AN ACTUARIAL NOTE ON EXPERIENCE RATING NUCLEAR PROPERTY INSURANCE

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By the end of 1971, the insurance pools writing nuclear property insurance (Nuclear Energy Property Insurance Association and Mutual Atomic Energy Reinsurance Pool) had since inception in 1959 earned about $47 million in premiums and had incurred loss and loss expense of nearly $15 million. After an accounting for all expenses, it was clear that a substantial profit had been made. However, it is recognized that this is a highly catastrophic coverage. The pools are now writing many policies with combined limits of $100 million. A nuclear accident might wipe out, in literally a few seconds, more than twice all premiums earned during the thirteen-year life of the pools. Since the level of earned premiums on all risks at the end of 1971 was only $11.5 million, the insurers were opposed to any reduction in rates, in spite of the good record.

Nevertheless, the insurers felt that an in-depth study of rating procedures was in order, and late in 1971 asked the Nuclear Insurance Rating Bureau to make one. NIRB appointed a subcommittee of five actuaries to undertake such a study and to make whatever recommendations it felt advisable. The subcommittee was also given an immediate assignment of developing a plan to make nuclear property rates more responsive to experience.

It was an interesting challenge. How do you recognize in a rating formula the real possibility of very severe losses? No such losses have yet occurred (the largest to date was one for about $3.5 million) but the potential is ever-present. A complete melt-down of the core of a large power reactor would probably cost the pools $30 million, and this assumes that no radioactivity escapes the reactor vessel. Contamination of the primary or secondary loops, or of the turbine equipment, would quickly run the loss very much higher.

The subcommittee, after consultations with engineers and underwriters, approached the problem by dividing the loss portion of the premium dollar into two equal parts: normal loss and excess loss. The subcommittee also assigned to the excess loss portion in the rating formula limited credibility, until the volume of premium has grown much greater.

Normal losses were arbitrarily defined as the first $5 million part of every loss, and excess losses as those parts of any losses in excess of $5 million. The split of total expected losses between normal losses and excess losses was necessarily arrived at on a judgment basis. There is no body of large nuclear property losses. Distributions of large fire losses were examined, and according to these indications, 50% is too much to assign to losses between $5 million and $100 million. While the standard should be considerably less, the engineers and the underwriters felt that the peril of nuclear contamination greatly enhances the probability of catastrophe loss and that a substantial part of the loss money must be set aside for such an event.

Based on these concepts, a complete rating guide was developed and submitted to the Nuclear Insurance Rating Bureau, which adopted it to apply to policies effective on or after March 1, 1972.

Industry Experience Rating Guide

The experience rating guide is traditional in form, in that it seeks to compare expected losses with actual losses, modified by various credibility factors, and thus to establish credits or debits prospectively. It is unique in the following respects:

1. It applies equally to all domestic policies issued by the pools, regardless of the loss history of any particular risk, and thus provides an element of stability and uniformity to insurers and insureds alike. To proceed otherwise would either mean very wide swings in the rates for particular insureds or a relatively insensitive formula.

2. The experience rating period is 10 years for normal losses and 20 years for excess losses. Normal and excess losses are defined as above. The bulk of the total losses is expected to be normal losses, and a 10-year period is felt to be sufficient to give them full credibility. The 20-year period for excess losses, for which there is precedent in the making of windstorm rates in many states, is needed to provide stability and continuity in the nuclear structure. Until such time as 20 years of experience is available, the total experience since inception will be used. Limited credibility is given to excess losses.

Rating Formula

The formula for the rate modification is:

$$\frac{A_n + A_e Z + E_e (1.000 - Z)}{E_t}$$

Where A_n is actual Normal Limits loss ratio,
A_e is actual Excess Limits loss ratio
Z is the credibility factor
E_e is expected Excess Limits loss ratio, and
E_t is total expected loss ratio

"Loss" includes loss expense.
The expected loss ratio is unity minus the expense ratio.

The Normal Limits loss ratio is the normal losses incurred in the latest 10 years divided by the total premiums earned in the 10 years. The Excess Limits loss ratio is the excess losses incurred in the latest 20 years divided by the total premiums earned in the 20 years. All earned premiums are modified to eliminate the effect of the experience rating modifications produced by this guide.

The experience periods end November 30 of the year prior to the rating year for which experience rates are to be calculated. This coincides with the fiscal year of the pools. The rating year commences the subsequent March 1, an arrangement which permits sufficient time to collect and consolidate the experience and to make the necessary rating calculations. The experience rating modification applies to all policies effective on and after that date, for a period of one year, and policies may not be cancelled and rewritten to take advantage of, or to avoid, a change in such factor. All nuclear property policies are written for a period of one year.

Expenses

The expenses since inception were carefully reviewed and current expense levels were determined. These include commissions, pool administration, inspections (both fire and boiler and machinery), taxes, company overhead and a loading for profit and contingencies.

The total expense factor for the first year of the rating guide is .336. Thus, the total expected loss ratio is .664, and is divided equally between expected normal and expected excess loss ratios, or .332 each.

The expense factors are to be reviewed periodically and updated to reflect actual current costs.

Credibility

The Normal Limits loss ratio receives 100% credibility. The Excess Limits loss ratio receives up to 50% credibility, depending on the total earned premium during the 20 year period, as follows:

Total Earned Premium in Millions of Dollars	Credibility Factor
0-12	.00
13-40	.05
41-71	.10
72-106	.15
107-145	.20
146-189	.25
190-240	.30
241-300	.35
301-369	.40
370-452	.45
453-552	.50
over 552	to be determined

In this context also, the earned premium is adjusted to eliminate the effect of experience rating factors of this guide.

The table is based on the formula:

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

where P is the 20-year earned premium and K is a constant. The subcommittee wanted a substantial amount of premium built up before applying a credibility factor as high as 50%. From reports of power reactors under construction and in planning, it is estimated that at the end of the next ten years, or about 1982, the pools will have earned $500 million premium since inception. Thus, it appeared reasonable to set K at $500 million and to construct the table. It is not intended to interpolate the credibility factors, and on this basis the premium intervals were calculated.

The course of action to be taken when earned premium over a 20-year period exceed $552 million was deferred for a future decision.

Computation Of A Sample Modification

1.	Normal Limits losses For 10 year rating period	$15,000,000
2.	Total earned premium for 10 year rating period	45,000,000
3.	Actual Normal Limits loss ratio (1) ÷ (2)	.333
4.	Excess Limits losses for 20 year rating period	$ 0
5.	Total earned premium for 20 year rating period	$48,000,000
6.	Actual excess Limits Loss Ratio (4) ÷ (5)	.000
7.	Total Expected loss ratio	.664
8.	Excess Limits expected loss ratio .5 × (7)	.332
9.	Credibility factor based on (5)	.100
10.	Modification: $\dfrac{(3) + (6)(9) + (8)[1.00 - (9)]}{(7)}$	.951
11.	Credit	4.9%

Comments

The actual modification produced for 1972 was a rate credit of 7.7%. This is a modest credit, and it is certainly hoped that such a situation will continue indefinitely. Tests have shown that if there are no excess losses and if the normal limits loss ratio continues to hover around 30%, credits will gradually build up to about 16% in 1975 and over 30% in 1979.

On the other hand, a $25 million loss in 1972, a thoroughly catastrophic event to the pools, would produce a modification of .998, or a credit of 0.2% on the rates. This calculation assumes that the 1972 earned premium, unmodified, is $15 million and that the normal loss ratio is the expected, .332.

Under the same conditions a $50 million loss in 1972 would produce a debit of 6.0%.

If there were $12 million losses in 1972, with no single loss over $5 million, the resulting debit would be 12.7%.

Thus it is clear that the rating guide, as constructed, prevents wild rate swings from year to year, yet appears to produce a reasonable and balanced response to actual experience.

In conclusion, it is hoped that there will be a frequent review of this guide, and of the many assumptions underlying it, in the light of actual experience. Perhaps the $5 million excess loss definition could be set at $7.5 million, or $10 million, with an increasing emphasis on normal loss experience. Even without such change, consideration may be given to the allocation of more than 50% of the loss portion of the premium to expected normal losses, with less to expected excess losses. The expense portion, of course, should be updated constantly to reflect actual costs. The ultimate objective is to produce the most equitable results to insureds and insurers alike.