Inspection and Schedule Rating for Coal Mine Insurance.

BY

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When I was invited by your committee on program to address you on my subject I hesitated for some time to accept the invitation because I felt as a layman in appearing before you specialists concerning a matter which has occupied your professional talents for many years. I concluded, however, that regardless of my unfamiliarity with the subject and the fact that the methods to be pursued by The Associated Companies in schedule rating are not yet fully developed, I at least should gain sufficient benefit from your discussion of my paper to warrant me in running this risk.

You may recall that Mr. Carl M. Hansen in his address two years ago before the International Association of Casualty and Surety Underwriters stated that there were three methods through which merit rating can be successfully applied.

First, by assuming a hypothetically perfect plant, establishing the standards for safety therein and making charges for every deviation from these standards.

Second, by establishing a hypothetically very poor plant, applying the standards of safety established in the perfect plant, and crediting the owner for each item of standards complied with.

Third, by establishing an average plant with sub- and superstandards and corresponding charges or credits for each item of deviation therefrom.

The first he calls the most logical and scientific because it keeps before us at all times the standard of perfection aimed at, but there are some objections to it, especially on psychological grounds, because the base rate must be made comparatively low and be built up on by charging for deficiencies.

The second method calls for a comparatively high base rate which has a bad effect on securing business. In crediting reductions therefrom there is among others the objection that this method remunerates the employers for obeying the law.

The third method is that adopted by the Workmen's Compensation Service Bureau. This method has the distinct advantage that the base rate will be more easily determinable than under either of the other plans. It will more nearly approximate rates for insurance as based on the law of average.

The method which has been tentatively adopted by The Associated Companies is a fourth one not enumerated by Mr. Hansen. It is a combination of the first and third methods. It assumes the theoretically perfect mine, establishes standards for each item of hazard in that mine, with relative charge values for failure of any item to comply with the standard adopted. No deviation or discretion is allowed the inspector from the charge values adopted. It then establishes as the basis rate for each state or coal-mining district that rate which would apply to the average mine, one predicted on the law of average over a wide area of the same type of coal formation, as derived from the large amount of statistical experience available from state mine inspection departments, and standardized by the U. S. Bureau of Mines.

It is only necessary then to take the total number of charges or deviations for the particular mine from the standard mine for that district, compare this with the number of charges which correspond with the average mine for the state or district, and the difference is the deviation from the average mine or the number of credits or charges against the particular mine. These applied to the base rate adopted for the state or district give the adjusted schedule rate sought.

The relations which the Department of Inspection and Safety of The Associated Companies bear on behalf of coal-mining risks to the several member casualty insurance companies are quite similar to, though they differ in a few material respects from, the relations which the Inspection Department of the Workmen's Compensation Service Bureau bears on behalf of other industrial risks to the several subscribing casualty insurance companies. The chief point of difference is one which, however, while it affects the purposes of the two bureaus does not affect the methods employed in schedule rating by The Associated Companies. This chief difference consists in the fact that the associated companies act as one pooled or syndicated interest, each member receiving one-tenth of the net premium collected and each underwriting and being responsible for one-tenth of the liabilities; whereas, the larger group of casualty

companies served by the Workmen's Compensation Service Bureau acts each independently in receiving the whole premium earned on any risk and being each solely liable for the whole of any risk underwritten by it.

In some measure because of these differences, but particularly because the Department of Inspection and Safety of The Associated Companies had the way already blazed for it by the Workmen's Compensation Service Bureau, the former was confronted by a much easier task in the development of the methods of inspection and schedule rating necessary to coal-mine insurance under workmen's compensation. Furthermore, there was available to The Associated Companies as a scientific basis for its manual or base rate-making and for its inspection and merit rating a large amount of fairly accurate statistical data concerning accidents in coal mines, their causes and the possible means of preventing them which had been accumulated by the various state mine inspection departments and had been co-ordinated and utilized in the experimental work of the U. S. Bureau of Mines.

As a result of these conditions it seemed practicable at the outset to adopt what has been by some called the most scientific method of merit rating, viz., that based wholly on charges as distinguished from the system of charges and credits from a series of standards as adopted by the Workmen's Compensation Service Bureau. This decision was in a measure obligated, first by the opportunity to make use of the large amount of available statistical data showing fatalities by causes in each state, thus permitting the making of direct charges for improper mining practices or appliances in proportion to their effect on accident frequency, and, secondly, by the absence of standards as to safety in coal mining and the difficulty of fixing standards where the hazards are not those of machines, buildings or appliances but are chiefly such as differ with each mine according as the natural conditions under which the coal occurs and the methods of its extraction vary.

The reduction of the total number of charges made by the inspector against any mine to a system of credits and charges, thereby bringing into play the benefits of the merit system for schedule rating, is simply effected by the expedient of adopting in each state or mining district a standard percentage of perfection corresponding with the average mine. Any deviation in the number of charges recorded for the mine inspected, above or below the average

adopted as standard for the state, furnishes the basis for converting the charges into credits or charges and of consequently reducing or increasing the base rate adopted for the state.

There was available as a basis for the system the experience or statistical data tabulated by the Bureau of Mines from a study made of the causes of 49,733 fatalities officially recorded by state mining departments. These records extend over periods ranging from five to forty years according to the state. The Associated Companies has tested this data by the records of serious injuries, which are fairly extensive for some states, but less so in others, and though probably not accurate in any are doubtless reasonably consistent as to ratios of causes and because of the large number of cases available.

This accident experience by causes has been adopted by The Associated Companies as the basis of its system of inspection and merit rating.

It has been grouped for each state into ten classes of physical and two classes of moral causes of accidents. These are used as experience multiples according to percentages of each to the total.

The ratio of each of the ten classes of physical causes of accidents to the total fatalities studied was assumed to amount to sixty per cent. of all the preventive measures which might be adopted, the remaining forty per cent. of the preventive measures being allotted to the moral hazard or what the Workmen's Compensation Service Bureau classify under the heads of Safety and Welfare, and of General Order, Light and Sanitation, which groups are designated under the classification of The Associated Companies as Safety Organization and Safety Measures, respectively, to each of which is assigned one-half of the moral hazards.

Because the statistics of fatalities for the earlier years were not so reliable as the more recent data acquired since the creation in 1910 of the Bureau of Mines and because the data procured by the state departments for the Bureau of Mines since 1910 is of more scientific and co-ordinate nature, that only has been used in developing the experience multiples or weights used in each of the twelve classes of accident prevention measures adopted as a basis of the rating scheme of The Associated Companies for the whole United States as follows:

I. Safety Organization	20.0
II. Safety Measures	20.0
III. Surface Hazards	4.1
IV. Shaft Hazards	1.6
V. Haulage Underground	9.1
VI. Falls of Coal or Roof	28.3
VII. Explosives	3.2
VIII. Electricity	2.0
IX. Mine Gas	3.8
X. Coal Dust	5.0
XI. Mine Fires	0.6
XII. Miscellaneous Underground	2.3
Total	100.0

The above percentages or weights will differ in each state according to its experience. Thus, in Alabama the weight for coal dust (explosions) is 10.9, whereas in Iowa where coal dust explosions rarely occur the corresponding weight is but 2.1. Similarly, in Alabama the weight for falls of coal or roof is 23.0, and in Iowa 35.4.

Each of the above twelve experience classifications is subdivided into a number of secondary causes each of which if removed would make the mine more safe in so far as anything can be made physically safe with due allowance only for carelessness, negligence and unavoidable causes. This subdivision consists in dividing each class into 100 charge points or values and these are apportioned among the subdivisions of each class proportionally to their relative influences in producing accidents. Thus, for example under Class VII, Explosives, the 100 points are distributed among fourteen charge items, the presence of any of which may cause an accident in the handling or use of explosives. These are: the kind of explosive 10 points, surface magazines 4 points, maximum amount of explosive allowed per miner daily 8 points, method of carrying to face and storing underground 7 points, maximum amount and position of charge 12 points, use of mixed charges 4 points, methods of cleaning and loading holes 4 points, tamping material and method 5 points, shooting, by whom done 10 points, method of firing 10 points, time of shooting 5 points, treatment of misfires 12 points, careless use of powder and detonators 5 points, simultaneous firing of shots 4 points. Similarly, for the other classes.

It is pertinent to state here that while the adopted method of arranging experience weights for each class by states was obligated

by the existence of statistical data by states only, it furnishes by no means an accurate or scientific basis on which to schedule rate coal mines. This is because there are sometimes found even wider differences in the hazards of coal mining within the borders of one state than exist between two separate states. This is due to the differences in chemical composition and physical properties and occurrence of the coal. For example, this difference is so wide and so well known in Pennsylvania, as between the anthracite and bituminous districts, that fortunately the state mining laws and departments, as well as the statistics procured thereby permit the separation of Pennsylvania into two distinct districts with separate experience weights. Actually, for schedule rating purposes, there should be at least three districts produced by a separation of the bituminous coal mines into those which are gaseous and those which are non-gaseous. Similarly, for the state of Colorado, which like Pennsylvania, has a large catastrophe hazard, its mines should be divided and weights separately derived for at least three types or districts of coal in which the hazards of working differ materially. In Colorado, the chief catastrophe hazard is found in the gaseous or coking coals in the extreme southern portion of the state and another district of like kind which occurs near the central part of the state. In another portion of the state there occur lignitic coals with which the dust explosion hazard is probably very low, and in still another district non-gaseous bituminous coals are found. It is hoped through co-operation with the Bureau of Mines and also with the accumulation of experience by The Associated Companies to ultimately classify the coal mines by districts rather than by states. For the present this difference is cared for through the employment of inspectors skilled in the theory and science of mining as well as experienced in practical coal mining and inspection. Wherefore, a larger amount of personal latitude or deviation from the fixed charge values recorded in the inspection book is permitted these inspectors than would be desirable or necessary were the classification by mining districts or kinds of coal rather than by states.

Regarding the apportionment under each class of the 100 charge points among the several hazards as illustrated above for Explosives, it is recognized that these are subject to some modification with experience, though the experience so far had by The Associated Companies indicates much less liability to change in this

respect than in that relating to geographic classification. There was fortunately available a large amount of detail statistical data regarding the causes of mine accidents which aided materially in apportioning the charge points among the various subcauses under each class, and in addition The Associated Companies were fortunate in securing the advice of a number of mining men well qualified to discuss the subject. These included mining engineers, mine superintendents, state inspectors, the experts of the Bureau of Mines, and some of the more intelligent miners.

The inspector is provided with a Coal Mine Inspection and Rating Record somewhat similar in general arrangement to the Universal Inspection Report of the Workmen's Compensation Service Bureau. In this, under the twelve primary classifications are printed 148 principal sub-classifications each with the corresponding charge value adopted. In examining a mine he credits by check mark each item which he finds up to the standard provisionally adopted or enters the charge value in the appropriate column where the item of hazard falls below the standard. No latitude is allowed the inspector regarding the number of charge points he shall enter opposite the charge item. He may record the printed value only. Any recommendation for change therein is made by him as a comment.

After examination of the Inspection Report by the chief inspector there may develop reasons for modifying the charge values and the standards furnished the inspector authorize under certain circumstances the doubling of the charge value or its entire omission. Such remission of charge, for example, might be made under the classification Coal Dust even though the mine were dusty, were all sources of ignition removed, such as the firing of all explosives from the outside with all men out of the mine, coupled with the use of no open lights and of low voltage, well insulated and grounded electric installation. Under such circumstances the only source of ignition and the only opportunity for explosion would be present when there were no men in the mine to be injured. An occasion for double charge by the chief inspector would be, for example, flagrant lack of discipline or a particularly bad practice in shooting coal or the use of open or mixed lights in a gaseous or dusty mine.

The inspector transcribes the rough notes entered in his Record book to a carboned duplicate in letter form known as the Inspection

Report, one copy of which is retained in the Department of Inspection and Safety and one transmitted to the proposing company in order that the agent may take up in detail with the insured the nature of the hazards charged against this mine and may explain to him in detail or through reference back to the Department of Inspection and Safety have the mine operator technically advised as to the methods whereby he may correct the hazards charged and thereby earn on a subsequent inspection a reduction in his schedule rating.

The total charges entered by the Inspector under each class in his Report are transferred to a Rating Sheet which corresponds somewhat to the Universal Analytic Schedule of the Workmen's Compensation Service Bureau. The office and adjusted corrections made by the chief inspector are then entered. A correction may also be made for catastrophe hazard and under certain conditions for the proportion of payroll affected. The adjusted charge under each class is then multiplied by the experience weight for that class in the particular state. The effect is to make the charges under each class bear a direct relation to the accident frequency for that class in the state; as for example the frequency due to falls of coal, or to coal dust explosions in the particular state as distinguished from the accident frequency for the same class in another state.

The sum of these products of charges for the class multiplied by the class weight is a total percentage of charges for the state, or conversely this sum subtracted from one hundred gives the total relative percentage of perfection of the particular mine.

A number of methods of mathematically converting the total reduced charges or the percentage of perfection of the mine to a schedule rating have been tested. The essence of these lies in the adoption of a certain percentage of perfection as a standard or that corresponding with the average mine. This is also that which corresponds with the base or manual rate adopted for each state.

The only other element of the schedule rating plan of The Associated Companies yet awaiting final adoption is the fixing of standards for the several hazards. This has now been done tentatively and in a manner which will probably call for no more change hereafter than is now made from time to time in the safety standards adopted by the Workmen's Compensation Service Bureau. In the case of the latter the standards are as a rule those of a mechanical nature such as safeguards to machinery, protection to platforms or stairways, or other artificial physical hazards.

The standards for safety in coal mining are almost wholly of an entirely different nature, as they concern natural hazards of all kinds to which physical safeguards are difficult of application. They relate to the occurrence of gas in coals of different kinds and under different geologic and mining conditions. The occurrence of coal dust, its fineness and the condition of its admixture with air, its inflammability, the method of immunizing it by removal or wetting or admixture with non-explosive coal dust; the character and temperature of the source of ignition which may explode gas or dust, such as an explosive of more or less amount and of various kinds, the nature of the detonator which will fully explode the charge or may cause it to burn or blow out; the manner in which the explosive is placed which may effect its complete and harmless detonation or cause it to enflame or blow out; the resistance of the coal to the explosion which may affect either the possibility of igniting coal dust or the possibility of weakening the adjacent rock or roof thereby rendering it liable to disintegrate and fall at some subsequent date; the heat of other sources of ignition such as electric sparks, the flame of an open light, in fact a hundred interrelated elements none of which alone is practicable of standardization by the adoption of physical safeguards.

The moral hazards have been standardized to some extent by fixing the ratio of foremen, shot bosses and other safety bosses or inspectors to the number of employees underground and modified by the conditions and distances of travel underground; by defining the safety organization requisite, and the educational measures to be adopted for acquainting the miners with the hazards and the safe methods of their occupation; by the extent to which first aid materials and instruction, rescue apparatus, telephones, escapeways and other protective devices are necessary.

For the purpose of standardization mines have been divided into five classes, those employing less than ten men, those having between 10 to 50 men, from 50 to 150, from 150 to 500, and over 500 men, and the standards vary according to these classes.

Like the Workmen's Compensation Service Bureau the purposes of The Associated Companies in establishing a Department of Inspection and Safety may be stated, as follows:

To provide for the inspection of coal mines by mining men skilled in the inspection of mines with regard to the safety measures

applicable therein, and their classification according to merit as regards the safety and efficiency of methods, appliances and machinery, the care and discipline exercised in the management and conduct of the work, the history of the risk in respect to casualties, and such conditions, moral, physical or otherwise as may affect the safety of the mine operation.

To secure to mine operators equitable rates of insurance as a reward for efforts made to reduce the number of accidents and eliminate the danger of personal injuries to workmen.