760	1649 - 1676	1110	4329 - 4656	1460
881 - 898	770	1677 - 1710	1120	4657 - 5029	1470
899 - 913	780	1711 - 1745	1130	5030 - 5684	1480
914 - 931	790	1746 - 1776	1140	5685 - 7170	1490
932 - 950	800	1777 - 1813	1150	7171 & over	1500
951 - 966	810	1814 - 1851	1160		

TABLE OF MERITS OF ACTUAL LOSS AMOUNTS CORRESPONDING TO
GIVEN RATING VALUES
GENERAL FORMULA USED

a = 300
r = .667
 $S = \frac{a}{1-r} = 900$

Actual Loss = $\frac{a \log \left(1 - \frac{s}{S}\right)}{\log r} = 1705.51 \log \left(1 - \frac{s}{900}\right)$

(1) Rating Value s	(2) Mid- Point s	(3) $\frac{s}{900}$	(4) $1 - \frac{s}{900}$	(5) $\log \left(1 - \frac{s}{900}\right)$	(6) 1.0 - (5)	(7) (6) × 1705.51	(1) Rating Value s	(2) Mid- Point s	(3) $\frac{s}{900}$	(4) $1 - \frac{s}{900}$	(5) $\log \left(1 - \frac{s}{900}\right)$	(6) 1.0 - (5)	(7) (6) × 1705.51
300	305	.339	.661	.8202	.1798	307	610	.683	.317	.5011	.4989	.851	
10	15	.350	.650	.8129	.1871	319	20	.694	.306	.4857	.5143	877	
20	25	.361	.639	.8055	.1945	332	30	.706	.294	.4683	.5317	907	
30	35	.372	.628	.7980	.2020	345	40	.717	.283	.4518	.5482	935	
40	45	.383	.617	.7903	.2097	358	50	.728	.272	.4346	.5654	964	
50	55	.394	.606	.7825	.2175	371	60	.739	.261	.4166	.5834	995	
60	65	.406	.594	.7738	.2262	386	70	.750	.250	.3979	.6021	1027	
70	75	.417	.583	.7657	.2343	400	80	.761	.239	.3784	.6216	1060	
80	85	.428	.572	.7574	.2426	414	90	.772	.228	.3579	.6421	1095	
90	95	.439	.561	.7490	.2510	428	700	.783	.217	.3365	.6635	1132	
400	405	.450	.550	.7404	.2596	443	10	.794	.206	.3139	.6861	1170	
10	15	.461	.539	.7316	.2684	458	20	.806	.194	.2878	.7125	1215	
20	25	.472	.528	.7226	.2774	473	30	.817	.183	.2625	.7375	1258	
30	35	.483	.517	.7135	.2865	489	40	.828	.172	.2355	.7645	1304	
40	45	.494	.506	.7042	.2958	504	50	.839	.161	.2068	.7932	1353	
50	55	.506	.494	.6937	.3063	522	60	.850	.150	.1761	.8239	1405	
60	65	.517	.483	.6839	.3161	539	70	.861	.139	.1430	.8570	1462	
70	75	.528	.472	.6739	.3261	556	80	.872	.128	.1072	.8928	1523	
80	85	.539	.461	.6637	.3363	574	90	.883	.117	.0682	.9318	1589	
90	95	.550	.450	.6532	.3468	591	800	.894	.106	.0253	.9747	1662	
500	505	.561	.439	.6425	.3575	610	10	.906	.094	.9731	*1.0269	1751	
10	15	.572	.428	.6314	.3686	629	20	.917	.083	.9191	1.0809	1843	
20	25	.583	.417	.6201	.3799	648	30	.928	.072	.8573	1.1427	1949	
30	35	.594	.406	.6085	.3915	668	40	.939	.061	.7853	1.2147	2072	
40	45	.606	.394	.5955	.4045	690	50	.950	.050	.6990	1.3010	2219	
50	55	.617	.383	.5832	.4168	711	60	.961	.039	.5911	1.4089	2403	
60	65	.628	.372	.5705	.4295	733	70	.972	.028	.4472	1.5528	2648	
70	75	.639	.361	.5575	.4425	755	80	.983	.017	.2304	†1.7696	3018	
80	85	.650	.350	.5441	.4559	778	90	.994	.006	.7782	2.2218	3789	
90	95	.661	.339	.5302	.4698	801	900						
600	605	.672	.328	.5159	.4841	826							

*From here on subtract column (5) from 2.0.

†Subtract column (5) from 3.0.

EXHIBIT II—(CONTINUED)

TABLE OF LIMITS OF ACTUAL LOSS AMOUNTS CORRESPONDING TO GIVEN RATING VALUES
 GENERAL FORMULA USED

$a = 500$
 $r = .667$

$S = \frac{a}{1-r} = 1500$ Actual Loss = $\frac{a \log \left(1 - \frac{s}{S}\right)}{\log r} = 2842.52 \log \left(1 - \frac{s}{1500}\right)$

(1) Rating Value s	(2) Mid Point s	(3) $\frac{s}{1500}$	(4) $1 - \frac{s}{1500}$	(5) $\log \left(1 - \frac{s}{1500}\right)$	(6) 1.0 - (5)	(7) (6) × 2842.52
500	505	.337	.663	.8215	.1785	507
10	15	.343	.657	.8176	.1824	518
20	25	.350	.650	.8129	.1871	532
30	35	.357	.643	.8082	.1918	545
40	45	.363	.637	.8041	.1959	557
50	55	.370	.630	.7993	.2007	570
60	65	.377	.623	.7945	.2055	584
70	75	.383	.617	.7903	.2097	596
80	85	.390	.610	.7853	.2147	610
90	95	.397	.603	.7803	.2197	625
600	605	.403	.597	.7760	.2240	637
10	15	.410	.590	.7709	.2291	651
20	25	.417	.583	.7657	.2343	666
30	35	.423	.577	.7612	.2388	679
40	45	.430	.570	.7559	.2441	694
50	55	.437	.563	.7505	.2495	709
60	65	.443	.557	.7459	.2541	722
70	75	.450	.550	.7404	.2596	738
80	85	.457	.543	.7348	.2652	754
90	95	.463	.537	.7300	.2700	767
700	705	.470	.530	.7243	.2757	784
10	15	.477	.523	.7185	.2815	800
20	25	.483	.517	.7135	.2865	814
30	35	.490	.510	.7076	.2924	831
40	45	.497	.503	.7016	.2984	848
50	55	.503	.497	.6964	.3036	863
60	65	.510	.490	.6902	.3098	881
70	75	.517	.483	.6839	.3161	899
80	85	.523	.477	.6785	.3215	914
90	95	.530	.470	.6721	.3279	932
800	805	.537	.463	.6656	.3344	951
10	15	.543	.457	.6599	.3401	967
20	25	.550	.450	.6532	.3468	986
30	35	.557	.443	.6464	.3536	1005
40	45	.563	.437	.6405	.3595	1022
50	55	.570	.430	.6335	.3665	1042
60	65	.577	.423	.6263	.3737	1062
70	75	.583	.417	.6201	.3799	1080
80	85	.590	.410	.6128	.3872	1101
90	95	.597	.403	.6053	.3947	1122
900	905	.603	.397	.5988	.4012	1140
10	15	.610	.390	.5911	.4089	1162
20	25	.617	.383	.5832	.4168	1185
30	35	.623	.377	.5763	.4237	1204
40	45	.630	.370	.5682	.4318	1227
50	55	.637	.363	.5599	.4401	1251
60	65	.643	.357	.5527	.4473	1271
70	75	.650	.350	.5441	.4559	1296
80	85	.657	.343	.5353	.4647	1321
90	95	.663	.337	.5276	.4724	1343

EXHIBIT II—(CONTINUED)

TABLE OF LIMITS OF ACTUAL LOSS AMOUNTS CORRESPONDING TO GIVEN RATING VALUES

a = 500

r = .667

GENERAL FORMULA USED

$$S = \frac{a}{1-r} = 1500 \quad \text{Actual Loss} = \frac{a \log \left(1 - \frac{s}{S}\right)}{\log r} = 2842.52 \log \left(1 - \frac{s}{1500}\right)$$

(1) Rating Value s	(2) Mid Point s	(3) $\frac{s}{1500}$	(4) $1 - \frac{s}{1500}$	(5) $\log \left(1 - \frac{s}{1500}\right)$	(6) 1.0 - (5)	(7) (6) × 2842.52
1000	1005	.670	.330	.5185	.4815	1369
10	15	.677	.323	.5092	.4908	1395
20	25	.683	.317	.5011	.4989	1418
30	35	.690	.310	.4914	.5086	1446
40	45	.697	.303	.4814	.5186	1474
50	55	.703	.297	.4728	.5272	1499
60	65	.710	.290	.4624	.5376	1528
70	75	.717	.283	.4518	.5482	1558
80	85	.723	.277	.4425	.5575	1585
90	95	.730	.270	.4314	.5686	1616
1100	1105	.737	.263	.4200	.5800	1649
10	15	.743	.257	.4099	.5901	1677
20	25	.750	.250	.3979	.6021	1711
30	35	.757	.243	.3856	.6144	1746
40	45	.763	.237	.3747	.6253	1777
50	55	.770	.230	.3617	.6383	1814
60	65	.777	.223	.3483	.6517	1852
70	75	.783	.217	.3365	.6635	1886
80	85	.790	.210	.3222	.6778	1927
90	95	.797	.203	.3075	.6925	1968
1200	1205	.803	.197	.2945	.7055	2005
10	15	.810	.190	.2788	.7212	2050
20	25	.817	.183	.2625	.7375	2096
30	35	.823	.177	.2480	.7520	2138
40	45	.830	.170	.2304	.7696	2188
50	55	.837	.163	.2122	.7878	2239
60	65	.843	.157	.1959	.8041	2286
70	75	.850	.150	.1761	.8239	2342
80	85	.857	.143	.1553	.8447	2401
90	95	.863	.137	.1367	.8633	2454
1300	1305	.870	.130	.1139	.8861	2519
10	15	.877	.123	.0899	.9101	2587
20	25	.883	.117	.0682	.9318	2649
30	35	.890	.110	.0414	.9586	2725
40	45	.897	.103	.0128	.9872	2806
50	55	.903	.097	.9868	*1.0132	2880
60	65	.910	.090	.9542	1.0458	2973
70	75	.917	.083	.9191	1.0809	3072
80	85	.923	.077	.8865	1.1135	3165
90	95	.930	.070	.8451	1.1549	3283
1400	1405	.937	.063	.7993	1.2007	3413
10	15	.943	.057	.7559	1.2441	3536
20	25	.950	.050	.6990	1.3010	3698
30	35	.957	.043	.6335	1.3665	3884
40	45	.963	.037	.5682	1.4318	4070
50	55	.970	.030	.4771	1.5229	4329
60	65	.977	.023	.3617	1.6383	4657
70	75	.983	.017	.2304	1.7696	5030
80	85	.990	.010	.0000	2.0000	5685
90	95	.997	.003	.4771	†2.5229	7171
1500						

*Subtract column (5) from 2.0.

†Subtract column (5) from 3.0.

EXHIBIT II—(CONTINUED)

TABLE OF LIMITS OF ACTUAL LOSS AMOUNTS CORRESPONDING TO GIVEN RATING VALUES

a = 400

r = .667

GENERAL FORMULA USED

$$S = \frac{a}{1-r} = 1200 \quad \text{Actual Loss} = \frac{a \log \left(1 - \frac{s}{S}\right)}{\log r} = 2274 \log \left(1 - \frac{s}{1200}\right)$$

(1) Rating Value s	(2) Mid Point s	(3) $\frac{s}{1200}$	(4) $1 - \frac{s}{1200}$	(5) $\log \left(1 - \frac{s}{1200}\right)$	(6) 1.0 - (5)	(7) (6) × 2274
400	405	.337	.663	.8215	.1785	406
10	15	.346	.654	.8156	.1844	419
20	25	.354	.646	.8102	.1898	432
30	35	.362	.638	.8048	.1952	444
40	45	.371	.629	.7987	.2013	458
50	55	.379	.621	.7931	.2069	470
60	65	.387	.613	.7875	.2125	483
70	75	.396	.604	.7810	.2190	498
80	85	.404	.596	.7752	.2248	511
90	95	.412	.588	.7694	.2306	524
500	505	.421	.579	.7627	.2373	540
10	15	.429	.571	.7566	.2434	553
20	25	.437	.563	.7505	.2495	567
30	35	.446	.554	.7435	.2565	583
40	45	.454	.546	.7372	.2628	598
50	55	.462	.538	.7308	.2692	612
60	65	.471	.529	.7235	.2765	629
70	75	.479	.521	.7168	.2832	644
80	85	.487	.513	.7101	.2899	659
90	95	.496	.504	.7024	.2976	677
600	605	.504	.496	.6955	.3045	692
10	15	.512	.488	.6884	.3116	709
20	25	.521	.479	.6803	.3197	727
30	35	.529	.471	.6730	.3270	744
40	45	.537	.463	.6656	.3344	760
50	55	.546	.454	.6571	.3429	780
60	65	.554	.446	.6493	.3507	797
70	75	.562	.438	.6415	.3585	815
80	85	.571	.429	.6325	.3675	836
90	95	.579	.421	.6243	.3757	854
700	705	.587	.413	.6160	.3840	873
10	15	.596	.404	.6064	.3936	895
20	25	.604	.396	.5977	.4023	915
30	35	.612	.388	.5888	.4112	935
40	45	.621	.379	.5786	.4214	958
50	55	.629	.371	.5694	.4306	979
60	65	.637	.363	.5599	.4401	1001
70	75	.646	.354	.5490	.4510	1026
80	85	.654	.346	.5391	.4609	1048
90	95	.662	.338	.5289	.4711	1071
800	805	.671	.329	.5172	.4828	1098
10	15	.679	.321	.5065	.4935	1122
20	25	.687	.313	.4955	.5045	1147
30	35	.696	.304	.4829	.5171	1176
40	45	.704	.296	.4713	.5287	1202
50	55	.712	.288	.4594	.5406	1229
60	65	.721	.279	.4456	.5544	1261
70	75	.729	.271	.4330	.5670	1289
80	85	.737	.263	.4200	.5800	1319
90	95	.746	.254	.4048	.5952	1353

EXHIBIT II—(CONTINUED)

TABLE OF LIMITS OF ACTUAL LOSS AMOUNTS CORRESPONDING TO GIVEN RATING VALUES

a = 400
r = .667

GENERAL FORMULA USED

$$S = \frac{a}{1-r} = 1200 \quad \text{Actual Loss} = \frac{a \log \left(1 - \frac{s}{S}\right)}{\log r} = 2274 \log \left(1 - \frac{s}{1200}\right)$$

(1) Rating Value s	(2) Mid Point s	(3) $\frac{s}{1200}$	(4) $1 - \frac{s}{1200}$	(5) $\log \left(1 - \frac{s}{1200}\right)$	(6) 1.0 - (5)	(7) (6) × 2274
900	905	.754	.246	.3909	.6091	1385
10	15	.762	.238	.3766	.6234	1418
20	25	.771	.229	.3598	.6402	1456
30	35	.779	.221	.3444	.6556	1491
40	45	.787	.213	.3284	.6716	1527
50	55	.796	.204	.3096	.6904	1570
60	65	.804	.196	.2923	.7077	1609
70	75	.812	.188	.2742	.7258	1650
80	85	.821	.179	.2529	.7471	1699
90	95	.829	.171	.2330	.7670	1744
1000	1005	.837	.163	.2122	.7878	1791
10	15	.846	.154	.1875	.8125	1848
20	25	.854	.146	.1644	.8356	1900
30	35	.862	.138	.1399	.8601	1956
40	45	.871	.129	.1106	.8894	2022
50	55	.879	.121	.0823	.9172	2086
60	65	.887	.113	.0531	.9469	2153
70	75	.896	.104	.0170	.9830	2235
80	85	.904	.096	.9823	*1.0177	2314
90	95	.912	.088	.9445	1.0555	2400
1100	1105	.921	.079	.8976	1.1024	2507
10	15	.929	.071	.8513	1.1487	2612
20	25	.937	.063	.7993	1.2007	2730
30	35	.946	.054	.7324	1.2676	2883
40	45	.954	.046	.6628	1.3372	3041
50	55	.962	.038	.5798	1.4202	3230
60	65	.971	.029	.4624	1.5376	3497
70	75	.979	.021	.3222	1.6778	3815
80	85	.987	.013	.1139	1.8861	4289
90	95	.996	.004	.6021	†2.3979	5453
1200						

*Subtract column (5) from 2.0.

†Subtract column (5) from 3.0.

EXHIBIT III

TABLE III — MISSOURI

"B" and "W" Values

Average D. & P. T. Value = \$3975

NOTE: Use Table IB for Determining Primary Actual Losses —
\$400 Initial Value

Expected Losses	W	B	Expected Losses	W	B	Expected Losses	W	B
Below- 8000	.00	4300	32727-33454	.35	9097	58182-58908	.70	7107
8001- 8726	.01	4531	33455-34181	.36	9134	58909-59635	.71	6950
8727- 9454	.02	4757	34182-34908	.37	9166	59636-60363	.72	6788
9455-10181	.03	4977	34909-35635	.38	9192	60364-61090	.73	6621
10182-10908	.04	5192	35636-36363	.39	9213	61091-61817	.74	6447
10909-11635	.05	5401	36364-37090	.40	9228	61818-62544	.75	6269
11636-12363	.06	5604	37091-37817	.41	9238	62545-63272	.76	6084
12364-13090	.07	5802	37818-38544	.42	9242	63273-63999	.77	5895
13091-13817	.08	5995	38545-39272	.43	9240	64000-64726	.78	5699
13818-14544	.09	6182	39273-39999	.44	9233	64727-65454	.79	5498
14545-15272	.10	6363	40000-40726	.45	9221	65455-66181	.80	5292
15273-15999	.11	6539	40727-41454	.46	9203	66182-66908	.81	5080
16000-16726	.12	6709	41455-42181	.47	9179	66909-67635	.82	4863
16727-17454	.13	6874	42182-42908	.48	9150	67636-68363	.83	4639
17455-18181	.14	7033	42909-43635	.49	9115	68364-69090	.84	4411
18182-18908	.15	7187	43636-44363	.50	9075	69091-69817	.85	4177
18909-19635	.16	7335	44364-45090	.51	9029	69818-70544	.86	3937
19636-20363	.17	7477	45091-45817	.52	8978	70545-71272	.87	3692
20364-21090	.18	7615	45818-46544	.53	8921	71273-71999	.88	3441
21091-21817	.19	7746	46545-47272	.54	8859	72000-72726	.89	3185
21818-22544	.20	7872	47273-47999	.55	8791	72727-73454	.90	2923
22545-23272	.21	7992	48000-48726	.56	8717	73455-74181	.91	2656
23273-23999	.22	8107	48727-49454	.57	8638	74182-74908	.92	2383
24000-24726	.23	8217	49455-50181	.58	8554	74909-75635	.93	2104
24727-25454	.24	8320	50182-50908	.59	8464	75636-76363	.94	1820
25455-26181	.25	8419	50909-51635	.60	8368	76364-77090	.95	1531
26182-26908	.26	8511	51636-52363	.61	8267	77091-77817	.96	1236
26909-27635	.27	8599	52364-53090	.62	8160	77818-78544	.97	935
27636-28363	.28	8680	53091-53817	.63	8048	78545-79272	.98	629
28364-29090	.29	8756	53818-54544	.64	7930	79273-79999	.99	317
29091-29817	.30	8827	54545-55272	.65	7807	80000 & over	1.00	0
29818-30544	.31	8892	55273-55999	.66	7678			
30545-31272	.32	8952	56000-56726	.67	7543			
31273-31999	.33	9005	56727-57454	.68	7404			
32000-32726	.34	9054	57455-58181	.69	7258			

EXHIBIT IV

STATE—MASSACHUSETTS

Policy Years 1934-1935

Initial Value — \$400

METHOD OF DISCOUNTING STATE ACTUAL LOSSES

DISTRIBUTION OF SERIOUS LOSSES BY SIZE — FROM UNIT STATISTICAL PLAN REPORTS

METHOD A — DETAILED PROCEDURE						METHOD B — ABRIDGED PROCEDURE				
(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)
Loss Size Group	No. of Cases	In-curred Cost	Group Average (3) ÷ (2)	Primary Value	Dis-counted Losses (2) × (5)	Loss Size Group	Mid-point of Group	Primary Value	No. of Cases	Dis-counted Losses (3) × (4)
0- 299						0- 299	150	150		
300- 349						300- 399	350	350		
350- 399						400- 499	450	440		
400- 449						500- 599	550	510	5	2550
450- 499						600- 699	650	580	7	4060
500- 549						700- 799	750	640	12	7680
550- 599	5	2883	577	530	2650	800- 899	850	690	13	8970
600- 649	5	3078	615	560	2800	900- 999	950	740	14	10360
650- 699	2	1342	672	590	1180	1000-1099	1050	790	19	15010
700- 749	6	4337	728	630	3780	1100-1199	1150	830	26	21580
750- 799	6	4599	766	650	3900	1200-1299	1250	860	27	23220
800- 849	6	4966	827	680	4080	1300-1399	1350	890	27	24030
850- 899	7	6168	882	710	4970	1400-1499	1450	920	29	26680
900- 949	3	2717	905	720	2160	1500-1599	1550	950	34	32300
950- 999	11	10663	968	750	8250	1600-1699	1650	980	33	32340
000-1099	19	19683	1035	780	14820	1700-1799	1750	1000	34	34000
100-1199	26	29719	1144	820	21320	1800-1899	1850	1020	32	32640
200-1299	27	33701	1248	860	23220	1900-1999	1950	1030	28	28840
300-1399	27	36630	1357	900	24300	2000-2999	2500	1100	243	267300
400-1499	29	41547	1432	920	26680	3000-3999	3500	1170	531*	621270
500-1599	34	52554	1545	950	32300	4000-4999	4500	1190	82	97580
500-1699	33	54669	1656	980	32340	5000 & over		1200	117	140400
700-1799	34	58925	1735	990	33660					
300-1899	32	58835	1840	1010	32320					
300-1999	28	54405	1945	1030	28840					
300-2099	30	61073	2035	1050	31500					
100-2199	21	45032	2145	1060	22260					
300-2299	36	80946	2250	1080	38880					
300-2399	30	70383	2350	1090	32700					
300-2499	16	38810	2425	1100	17600					
300-2999	110	297888	2700	1120	123200					
300-3499	77	248768	3230	1160	89320					
300-3999	454*	1718695	3780	1170	531180					
300-4499	49	205329	4180	1180	57820					
300-4999	33	154576	4780	1190	39270					
300-5999	76	405215	5330	1190	90440					
300-6999	33	206328	6230	1200	39600					
300-7999	6	44050	7340	1200	7200					
300 & over	2	16529	8270	1200	2400					
TOTAL	1313	4075043			1426940				1313	1430810

includes 397 D. & P. T. cases costing \$1508946, average cost of a case is \$3800. All cases in excess are added to this average so that the corresponding Primary Rating Values should be used for the remaining cases.

MERIT RATING

EXHIBIT V

CALCULATION OF DISCOUNT RATIOS — MISSOURI
Policy Years 1934-1935

	(1) Incurred Losses	(2) Discounted Losses	(3) Discount Ratio (2) ÷ (1)
Serious	1,748,363	672,383	.385
Non-Serious	2,126,082	2,692,522	1.266
Medical	1,724,776	592,940	.344
TOTAL.....	5,599,221	3,957,845	.710

EXHIBIT VI

CALCULATION OF CLASSIFICATION "D" RATIO

	(1) Partial Pure Premiums Underlying Rate	(2) State "D" Ratios	(3) Partial Primary Loss Rates	(4) Classification "D" Ratio (3) ÷ (1)
Serious .....	.41	.385	.158	
Non-Serious .....	.44	1.266	.557	
Medical .....	.40	.344	.136	
TOTAL.....	1.25	XX	.851	.68

EXHIBIT VII

CALCULATION OF FACTORS TO DERIVE EXPECTED LOSS RATES
STATE — MISSOURI — REVISION UNDERLYING THE RATES APPROVED
DECEMBER 31, 1937

In- dustry Group	(1) Policy Year	(2) Off- Bal- ance Ad- just- ment	(4) Factors Derived from Latest Rate Revision				(7) Expense Loading	(8) Product	(9) Recip- rocal
			(3) Benefit Changes	(4) Loss Devel- opment	(5) Rate Level Projec- tion	(6) Contin- gency			
Mfg.	1934	1.03	1.000	1.000	1.045	1.091	1.667	1.9575	.511
	1935	1.03	1.000	1.000	.974	1.091	1.667	1.8245	.548
	1936	1.03	1.000	1.000	1.000	1.091	1.667	1.8732	.534

The same procedure is followed in calculating the factors for the Con-tracting and All Other groups.

EXHIBIT VIII

CALCULATION OF POLICY YEAR EXPECTED LOSS RATES
FOR A MANUFACTURING CLASS

Policy Year	(1) Policy Year Adjustment Factor	(2) Rate for Classifica- tion Excluding .01 for Catastrophe Losses	(3) Policy Year Expected Loss Rate (1) × (2)
1934	.511	2.19	1.12
1935	.548	2.19	1.20
1936	.534	2.19	1.17

ILLUSTRATIVE EXAMPLE #1

Note: This risk has a payroll exposure one third of that in Example #2

EXPERIENCE RATING FORM

Name of Risk Medium Risk Address _____
 Carrier _____ Policy No. _____
 Rating Applicable to Operations in State of MISSOURI Effective Date of Rating _____

PART I - EXHIBIT OF ACTUAL LOSSES				PART II - EXHIBIT OF EXPECTED LOSSES						
(1) Policy Year	(2) Actual* Incurred Losses	(3) Primary Actual Losses	(4) Classification	(5) Policy Year	(6) Payroll	(7) Expected Losses (100 x (1)(2) / (6))	(8) Expected Losses (100 x (1)(3) / (6))	(9) "R" Ratio	(10) Expected Primary Losses (100 x (1)(3) / (6))	
Total by policy year of all cases \$ 400 or under	34	749	749	2014	34	150,000	1.12			
	35	894	894		35	175,000	1.20			
	36				36	200,000	1.17	6120	.68	
Individual cases in excess of \$ 400	36	1016	1016							
(1) Case Number	(2) Date (M/Y)	(3) Amount	(4) Classification							
D	34	3975	1180							
D	35	3975	1180							
M	36	3491	1160							
Totals			(a) 14090	(b) 6169	Totals			(c) 6120	(d) 4162	

(c) Actual Excess (a)-(b) 7921 (f) Expected Excess (d)-(e) 1959

PART III - RATING PROCEDURE

	(1) Actual Item (b)	(2) Expected Item (c)
1. Primary Losses	6169	4162
2. "R" Value (Enter in both columns)	4300	4300
3. Rateable Excess Losses:	(a) 0	(b) 0
4. Totals	10469	8462

PART IV - ADJUSTED RATES

(1) Classification	(2) Manual Rate	(3) Subject Rating (1)-(2)	(4) Adjusted Rate 1
2014	2.20		2.721

5. Experience Modification (a) 1.237; (b) 25.7 % Charge; _____ % Credit.
 * Industry and medical conditions. Primary value of each case is from Table I. Health and Permanent Total cases to be included at average value of Table III. Maximum value of all other cases to be limited to average Death and Permanent Total value.

† Col. (1) x Experience Modification (Item 6 Part III).
 If Specific O.D. or Non-Table Loadings (Col. (4)) apply, use formula:
 [Col. (2) x Experience Modification] + Col. (4).

This risk has a payroll exposure three times that of Example #1
EXPERIENCE RATING FORM

ILLUSTRATIVE EXAMPLE #2

Name of Ins. Illustrative Example of Large Risk Address _____
 Office _____ Policy No. _____
 Rating Applicable to Operations by State of MISSOURI Effective Date of Rating _____

PART I - SUMMARY OF ACTUAL LOSSES				PART II - SUMMARY OF EXPECTED LOSSES								
(1) Policy Year	(2) Actual ^a Insured Losses	(3) Primary Actual Losses	(4) Classification	(5) Policy Year	(6) Payroll	(7) Expected Loss Rate	(8) Expected Losses (6) x (7) x (9)	(9) "P" Ratio	(10) Primary Expected Losses (8) x (9)			
Total by policy year of all cases \$ 400 or under	34 749	749	2014	34 450,000	1.12	35 525,000	1.20	36 600,000	1.17	18360	.68	12485
Individual cases to whom of \$ 400	36 1016	1016										
(11) Claim Number	(12) Age at Inj.	(13) O or P										
D	34	3975	1180									
D	35	3975	1180									
M	36	3491	1160									
Totals (a) 14090 (b) 6169				Totals (c) 18360 (d) 12485								
(1) Actual Excess (a)-(b) 7921				(2) Expected Excess (c)-(d) 5875								

PART III - RATING PROCEDURE		PART IV - ADJUSTED RATES					
(1) Item (b)	(2) Actual Excess	(3) Item (a)	(4) Classification	(5) Manual Rate	(6) % CHG. FROM (5)	(7) Subject Rate (5)-(6)	(8) Adjusted Rate (7)-(8)
1. Primary Losses	6169	12485	2014	2.20			1.558
2. "B" Values (Enter in both columns)	7187	7187					
3. Retable Excess Losses	1188	881					
(W) 15 % Actual Excess 7921 ; Expected Excess 5875							
4. Totals	14544	20553					

(1) Col. (7) x Experience Modification (Items 8 Part III)
 If Specific O.D. or Non-Ratable Loadings (Col. (4)) apply, use formula:
 [Col. (6) x Experience Modification] + Col. (4)

5. Experience Modification (5) = 70% ; % Change = 29.2 % Credit

^a Industry and medical conditions. Primary value of each case is from Table I. Death and Permanent Total cases to be included at average value of Table III. Maximum value of all other cases to be limited to average Death and Permanent Total value.

APPENDIX I

TESTS OF MULTI-SPLIT PLAN

This exhibit shows summaries comparing the results obtained by rating risks under the Multi-Split Rating Plan with the results obtained under the present plan.

The data used in making these tests are as follows:

Georgia—

436 Risks—Ratings effective April 1, 1937 to March 31, 1938

Massachusetts—

1571 Risks—Ratings effective in January 1938 and July 1938

New York—

1541 Risks—Ratings effective in July 1937

133 Large Risks (Expected Losses over 13,500)

The exhibits for each state are divided into two parts.

Part A is a general summary showing the ratio of premium produced by the multi-split plan to the premium produced by the present plan according to the type of modification under the present plan.

Part B summarizes the ratio of premium produced by the Multi-Split plan to the premium produced by the present plan according to size of expected losses for the three year experience period of the multi-split plan. The results are obtained by weighing the three-year expected losses by actual and multi-split modifications.

APPENDIX I—TESTS

GEORGIA MULTI-SPLIT RATING PLAN

Ratio of Premium Produced by Multi-Split Plan
to Premium Produced by Present Plan

PART A—SUMMARY

(1) Group	(2) No. of Risks	(3) Expected Losses (3 Year Period)	(4) Product (3) × Act. Mod.	(5) Product (3) × M-Split Mod.	(6) Ratio (5) ÷ (4)
(a)	239	535153	445601	432717	.971
(b)	160	350888	415936	419460	1.008
(c)	12	21426	20525	21952	1.070
(d)	25	91074	96774	86208	.891
TOTAL	436	998541	978836	960337	.981

- Group (a) Risks which bore a credit under both rating plans.
 (b) Risks which bore a debit under both rating plans.
 (c) Credit risks switching to debit under multi-split plan.
 (d) Debit risks switching to credit under multi-split plan.

APPENDIX I — TESTS (Continued)

PART B — BY SIZE OF EXPECTED LOSSES

Expected Losses Size	Number of Risks and Ratio of Multi-Split Premium to Standard					
	Credit Risks		Debit Risks		All Risks	
	No.	Ratio	No.	Ratio	No.	Ratio
0- 999	64	.993	38	1.015	102	1.002
1000-1999	117	.988	75	.992	192	.989
2000-3999	40	.980	53	1.001	93	.993
4000-6999	20	.970	11	.970	31	.970
7000-9999	5	.993	4	.904	9	.948
10000 & over	5	.918	4	.981	9	.953
ALL SIZES	251	.970	185	.986	436	.981

MASSACHUSETTS MULTI-SPLIT RATING PLAN
Ratio of Premium Produced by Multi-Split Plan
to Premium Produced by Present Plan

PART A — SUMMARY

(1) Group	(2) No. of Risks	(3) Expected Losses (3 Year Period)	(4) Product (3) × Act. Mod.	(5) Product (3) × M-Split Mod.	(6) Ratio (5) ÷ (4)
(a)	918	3099584	2570488	2518968	.980
(b)	493	1182422	1385441	1414723	1.021
(c)	81	236950	230003	251516	1.094
(d)	71	135793	143051	128561	.899
(e)	8	27584	27058	27595	1.020
TOTAL	1571	4682333	4356041	4341363	.997

- Group (a) Risks which bore a credit under both rating plans.
 (b) Risks which bore a debit under both rating plans.
 (c) Credit risks switching to debit under multi-split plan.
 (d) Debit risks switching to credit under multi-split plan.
 (e) Risks producing a neutral modification under either plan.

PART B — BY SIZE OF EXPECTED LOSSES

Expected Losses Size	Number of Risks and Ratio of Multi-Split Premium to Standard							
	Credit Risks		Debit Risks		Neutral Risks		All Risks	
	No.	Ratio	No.	Ratio	No.	Ratio	No.	Ratio
0- 999	390	1.005	220	.996	1	.939	611	1.001
1000-1999	278	1.001	162	.991	0	..	440	.997
2000-4999	206	.999	121	1.006	1	1.021	328	1.002
5000-9999	72	1.000	41	1.040	0	..	113	1.018
10000 & over	59	.976	20	1.005	0	..	79	.982
ALL SIZES	1005	.990	564	1.009	2	1.004	1571	.997

APPENDIX I — TESTS (Continued)

NEW YORK MULTI-SPLIT RATING PLAN

Ratio of Premium Produced by Multi-Split Plan
to Premium Produced by Present Plan

PART A — SUMMARY

(1) Group	(2) No. of Risks	(3) Expected Losses (3 Year Period)	(4) Product (3) × Act. Mod.	(5) Product (3) × M-Split Mod.	(6) Ratio (5) ÷ (4)
(a)	903	2861435	2403976	2384005	.992
(b)	524	1638182	1929962	1987472	1.030
(c)	72	253515	244954	264722	1.081
(d)	38	113970	117491	110459	.940
(e)	4	6971	6949	7002	1.008
TOTAL	1541	4874073	4703332	4753660	1.011

- Group (a) Risks which produced a credit under both plans.
 (b) Risks which produced a debit under both plans.
 (c) Credit risks switching to debit under multi-split plan.
 (d) Debit risks switching to credit under multi-split plan.
 (e) Risks producing a neutral modification under either plan.

PART B — BY SIZE OF EXPECTED LOSSES

Expected Losses Size	Number of Risks and Ratio of Multi-Split Premium to Standard							
	Credit Risks		Debit Risks		Neutral Risks		All Risks	
	No.	Ratio	No.	Ratio	No.	Ratio	No.	Ratio
0- 999	288	1.005	150	.999	..	..	438	1.003
1000-1999	343	1.004	208	1.013	1	1.058	552	1.008
2000-4999	209	1.006	138	1.025	2	.991	349	1.015
5000-9999	75	.999	34	1.045	..	..	109	1.016
10000 & over	61	.994	32	1.027	..	..	93	1.009
ALL SIZES	976	1.000	562	1.025	3	1.005	1541	1.011

SPECIAL TEST OF MULTI-SPLIT RATING PLAN

ON

NEW YORK LARGE RISKS

(Risks with Expected Losses over \$13,500)

PART A — SUMMARY BY INDUSTRY GROUP

Industry Group	(1) No. of Risks	(2) Expected Losses	(3) (4) Modified Losses		(5) Ratio (4) ÷ (3)
			Present	Multi-Split	
Manufacturing ..	66	1,895,491	1,734,898	1,757,061	1.013
Contracting	22	615,463	594,572	593,799	.999
All Other	45	1,777,042	1,562,578	1,584,612	1.014
TOTAL.....	133	4,287,996	3,892,048	3,935,472	1.011