A REVIEW OF NUCLEAR ENERGY INSURANCE

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It is now over eleven years since the first binder was issued by the nuclear insurance pools and it seems appropriate to take a new look at nuclear energy insurance. This cover is one of the smallest, but fastest growing, and certainly the most unique of modern times. It is important to understand, not only for its own sake, but also for the innovations in the formation of pools of insurance companies, the complete cooperation between stock and mutual companies, the close coordination with government agencies, and the many efforts to foster and encourage a growing, dynamic industry.

There are two sides to the story — liability insurance and property insurance. They will be treated here sometimes together, sometimes separately. As to liability insurance, we already are indebted to Mr. Richard H. Butler for his very fine paper, "Liability Insurance for the Nuclear Energy Hazard," published in Vol. XLVI of the *Proceedings*. The reader is strongly advised to review that work. It is surprising how little has changed since 1959. It is this writer's difficult task to follow in Mr. Butler's footsteps, summarize much of the information, set forth what changes have occurred, and (with the incalculable advantage of hindsight) comment on the underwriting experience. As to property insurance, the trail has not been blazed so thoroughly, but it is also a fascinating story and one of equal importance.

Atomic Energy Act of 1954

When President Eisenhower signed this act he inaugurated an era of the peaceful use of atomic energy. He invited the utility industry, medicine, research, geophysical exploration firms, and others of a wide variety of private endeavor to experiment with nuclear materials, either for profit or for advancement of knowledge, or both. A great deal of literature was declassified, and nuclear materials were made available under careful controls.

Response was initially slow. To the average man, nuclear energy was equated with the atom bomb and vast destruction. It was all so new and, so far as he knew, highly dangerous. One cannot see ionizing radiation, or feel it, or sense it in any way. Also, the financial planning required to

launch a power reactor was enormous. Most of them, in the beginning, were frankly experimental in nature, designed more as pilot plants to learn more about this new energy source than as practical money-makers.

Need for Huge Limits

It became obvious rather quickly that the nuclear reactor owners would require limits of liability far in excess of those available at the time. Liability insurance in amounts of $10 million, $25 million, $50 million, or even more was asked for. The values for property insurance started out at about $20-25 million, but very soon much larger installations were planned, having values over $75 million initially.

Demands in these amounts were quite beyond the capacities of individual insurance companies, even with heavy reinsurance, and it soon became clear that large pools of insurance companies would have to be formed.

Formation of Pools

During 1956 three nuclear energy insurance pools were formed, two of stock companies and one of mutual companies. One stock pool handles liability insurance only — Nuclear Energy Liability Insurance Association (NELIA). The other handles property insurance only — Nuclear Energy Property Insurance Association (NEPIA). They conduct their affairs quite separately. The mutual pool, Mutual Atomic Energy Reinsurance Pool (MAERP), is so constituted as to handle both liability and property insurance. The allocation of capacity to the two lines is made by its underwriting committee.

NELIA originally had 138 members and an underwriting capacity of $46,500,000 per risk. NEPIA originally had 189 members and an underwriting capacity of $50,000,000 per risk. MAERP originally had 105 members and an underwriting capacity of $13,500,000 per risk for liability and $10,000,000 per risk for property insurance. In each case the actual capacity of the pool was somewhat more than the indicated underwriting capacity; a margin was maintained so that fluctuations from year to year would not cause changes in limits afforded to those insureds purchasing maximum limits.

The combined pools thus could issue policies up to $60,000,000 separately for liability and for property, risking a possible exposure of $120,000,000 in one occurrence. Such figures were quite without precedent and are a great tribute to the courage and energy of the pioneers who undertook to put the pools together, and of the company executives across the country who subscribed unusually large amounts. Even after eleven

years of good experience no one will deny this is risky business indeed, but imagine how uncertain it looked then.

In 1965 the three pools made successful drives for new capacity and effective January 1, 1966 the underwriting limits stood at:

NELIA	— $57,350,000
MAERP (liability)	— 16,650,000
NEPIA	— 60,000,000
MAERP (property)	— 14,000,000

Thus for each line of insurance a single insured can purchase liability insurance policies with limits totaling $74,000,000, and the same for property insurance, or a total of $148,000,000 riding on one occurrence.

At the time of the writing of this paper the pools once more are seeking capacity. Success is uncertain. Not only have the numerous mergers acted to cancel some subscriptions, but also there has been a definite shrinkage in the reinsurance markets of the world, for a variety of reasons.

Mechanics of Policy Issuance

NELIA issues a "subscription" liability policy; that is, there are some forty-four pool members as primary insurers on the policy at present. These are the companies which are licensed to write liability insurance in all states. Each one insures "severally, not jointly," for a fixed percentage stated in a schedule attached to the policy. Of course, the entire policy is reinsured by NELIA as a whole.

Rather than involve so many companies, the mutuals organized a 6-company underwriting association — Mutual Atomic Energy Liability Underwriters — to write its liability policies. MAELU, indeed, is the name by which most people know the Mutual pool, rather than by its parent MAERP. These six large mutuals likewise insure severally, not jointly, for stated percentages.

NEPIA similarly issues a multi-insurer policy. This is the method used by the Factory Insurance Association, and since NEPIA is administered largely by FIA it is natural they do so. The mutuals, on the other hand, when issuing nuclear property insurance, do so through a single company, which is reinsured 100% back into MAERP.

Whether mutual or stock, the policy forms and rates are identical. When separate policies are issued insuring a single installation, they are on a pro rata participating basis, and one is never excess of the other.

For annual statement purposes, nuclear property insurance is coded to

line 5, Commercial Multiple Peril, and liability insurance to line 17, Liability Other Than Auto (B.I.).

Reinsurance

NELIA and MAELU mutually reinsure each other, and so do NEPIA and MAERP. Inasmuch as the policies are identical in substance and the pools reinsure each other on all domestic risks, the net underwriting results of NELIA and MAELU over the years have been substantially the same, and likewise those of NEPIA and MAERP.

The reinsurance percentages correspond roughly to the relative contributions to capacity. NELIA reinsures 77.5% of everything that MAELU writes, and MAELU reinsures 22.5% of evertyhing that MELIA writes. These liability percentages have been unchanged since the inception of the pools. The property percentages have changed slightly from year to year. Presently NEPIA and MAERP exchange reinsurance on every domestic risk on the basis of 81.1%-18.9%.

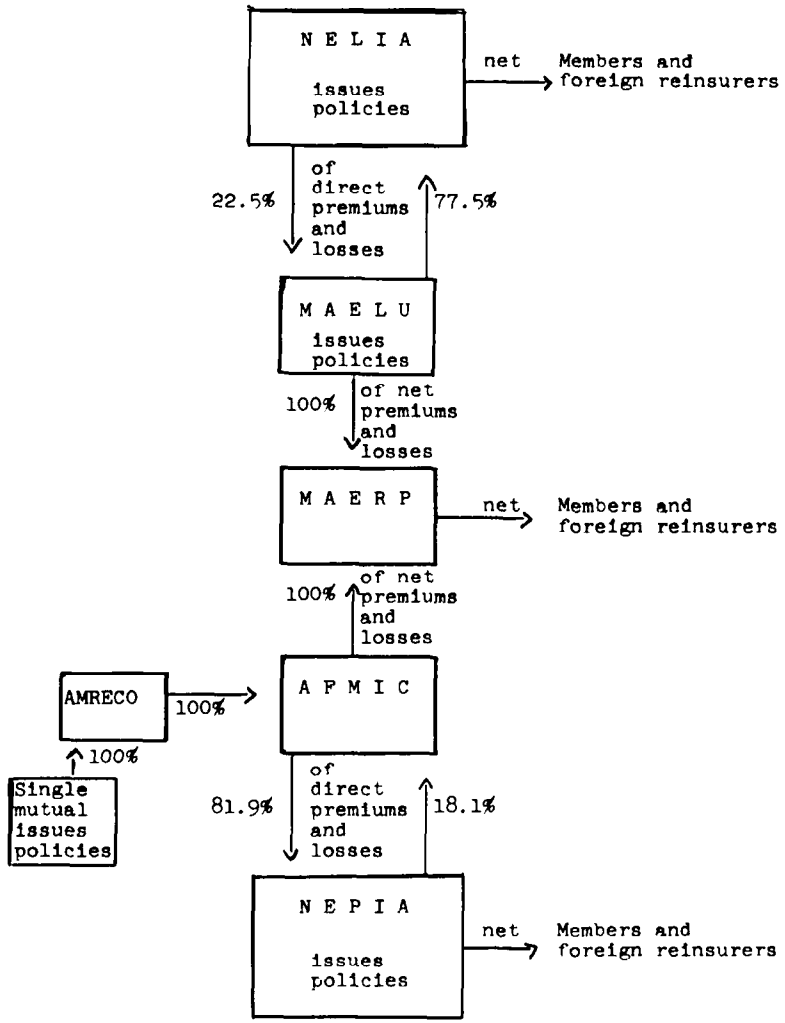
We have said that the original property policy on the mutual side is issued by a single insurance company. For technical reasons, this policy is not ceded directly to NEPIA, but rather is first ceded to American Mutual Reinsurance Company, then 100% to Associated Factory Mutual Insurance Companies (AFMIC), which in turn cedes it 100% to the parent pools.

About one-third of the capacity of all American nuclear pools is provided by foreign reinsurance. This is a tremendous amount, over $50 million, all on a pro rata basis. Support has been forthcoming from not only England and Europe, but also from companies in Sweden, Finland, Argentina, Colombia, Ecuador, India, Japan, and other countries around the world. Thus a contamination loss in Iowa may have its ultimate effect (very small, to be sure) on an insurance company in Australia.

Many of these countries have their own nuclear energy insurance pools, a few of which are supported by NELIA, NEPIA, or MAERP. For example, Nuclear Insurance Association of Canada (NIAC) draws some support from the American pools. These underwriting results are not shared among the American pools; only domestic risks are mutually reinsured, and the pools do not cooperate with respect to foreign risks.

Exhibit A illustrates the flow of reinsurance among the domestic pools and to foreign reinsurers. The whole thing appears rather complex, and certainly there have been problems, but it has worked out rather smoothly once the concepts were agreed on and the contracts exchanged.

EXHIBIT A



NELIA - Nuclear Energy Liability Insurance Association
MAELU - Mutual Atomic Energy Liability Underwriters
MAERP - Mutual Atomic Energy Reinsurance Pool
AFMIC - Associated Factory Mutual Insurance Companies
NEPIA - Nuclear Energy Property Insurance Association
AMRECO - American Mutual Reinsurance Company

Exhibit B sets forth the capacity story of the pools from 1957 to the present.

Exclusion Endorsements on Ordinary Policies

Almost all kinds of policies now carry some kind of exclusion for loss arising from the nuclear hazard. Insurers and reinsurers, having responded to the maximum to the appeal of the nuclear pools for support, simply cannot afford to exceed this maximum. Thus very careful steps have been taken to prevent any pyramiding of limits.

The Fire policy exclusion clause reads as follows:

"The word 'fire' in this policy or endorsements attached hereto is not intended to and does not embrace nuclear reaction or nuclear radiation or radioactive contamination, all whether controlled or uncontrolled, and loss by nuclear reaction or nuclear radiation or radioactive contamination is not intended to be and is not insured against by this policy or said endorsements, whether such loss be direct or indirect, proximate or remote, or be in whole or in part caused by, contributed to or aggravated by 'fire' or any other perils insured against by this policy or said endorsements; however, subject to the foregoing and all provisions of this policy, direct loss by 'fire' resulting from nuclear reaction or nuclear radiation or radioactive contamination is insured against by this policy."

An identical clause appears in the standard homeowner's policy, and a similar clause is included when the fire policy includes extended coverage. A very similar exclusion appears in the typical inland marine policy, of whatever sort. The various special multi-peril and commercial multi-peril policies all contain these wordings.

Automobile and aircraft physical damage policies all carry the simple exclusion "This policy does not apply to loss due to radioactive contamination."

The general boiler and machinery policy states:

"This policy does not apply . . . . . to loss, whether it be direct or indirect, proximate or remote (a) from an accident caused directly or indirectly by nuclear reaction, nuclear radiation or radioactive contamination, all whether controlled or uncontrolled, or (b) from nuclear reaction, nuclear radiation, or radioactive contamination, all whether controlled or uncontrolled, caused directly or

EXHIBIT B

HISTORY OF

NUCLEAR INSURANCE CAPACITY

(as of each January 1)

000 omitted
Even years omitted

Physical Damage	1957	1959	1961	1963	1965	1967	1968
NEPIA							
Domestic	$ 39,532	$ 39,307	$ 39,167	$ 36,432	$ 34,942	$ 40,517	$ 40,437
Foreign Reinsurers	18,615	18,497	17,004	16,329	17,518	21,240	21,837
Total	58,147	57,804	56,171	52,761	52,460	61,757	62,274
MAERP							
Domestic	7,161	7,255	7,255	7,278	7,301	9,532	9,508
Foreign Reinsurers	3,491	3,489	3,149	3,264	3,660	4,997	5,135
Total	10,652	10,744	10,404	10,542	10,961	14,529	14,643
Total Phys. Dam.	$ 68,799	$ 68,548	$ 66,575	$ 63,303	$ 63,421	$ 76,286	$ 76,917
Liability							
NELIA							
Domestic	$ 34,435	$ 34,056	$ 33,712	$ 33,220	$ 33,271	$ 38,610	$ 38,345
Foreign Reinsurers	16,108	15,886	14,230	14,474	16,235	20,334	19,916
Total	50,543	49,942	47,942	47,694	49,506	58,944	58,261
MAELU							
Domestic	9,889	10,019	10,019	10,051	10,083	11,985	11,915
Foreign Reinsurers	4,679	4,675	4,229	4,379	4,920	6,002	6,209
Total	14,568	14,694	14,248	14,430	15,003	17,987	18,124
Total Liability	$ 65,111	$ 64,636	$ 62,190	$ 62,124	$ 64,509	$ 76,931	$ 76,385
Grand Total	$133,910	$133,814	$128,765	$125,427	$127,930	$153,217	$153,342
Domestic Stock	73,967	73,363	72,879	69,652	68,213	79,127	78,782
Domestic Mutual	17,050	17,274	17,274	17,329	17,384	21,517	21,463
Foreign Reinsurance	42,893	42,547	38,612	38,446	42,333	52,573	53,097
Total	$133,910	$133,184	$128,765	$125,427	$127,930	$153,217	$153,342

indirectly by, contributed to or aggravated by an accident; nor shall the Company be liable for any loss covered in whole or in part by any contract, carried by the insured, which also covers any hazard or peril of nuclear reaction or nuclear radiation."

Notice that the fire policy does cover loss from fire even if a nuclear incident started the fire, while the boiler policy excludes any loss caused by a nuclear incident, or any nuclear damage caused by a non-nuclear accident. Also, the policy will not share a loss, nuclear or non-nuclear, with a policy which does cover nuclear damage.

The plate glass policy says:

"The insurance does not apply . . . . . to nuclear reaction, nuclear radiation, or radioactive contamination, or to any act or condition incident to any of the foregoing."

All liability policies (save only aircraft liability) carry an exclusion which we will examine in some detail later on. Thus, the only ordinary fire and casualty policies which carry no nuclear exclusion are workmen's compensation, accident, burglary, fidelity, surety, and (curiously) ocean marine policies.

Radioactive Contamination Assumption Endorsement

In spite of all the foregoing, the fire insurance companies have responded to a demand by users of certain nuclear materials (such as hospitals with radiation sources, or factories using radioisotopes in thickness gauges) for clean-up insurance in the event of a spillage or other accident. So long as the loss arises from material on the premises, a limited coverage is granted. The Radioactive Contamination Assumption Endorsement (Broad Coverage) reads (in part):

"In consideration of the premium for this coverage, and subject to the provisions herein and in the policy to which this endorsement is attached including endorsements thereon, the provisions of this policy, including other endorsements, are hereby modified and this policy is extended to insure against direct loss by sudden and accidental radioactive contamination, including resultant radiation damage to the property covered, provided such radioactive contamination arises out of material on the Insured's premises at the location(s) described in this policy, and provided, at the time of such loss, there is neither a nuclear reactor capable of sustaining nuclear fission in a self-supporting chain

reaction, nor any new or used nuclear fuel which is intended for or which has been used in such a nuclear reactor, on the Insured's premises at the location(s) described."

This type of accident cannot pyramid with other nuclear loss arising from a source *outside* the premises, so that it may be dealt with singly. However, caution must be exercised when issuing the Radioactive Contamination Assumption Endorsement. The company should check its reinsurance contract. The typical reinsurance contract excludes contamination, excepting only by radioactive isotopes. A laboratory studying plutonium in minute amounts, for example, would not be reinsured.

Nuclear Insurance Policy — Property

We are now ready to turn to the property policy which the pools issue.

It is an all-risk policy. In the beginning, some thought was given to insuring only nuclear perils, leaving the fire and other perils under ordinary insurance. This was found not feasible, however, because of the difficulty of distinguishing a nuclear from a non-nuclear loss. If we had separate policies on a power reactor, and an explosion occurred, it might be very difficult to determine whether the nuclear damage was caused *by* the explosion, or whether some untoward nuclear occurrence caused the explosion. The same dilemma occurs when we consider the fire peril.

The solution is to include all perils in the same policy, excluding only what is specifically excluded. The insuring clause reads:

"The Company . . . agrees to indemnify the insured and legal representatives, to the extent of the actual cash value of the property at the time of loss, but not exceeding the amount which it would cost to repair or replace the property with material of like kind and quality within a reasonable time after such loss, without allowance for any increased cost of repair or reconstruction by reason of any ordinance or law regulating construction or repair, and without compensating for loss resulting from interruption of business or manufacture, nor in any event for more than the interest of the Insured, against RADIOACTIVE CONTAMINATION AND ALL OTHER RISKS OF DIRECT PHYSICAL LOSS, EXCEPT AS HEREINAFTER PROVIDED, to the property described in the Declarations and situated at the location(s) specified therein." (Capital letters *not* mine.)

The policy also includes limited insurance for debris removal and decon-

tamination, for property of others, and for removal of property from premises.

The exclusions follow (some are quoted here in full for their special interest, while others are abbreviated):

(1) "Gradual accumulation of radioactive contamination."
Comment: All nuclear installations are subject to gradual contamination, cleaned up from time to time, and this is virtually uninsurable.

(2) "Radioactive contamination at any location specified in the declarations, resulting from matter released from any source outside the premises of that location."
Comment: Here again is the precaution against "doubling up" on the limits.

(3) Neglect . . . to save and preserve. . . .

(4) Mysterious disappearance, or shortages.

(5) Fraud, etc., by an officer.

(6) Order of civil authority.

(7) Theft, pilferage, burglary or larceny, etc.

(8) "Depletion, depreciation, wear and tear; or deterioration, including that of fuel element cladding."

(9) Damage to stock in process from manufacturing operations.

(10) Dampness, dryness, rust, corrosion, etc.

(11) Water damage, variously described.

(12) Earthquake, volcanic eruption, landslide or sinking of land, etc.
But the Company agrees, with respect to exclusions 7 to 12 inclusive, to be liable for ensuing loss by fire, explosion, radioactive contamination or any other peril not excluded.

(13) Accounts, bills, currency, deeds, etc.

(14) (a) "Records, manuscripts, and drawings, for loss in excess of their value blank plus the cost incurred for actually transcribing or copying them, except as provided in (b);

(b) media, data storage devices, and program devices for electronic and electro-mechanical data processing or for electronically controlled equipment, for loss in excess of the cost of reproducing such media, data storage devices and program devices from duplicates of from originals of the previous generation of the media, and no liability is assumed hereunder for the cost of gathering or assembling information or data for such reproduction."

(15) "Land, unless otherwise provided by endorsement added hereto."

(16) "Animals, lawns, plants, shrubs or trees."

(17) "Vehicles licensed for highway use, aircraft or watercraft, except when such vehicles, aircraft or watercraft are being used for the servicing of or in connection with the operation of the property covered by this policy."

There follows the usual war clause which, however, also excludes "loss caused directly or indirectly by . . . any weapon of war employing nuclear fission or fusion whether in time of peace or war."

There is a mandatory deductible clause with the provision that it shall not apply to a loss in excess of 50% of the amount of insurance applicable to the location covered under the policy. The mandatory deductibles are:

1. Fuel fabricators, fuel processors, etc., with no reactor on the premises over one megawatt thermal capacity: — $1500 plus ¼ of 1% of the amount of insurance, not to exceed $5000.

2. Reactors over one megawatt thermal capacity, other than power reactors: — $2500 plus ¼ of 1% of the amount of insurance, not to exceed $10,000.

3. Power reactors and fuel reprocessing plants: — $5000 plus ¼ of 1% of the amount of insurance, not to exceed $50,000.

An apportionment (other insurance) clause follows, providing for the usual pro-ration on the basis of limits. It becomes meaningful when we consider the larger locations requiring a policy from both the stock and the mutual pools.

The remaining parts of the policy, except those below, are those usually appearing in the typical property policy. The unusual clauses follow:

1. INSPECTION AND SUSPENSION. *Comment:* This clause permits the Company to suspend the insurance on the spot should an engineer or inspector discover a dangerous condition with respect to a machine or vessel, and the insured does not comply with a request to take such vessel or machine out of service for correction. The suspension notice must be in writing. Any reinstatement must be by an endorsement issued to form a part of the policy.

2. SUBROGATION: *Comment:* (a) Except as provided in (b), the Company enjoys the usual right to require action by the insured against any one responsible for a loss, except that prior to a loss the insured may waive any or all right of recovery against a specific party.

   (b) "This Company hereby waives any right of subrogation acquired against any party, furnishing services, materials, parts or equipment in connection with the planning, construction, maintenance or operation, or use of property covered hereunder by reason of any payment under this policy arising out of any loss resulting from the radioactive, toxic, explosive or other hazardous properties of 'source material,' 'special nuclear material,' or 'by-product material' as such terms are defined in the Atomic Energy Act of 1954 or any law amendatory thereof."

   Comment: Part (a) of the clause permits an insured, prior to a loss, to agree to hold anyone harmless from liability for such loss, be it a fire loss, or a boiler explosion or what have you. Part (b) is a blanket waiver with respect to nuclear losses, as defined, before such losses may occur. It is of considerable importance to the liability pools, who may be insuring the designer of or a supplier to an installation, and it minimizes the possibility of the property pools seeking recovery from the liability pools for a loss.

3. AGGREGATE LIMIT OF LIABILITY AND REDUCTION OF POLICY AMOUNT BY LOSS. "The amount of insurance at any one location as stated in the Declarations is the limit of this Company's liability for the aggregate of all losses occurring within the policy period . . ." (etc.). *Comment:* A loss reduces the insurance Reinstatement, optional with either party, is only by endorsement. Years ago this is the way all property policies worked, but gradu-

ally automatic reinstatement of loss came about in its place. Not so with nuclear policies.

Rating Nuclear Property Insurance

Rates and forms are prescribed by the Nuclear Insurance Rating Bureau, through committees and subcommittees appointed for that purpose. Theirs was never an easy task. It is seen from the discussion of the policy coverage above that the perils are those of fire and EC, vandalism and malicious mischief, boiler and machinery, nuclear and whatever perils are left by virtue of the all-risk coverage. The traditional fire coverages as such pose no insuperable problems. But since it was decided to base the entire policy premium on the amount of insurance, like fire insurance, it becomes necessary to translate boiler and machinery premiums from ones based on schedules of objects to ones as loadings in the fire rate. This is hard under the best of circumstances, and even more difficult in view of the large deductibles associated with some of the larger power reactors.

Let us assume a nuclear power reactor is to be insured. First, an exhaustive inspection is made by the pool engineer, and a copy submitted to the local fire rating bureau for development of advisory fire and EC, vandalism and malicious mischief, and sprinkler leakage rates, as guides to the Nuclear Insurance Rating Bureau. This is much the same as is done for a highly protected risk, which, indeed, most of these installations are. The Nuclear Insurance Rating Bureau then adds to these rates the boiler and machinery increment mentioned above, a nominal loading for the all-risk, and a loading for the nuclear exposure.

Calculation of the nuclear loading in the rate for reactors is a somewhat complex affair, with the final rate depending on (a) the type of reactor, (b) its use, (c) its authorized power level, and (d) how well it is contained. A number of "value units" is assigned, depending on these factors.

The value units are multiplied by a base rate to arrive at the nuclear rate, in cents.

A similar plan is established for premises, other than reactors, which are used to store, handle, or process nuclear materials (such as fuel fabricators), and for adjacent buildings. There is another schedule of rates for nuclear materials in transportation (there is a Supplier's form and a Carrier's form),

and one for nuclear risks in the course of construction, the Builders Risk policy.

All rates are annual rates. Although the effective date of the nuclear property policy may be at any time during the year, its term may not exceed one year.

Deductible Credits

An insured may elect a deductible in excess of the mandatory deductible, and it has been the practice of some of the larger utilities to elect the maximum, $250,000. The table of credits follows:

Deductible	% Credit
$ 1,500	7.0
2,500	9.7
5,000	13.2
10,000	15.0
25,000	20.0
50,000	25.0
75,000	27.5
100,000	30.0
250,000	32.9

In applying the deductible credits, it is assumed that the rates promulgated for the all-risk and nuclear loadings already reflect the mandatory deductible. The fire and EC rates published by the local fire bureau, of course, are base rates.

The formula for mandatory deductibles produces odd amounts, which are rounded to the nearest $5. Thus, a deductible of $1,975 may be required for a certain installation. A graph is used for interpolating the above table to arrive at the proper credit. The following are examples of the application of the credit schedule (omitting consideration of the boiler and machinery component of the rate):

a. Typical fuel fabrication facility

Amount of insurance: $45,400,000 P.D. with $5,000 mandatory deductible

	Make-up Reflecting Credit for Mandatory Deductible	Make-ups Reflecting Optional Deductibles				
	$5,000	$10,000	$25,000	$50,000	$75,000	$100,000
Fire and EC	.042	.041	.038	.036	.035	.033
Nuclear	.060	.059	.056	.053	.052	.050
All risk	.015	.015	.014	.014	.013	.013
Total	.117	.115	.108	.103	.100	.096
% Credit in total rate (Ex B & M)		1.7%	7.7%	12.0%	14.5%	17.9%

b. Typical power reactor facility

Amount of insurance: $53,006,000 with $50,000 mandatory deductible

	Make-up Reflecting Credit for Mandatory Deductible	Make-ups Reflecting Optional Deductibles	
	$50,000	$75,000	$100,000
Fire & EC	.044	.043	.040
Nuclear	.289	.282	.275
All risk	.015	.015	.015
Total	.348	.340	.330
% Credit in total rate (Ex B & M)		2.4%	5.2%

When business interruption insurance is afforded (presently prohibited on reactors and fuel separation plants), the rates promulgated contemplate the "72 hour waiting period," after the style of ordinary fire and inland marine insurance. If a dollar deductible is also required, this is established and then the above table applies.

Coinsurance

The nuclear property policy carries a mandatory 90% co-insurance clause (a few reporting form policies are on a 100% co-insurance basis). The rates published are 90% rates. With a capacity of $74 million available, utilizing both pools, there is seldom any difficulty. The pools are running into an increasing number of situations, however, where the value of the property exceeds the insurance available. Under these conditions it is necessary to introduce a reduced coinsurance, and, since the first part of any loss up to $74 million is still to be covered, an increased rate is in order. The following table is used:

Percentage of Coinsurance	Multiple of 90% rate	Multiple of 100% rate
100%	—	1.00
95	—	1.02
90	1.00	1.05
85	1.03	1.09
80	1.07	1.13
75	1.12	1.18
70	1.18	1.24
65	1.25	1.31
60	1.34	1.41
55	1.45	1.53
50	1.58	1.66
45	1.73	1.84
40	1.88	2.02
35	2.06	2.23
30	2.34	2.51
25	2.67	2.89
20	3.15	3.42
15	3.90	4.28
10	5.28	5.80

While the policy coinsurance percentage is rounded to the nearest 5%, the rate multiplier is interpolated exactly, using a special graph which consists of a straight line on log-log paper.

As an example, let us suppose we have a power reactor whose insurable value is $99 million. With a capacity of $74 million, a 75% coinsurance

clause is indicated. For such a clause, the 90% coinsurance rate is to be increased by a factor of 1.12.

Nuclear Property Insurance Losses

The physical damage loss and expense ratio since inception is in the middle fifties. Were this the normal case of thousands of policies with nominal limits, an easing of the rates would be called for. Here, however, we have a limited number of policies, some at huge amounts, and in the absence of a big loss it is imperative that the experience be excellent, or else support of the pools would slip. In literally one second a meltdown can occur, the cost of which can run into many millions.

In number, most of the physical damage losses which have occurred have been non-nuclear. There have been numerous small fires, transformer burnouts, damage to nuclear fuel in transit, failure of turbine blades, ruptured pressure lines, and the like. There have been at least two large bona-fide nuclear losses, both resulting in momentary over-heating of the reactor core. The first, at Waltz Mills, Pa., cost the pools about $1,000,000. The second, at Lagoona Beach, Mich., is still being settled at the moment, but it appears the loss will be very near $2,000,000. Two nuclear loses occurred at a new fuel separation plant at West Valley, N. Y., costing the pools over $550,000. In general, in spite of intensive loss prevention work, there probably will be a similar variety of losses in the future. Intensive efforts will be made to avoid the large losses.

It is interesting to observe that only rarely has a physical damage loss also resulted in a liability loss.

Let us now turn to the liability side of the story.

Government Indemnity
Price-Anderson Act of 1957

Before examining the liability policies we must take a look at the Price-Anderson Act passed by Congress in 1957. By virtue of this legislation the government agrees to indemnify certain persons for any liability they may have to others for nuclear injuries or damage arising out of a specified nuclear installation. Although a charge is made by the government to the persons indemnified, it is a very small one, and the protection afforded is in effect a subsidy to the small but fast-growing nuclear industry. Indeed, without this additional protection most nuclear reactors would not be able to operate, because early studies indicated that while a really large loss is

extremely remote, it nevertheless *could* happen and might result in damages theoretically running a billion dollars or more. The amount of the indemnity is $500,000,000, which applies in excess of an amount of "financial protection." The Atomic Energy Commission, which administers the law, specifies how much "financial protection" is required to be carried, and if this is forthcoming grants the indemnity. The financial protection may be posted in the form of cash, qualified self-insurance, or private insurance. So far, only NELIA and MAELU liability policies have actually been used to satisfy the financial protection requirements of the law.

If a loss theoretically could run a billion dollars or more, an insured with $60 million insurance from the pools and $500 million government indemnity, $560 million in all, might still refuse to operate, deeming the protection insufficient. The Price-Anderson Act takes care of this by limiting the licensee's liability to $500 million plus the amount of financial protection stipulated. It cuts off any further liability, and sets up procedures for pro-rating all claims should it appear possible that such a high figure may be exceeded.

The AEC is required to execute contracts of indemnity with all qualified owners of reactors, critical facilities, and plants designed for the separation or purification of the isotopes of uranium or plutonium (chemical, aqueous, or gaseous diffusion). It is within the discretion of the AEC to afford indemnity to other types of nuclear plants, such as uranium mines and ore mills, fuel fabricators, research laboratories, etc. But the AEC in its wisdom has decided not to exercise this discretion. Thus the mines, ore mills, fuel fabricators, research laboratories, etc. are without indemnity. Most of them, of course, buy liability insurance from the nuclear pools. A few of them buy very high limits, while some buy none at all.

The law specifically provides that the AEC *may* require financial protection of those firms having direct operational contracts with the AEC (contractors, not licensees). It has been a disappointment to the pools that the AEC has not done so, but rather has indemnified its contractors from the ground up. Efforts by the pools over the years to persuade the Congress to change "may" to "shall" have hitherto failed.

Another disappointment to the pools has been the *amount* of financial protection that the AEC has prescribed. To be sure, the law itself specifies that the amount must be the maximum private insurance available, as respects reactors of 100,000 electrical kilowatts or more. However, in the beginning there were very few this large, and for the smaller ones the AEC

specified only a proportionate amount, down to a minimum of $250,000 for the smallest reactors, and for critical facilities. An amendment to the act in 1958 requires the AEC to indemnify non-profit educational institutions (colleges and universities) above $250,000 without any financial protection requirement, it being optional with the licensee whether they carry pool coverage or not.

However, over the years more large reactors have become operational, and premiums have slowly increased. Furthermore, the AEC did eventually revise its guidelines, employing a more sophisticated formula to arrive at the amount of financial protection, and generally increasing the amount of insurance required.

The indemnity, like the insurance, runs only to a nuclear incident. The law states "the term 'nuclear incident' means any occurrence within the United States causing bodily injury, sickness, disease or death, or loss of or damage to property, arising out of or resulting from the radioactive, toxic, explosive or other hazardous properties of source, special nuclear, or by-product material." We have seen these latter phrases in the subrogation clause of the nuclear property policy, and we shall see them again all through the liability forms.

The person indemnified under the Act "means the person with whom the indemnity agreement is executed *and any other person who may be liable for public liability.*" (Emphasis added.) This is of tremendous importance to the liability insurers. Since the policy must correlate closely with the government indemnity, it means that the insured on the policy must include any and all other persons liable, whether named or not. This omnibus provision, as we shall see, has its direct effect on every ordinary liability policy (OL&T, M&C, auto, etc.) issued in this country.

Two other sections of the Act add to the unusual nature of nuclear energy liability insurance. The first excludes indemnity for claims under State or Federal Workmen's Compensation Acts of employees of persons indemnified who are employed at the site of and in connection with the activity where the nuclear incident occurs. Notice that employees working elsewhere are not excluded; indemnity runs to the employer should they be injured in a nuclear incident, and the pool policies must afford like coverage.

The second feature has proven far more troublesome to the liability pools. It provides coverage for damage to property owned by the indemnitee, excluding only "property which is located at the site of and used in

connection with the activity where the nuclear incident occurs." This off-site clause is intended to place the owner of a nuclear installation in the same position as any other property owner in the vicinity, with respect to other property he may own away from the premises. Should such other property become damaged because of a nuclear incident arising out of his own nuclear installation, he can in effect sue himself and recover under the terms of the NELIA-MAELU policy and under government indemnity. This provision may have appeared reasonable enough at the time it was framed, but its original designers surely did not foresee what was to happen. It has become increasingly commonplace to build power reactor #2 right next to reactor #1. Indeed there are plans for several clusters of three reactors and, in Canada, there is to be one of eight in a row. Now, when #2 is being built, the AEC deems it off-site to #1, by not broadening the site definition in the indemnity agreement applying to #1. The broadening is not done until nuclear fuel intended for #2 actually arrives on the premises. Thus the liability insurance pools, whose policies must be closely parallel with the indemnity, are put in the very awkward position of affording property insurance (for the nuclear hazard only, to be sure) for this builder's risk exposure. It was a bitter pill for them to swallow.

The Price-Anderson Act has been amended to bring the nuclear ship Savannah within the purview of government indemnity, extending protection up to $500 million to any person who may be legally liable for a nuclear incident in connection with the design, development, construction, operation, repair, maintenance, or use of this, the first, nuclear-powered merchant vessel. The amendment extends the indemnity to occurrences outside as well as inside the U.S.A. It specifies that the AEC *may* require financial protection, i.e., underlying private insurance. The liability pools offered, separately, to provide such insurance, but the AEC has seen fit to grant indemnity from the ground up. The decision, in this case, comes as no disappointment to the pools, which really were not oriented toward ocean marine protection and indemnity insurance.

Another amendment extends the indemnity to persons or firms under contract with government, with respect to their activities *outside* the U.S.A., with the amount reduced from $500 to $100 million. This amendment is for the protection of the named contractor only and does not include the omnibus interests provision. The Congress was reluctant to make as much as $500 million subject to the vagaries and uncertainties of the courts of foreign countries.

A further change was made when, effective January 1, 1966, the liability pools increased their combined maximum limit from $60 to $74 million. The Congress simultaneously enacted an amendment reducing government indemnity for those purchasing the maximum from $500 to $486 million. Thus the total protection to the public remains at $560 million. The government has professed a hope that the day will come when private insurance becomes available in such large amounts that the indemnity may be dropped altogether, and of course the insurance industry also would be happy to reach this ideal position.

1966 Amendments to Price-Anderson Act

There has always been some uneasiness on the part of legislators and others that the insurance companies, following a nuclear incident, might unduly resist claims, and prolong settlements until liabilities were finally and ultimately established. Some lawyers have indeed felt that, with respect to nuclear installations, ordinary tort liability should be replaced by absolute liability. The insurers have always argued that the public will receive prompt and adequate treatment. However, they wanted no part of absolute liability, largely because of the danger of such a precedent carrying over into other areas of high hazard. After long discussions between the AEC, the nuclear industry, and the insurance companies, a system was evolved under which the companies, under certain conditions, will waive defenses based on negligence or fault.

Effective January 1, 1966 the Congress amended the Price-Anderson Act, so that the AEC may require provisions in its indemnity contracts and in the insurance policies, which

(a) waive any defense as to conduct of the claimant or the fault of the persons indemnified,

(b) waive the defense of charitable or governmental immunity, and

(c) waive any defense based on a statute of limitations, if suit is instituted within three years from the date on which the claimant first knew of his injury, but in no event more than ten years after the date of the nuclear incident.

The law applies only to "extraordinary nuclear occurrences" which are defined as "any event causing a discharge or dispersal of source, special nuclear or by-product material from its intended place of confinement in amounts off-site, or causing radiation levels off-site, which the Commission deter-

mines to be substantial, and which the Commission determines has resulted or will probably result in substantial damages to persons off-site or property off-site."

The Commission has promulgated its regulation as to what constitutes substantial damages. Briefly, it will deem a nuclear occurrence to be extraordinary if:

(a) 10 or more people are killed or hospitalized, or
(b) any one person sustains damage of $2,500,000, or the total damage is $5,000,000 or more, or
(c) 50 or more persons sustain damages of $5,000 or more each, provided the total damage is at least $1,000,000.

Another section of the amendment deals with emergency payments to the public. It authorizes the AEC, also NELIA and MAELU, to make immediate emergency payments to victims of an extra-ordinary nuclear occurrence. NELIA and MAELU, of course, do not require authorization to make such payments. But the AEC does, in the area of government indemnity, so the pools were swept in. Such payments will probably be in reimbursement of out-of-pocket medical expenses, living expenses and the like. No release will be required, nor will any payment constitute an admission of liability. However, such payments will be limited to 15% of the overall estimated aggregate loss. In most cases liability will be fairly apparent immediately, and the payments reduce the ultimate amount to which a claimant is entitled.

Very soon after the Price-Anderson Act was passed in 1956, NELIA and MAELU contracted to handle, on behalf of the AEC, claims in the area of government indemnity. The agreement has obvious benefits for the pools, one of which is to eliminate the vexing problem of how to adjust claims if the total loss is likely to run more than the insured limit of liability. Without the contract, the insurers would have to delay settlements until every last liability had been determined. With the contract they are able to settle without really caring whether it is an insurance claim or a government indemnity claim. That matter can be determined later between the pools and the AEC. Of course, the company adjusters do not have carte blanche to settle any and all indemnity claims; there are reasonable restrictions and procedures. The companies, for their services, are paid their out-of-pocket expenses and an hourly rate on the time of their men involved.

How government indemnity would work in the event of a nuclear holo-

caust remains to be seen, fortunately. But there is no doubt that this unique legislation has worked well to solve a complex problem — to encourage a budding industry and at the same time to provide protection to the public in very large amounts. It is a credit to the original drafters that before the Act expired in 1967, it was extended an additional ten years to 1977, without change. It is also a credit to the private insurance industry that it has been able to accommodate to the Act's unusual terms by providing underlying financial protection in the form of insurance coverage which is very nearly indentical in form and content.

Nuclear Energy Liability Exclusion Endorsement

We have already commented on the absolute necessity that an insurance company's total liability, after a nuclear occurrence, not cumulate among two or more policies. Each company has already pledged to the pools an amount it considers maximum, and to incur any further loss through duplication or pyramiding of other policies is considered intolerable. Therefore it was decided to concentrate *all* liability for a nuclear occurrence in the nuclear energy policies, and to provide *no* nuclear energy insurance in any other policy. Thus nearly all non-nuclear liability policies carry a clause excluding nuclear liability. Major exceptions are automobile liability insurance in New York, and statutory automobile liability insurance in Massachusetts, where the exclusion was never approved.

There is a short form and a broad form endorsement. The short form is intended for all personal policies, as opposed to business or commercial policies. It apears, for example, in the Family Automobile Policy and in Section II of the Homeowner's Policy. The clause follows:

> "This policy does not apply to bodily injury or property damage with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limits of liability."

The point is, anyone liable is an omnibus insured under the policy issued by NELIA, MAELU or NIAC. Should a nuclear incident appear to be covered both by a NELIA policy issued to Corporation A and also by a Family Automobile Policy issued to Mr. B, the latter is automatically an insured under the NELIA policy, and thus his auto policy therefore affords

no liability coverage, by virtue of the quoted exclusion. Duplication of limits has been avoided. If there is no nuclear policy in force covering the incident, the company could be liable, but the chance of an FAB policy becoming involved in a nuclear incident is so remote that the companies are not concerned.

The chance that a firm or corporation could get involved under a commercial policy is far greater, and for this reason the Broad Form endorsement is much more complex. It begins the same way:

"It is agreed that the policy does not apply:

I. Under any Liability Coverage, to injury, sickness, disease or destruction

(a) with respect to which an insured under this policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters, or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limits of liability, or

(b) resulting from the hazardous properties of nuclear material and with respect to which (1) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (2) the insured is, or had not this policy been issued would be, entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization."

Paragraph 1(a) is the short form already discussed. Part (1) of paragraph 1(b) knocks out insurance for the nuclear hazard when *any* person is required to maintain financial protection. Such person is required to carry his own nuclear insurance, and will receive a contract of government indemnity, both of which have the omnibus protection for all persons liable. Part (2) of the clause is needed in those situations where there is indemnity without financial protection. Government contractors are in this position; with respect to the hazardous properties of nuclear material the standard liability policy will not cover them or their suppliers. The Broad Form endorsement continues:

"II. Under any Medical Payments Coverage, or under any Supplementary Payments provision relating to immediate medical or surgical relief, to expenses incurred with respect to bodily injury, sickness, disease or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization.

"III. Under any Liability Coverage, to injury, sickness, disease, death or destruction resulting from the hazardous properties of nuclear material, if

(a) the nuclear material (1) is at any nuclear facility owned by, or operated by or on behalf of, an insured or (2) has been discharged or disposed therefrom;

(b) the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported or disposed of by or on behalf of an insured; or

(c) the injury, sickness, disease, death or destruction arises out of the furnishing by an insured of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility, but if such facility is located within the United States of America, its territories or possessions or Canada, this exclusion (c) applies only to injury to or destruction or property at such nuclear facility.

"IV. As used in this endorsement:

'hazardous properties' include radioactive, toxic or explosive properties;

'nuclear material' means source material, special nuclear material or by-product material;

'source material,' 'special nuclear material,' and 'by-product material' have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;

'spent fuel' means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a nuclear reactor;

'waste' means any waste material (1) containing by-product material and (2) resulting from the operation by any person or organi-

zation of any nuclear facility included within the definition of nuclear facility under paragraph (a) or (b) thereof;

'nuclear facility' means:

(a) any nuclear reactor,

(b) any equipment or device designed or used for (1) separating the isotopes of uranium or plutonium, (2) processing or utilizing spent fuel, or (3) handling, processing or packaging waste,

(c) any equipment or device used for the processing, fabricating or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235.

(d) any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste,

and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;

'nuclear reactor' means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;

with respect to injury to or destruction of property, the word 'injury' or 'destruction' includes all forms of radioactive contamination of property."

A detailed analysis of all these words, which is necessary for their complete understanding, is out of place here. Rather we shall comment on how some of the more important elements of coverage work out.

1. There is no insurance under medical payments coverage or under the immediate medical aid clause of the insuring agreement, for bodily injury loss resulting from the nuclear hazard.

2. No coverage is afforded for nuclear loss arising from a nuclear facility owned or operated by an insured, or arising from spent fuel or waste at any time owned or handled by an insured. The NELIA-MAELU policy stand ready to furnish such insurance.

3. One will recognize paragraph III (c) to be a product liability exclusion. It appears to eliminate coverage for all products (including the furnish-

ing of services or goods) going into reactors but it is far less drastic. In effect it says "No coverage is afforded for products claims arising from the nuclear hazard (a) for damage to any facility itself or property thereat, when located in the U.S.A. or Canada, or (b) which occur *to or from* a facility located outside U.S.A. or Canada."

A great deal of products coverage still remains. If there is no nuclear energy liability insurance policy in force for the facility and an incident occurs at the facility within the U.S.A. or Canada, the ordinary product liability policy, even with the exclusion endorsement attached, still covers all the bodily injury claims it would cover in the absence of the endorsement, *including* claims arising from the nuclear energy hazard. Likewise, it would cover all property damage claims otherwise covered, except damage to the facility itself.

For example, let us suppose there is a product liability policy covering a valve manufacturer who has sold valves used in a liquefied petroleum gas tank owned by a reactor operator. Because of a faulty valve there is a tremendous explosion without, however, any radiation or contamination damage. The product policy, even with the exclusion endorsement attached but subject to its normal exclusions and conditions, covers all resulting claims, excepting damage to the valve itself.

Now let us suppose the valve is part of the reactor system and causes losses arising from the nuclear energy hazard. If there is no nuclear energy liability policy in force for the reactor the same product policy still covers resulting bodily injury claims, and property damage claims except to the facility itself and to all property thereat.

Notice that in the one case the only property damage excluded is damage to the valve itself (the insured's own product) while in the second the exclusion runs to the entire facility and all property thereat.

The two examples cited above are based on the assumption that paragraph I of the exclusion endorsement has no application to our insured, that is, there is no nuclear energy liability insurance in force covering him. If he is an omnibus insured under that policy, by virtue of Paragraph 1(a) of the Exclusion Endorsement, the nuclear policy affords the insurance, and coverage is eliminated from the product liability policy.

A supplier may wish to purchase product liability insurance against nuclear damage to a nuclear facility. It is true that the property pools permit their insured owner to waive right of recovery against a specific party in advance

of a loss, and, more important, to waive right of subrogation against any supplier for nuclear loss as defined. But the supplier observes that nuclear energy property insurance contains a deductible, and the owner may wish to seek recovery for at least the deductible. An uninsured or underinsured reactor owner may go after him for all or part of the loss. The pools even now will not afford business interruption insurance to power reactors, and following some incident the reactor owner may wish to attempt to recover against the negligent supplier for loss of use of the facility. But the supplier will find he cannot buy insurance to protect him for such loss. There simply is no market for it, for the oft-repeated reason of lack of capacity.

Commercial Radioactive Isotopes and Source Material

A great variety of commercial radioactive isotopes are used in medicine, biology, laboratory research, and also in industry. An example of the latter is the isotope used in a gauge which measures the length of cigarettes in their manufacture. Massive doses of cobalt-60 are also used to irradiate various foods for sterilization and to retard spoilage. It is the intent of the exclusion endorsement *not* to knock out coverage for the use of such isotopes, and a minute examination of all the definitions will reveal this has been accomplished. Thus, coverage for small amounts of nuclear material in a "hot" laboratory remain under the laboratory's conventional OL&T or CGL policy. Occasionally, when the concentration of isotopes on a premises becomes unusually large, the conventional insurer may become nervous and ask the pools to take over. The pools can do so, but have been quite successful in persuading the carrier to stay on. Incidentally, the experience from such operations has been excellent. As to irradiation of foods and other substances, the pools have decided to decline to cover, without exception.

Coverage for liability arising from source material is also to be retained under the conventional liability policy; the endorsement does not exclude it as such. Source material generally is unenriched uranium and thorium and is not hazardous. Thus uranium mines and mills are insured in the conventional market and not by the pools.

Nuclear Energy Liability Policies

At long last we are able to discuss the policies of insurance which NELIA and MAELU issue. There are two forms. The first Facility Form, is issued to nuclear reactors, fuel fabricators, fuel separation plants, and other such facilities having quantities of nuclear material on the premises.

The second, Supplier's and Transporter's Form, is intended for suppliers to nuclear facilities and for transporters of nuclear materials.

Facility Form

This is the policy which is furnished as financial protection by an indemnitee under the Price-Anderson Act. The grant of coverage, except for the limit of liability is substantially the same as the indemnity granted by the government. It is unique in so many ways that it is hard to know where to start.

First, the Facility Form covers all persons liable (excepting only the United States of America or any of its agencies). We have already discussed this omnibus provision. It is necessary in government indemnity to provide the fullest protection of the public. The inclusion of the omnibus provision in the policy permits us to concentrate nuclear liability insurance in the pools, and away from conventional liability policies, by way of the exclusion endorsements on the latter. And its inclusion in the Facility Form certainly reduces to the vanishing point possible delays in settlements which might result from bickering over which person is liable, whether liability is to be shared among several defendants, etc.

Next, the limit of liability is an *aggregate* limit for the entire life of the policy. At the same time, the policies are written *without expiration.* These two features in combination act to prevent cumulation or pyramiding of an insurer's liability. Consider, for example, a radiation injury which is sustained over a period of several years. If a series of one-year policies were issued, each policy could be called upon to respond, and the overlapping of limits could become intolerable to the insurers. For the same reason, an aggregate limit is used, rather than the usual "per accident" or "per occurrence." Following the payment of a loss, the limit on the policy is automatically reduced. Loss expense is included as loss. Restoration of limits may be made, at the option of the insured and of the pools, but the pools will do this for a large loss only after a careful scrutiny of the situation, and along with plenty of engineering and legal advice. The limit of liability, as in the government indemnity, includes both bodily injury and property damage liability. Policies may be terminated, but only by formal cancellation. The insured must give 30 days notice, and the companies 90 days notice, with a copy to the AEC. The policy also is cancelled, without notice, if the limits of liability become exhausted by reason of payments for losses and loss expense.

In the case of a facility which is indemnified by the government, the public is not short-changed by the lack of insurance which has become exhausted by reason of payments. Where the insurance leaves off the indemnity takes on, without a gap.

The policy applies "only to bodily injury or property damage (1) which is caused during the policy period by the nuclear energy hazard and (2) which is discovered and for which written claim is made against the insured, not later than two years after the end of the policy period." The two-year discovery clause may be extended by payment of a small additional premium. Also, some insureds upon termination of nuclear activities have chosen to keep the clause open indefinitely, by not terminating the policy and by paying a greatly reduced annual premium. The endorsement needed to accommodate the policy to the new provisions in the Price-Anderson Act involving "extraordinary nuclear occurrences," which we discussed earlier, has not yet finally been worked out at the time of this writing. However, it obviously will have an effect on the two-year discovery clause.

Nuclear property insurance, you will recall, was all-risk in nature, covering not only the nuclear hazard but also all other perils not excluded. Nuclear liability insurance, in contrast, covers the one peril only. The reactor owner must also purchase an ordinary M&C, OL&T, or CGL Policy to have protection for trips, falls, and other non-nuclear occurrences.

Another unique feature of the Facility Form is the Common Occurrence Clause, also born of the importance that a pool subscriber never be charged for more than his subscription. It defines a common occurrence as one which (a) arises out of nuclear materials discharged or dispersed from more than one facility at the same time, over a short or a long period, or (b) involves two or more Facility Form policies covering nuclear materials in the course of transportation. In the event of such a common occurrence the clause provides that the applicable limit of liability is the sum of the limits on all the policies which afford coverage, subject, however, to a total aggregate limit equal to the pool capacities, separately. The total aggregate NELIA limit is $57,350,000, and MAELU limit $16,650,000, and these numbers appear in the clause. In the event the arithmetical sum of the limits exceeds these numbers, the clause sets forth a procedure for pro-rating. This clause, hopefully, may never be invoked, but is considered absolutely necessary to the pool members. The example of a common occurrence which comes easiest to mind is the nuclear pollution of a watershed by two or more independent reactors.

The policy excludes:

1. Workmen's compensation. But other provisions in the policy operate so that the policy reimburses a workmen's compensation carrier for injury to off-site employees.

2. Liability assumed under contract (with some exceptions).

3. "Bodily injury or property damage due to the manufacturing, handling or use at the location designated in Item 3 of the declarations, in time of peace or war, of any nuclear weapon or other instrument of war utilizing special nuclear material or by-product material."

4. War.

5. Damage to property at the facility site (excepting vehicles used in connection with the facility). Note that owned property, located elsewhere, is not excluded.

6. Damage to nuclear material moving to or from the facility. The preceding exclusion, with this one, operates to exclude all damage to nuclear material. Insurance for this hazard may be purchased from the property pools.

There is a save and preserve clause, adapted from the standard fire policy, inserted to apply to damaged off-site property owned by the insured.

Supplier's and Transporter's Form

Even though the Facility Form will cover, as an insured, anyone liable, many corporations early in the game expressed a desire for their own policies. These are largely manufacturers and suppliers to the nuclear industry, and transporters of nuclear materials (truckmen and railroads). They reason that it may be unwise to rely on somebody else's policy because:

1. That policy may carry lower limits of liability than they would carry for themselves. Many university educational reactors carry only $250,000. Further, some facilities such as fuel fabricators, do not enjoy government indemnity; interestingly, many of them carry pool insurance with rather substantial limits of liability, but not all of them do.

2. There may be no facility policy at all. Some university reactors self-insure the $250,000. Further, some large chemical fuel converters do not carry pool insurance.

The Supplier's and Transporter's Form is like the Facility Form in many ways:

1. It covers only the nuclear energy hazard.
2. The limit of liability is an aggregate one for the entire life of the policy, and the policy is written without expiration. Loss expense is included as loss.
3. It likewise has the two-year discovery feature, also probably to be modified when the language to adapt "extraordinary nuclear occurrence" is finally shaped up.
4. When used in both policies, the definitions are identical.

The S. & T. policy differs from the Facility Form in three major respects:

1. It covers only the named insured, and any employee, officer, director or stockholder thereof while acting within the scope of his duties as such. No omnibus coverage here. However, with respect to the transportation hazard, and in line with the standard automobile liability policy, the policy does cover "any other person or organization with respect to his legal responsibility for damages," excepting only the U.S.A. or any of its agencies.
2. A very carefully worded provision specifies that the limit of liability for an occurrence for all nuclear energy liability policies shall not cumulate beyond the pool aggregate limit, separately for each pool. First, the limits for all S. & T. policies applicable to an incident are added together, and pro-rated if the aggregate capacity is exceeded. Further, any Facility Form insurance applicable is primary and is subtracted and there may very well be such insurance in effect. Indeed, if there is a Facility Form policy carrying the maximum limit, all S. & T. insurance becomes zero.
3. Since the S. & T. policy is not designed to be used for "financial protection" under the Price-Anderson Act, it need not cover injury to off-site employees or damage to owned off-site property, and those features are omitted.

The exclusions are:

(a) Workmen's compensation.

(b) Employer's liability. These two coverages are available under the regular workmen's compensation policy.

(c) Certain contractual. The exclusion may be modified, just as in a conventional liability policy.

(d) "Bodily injury or property damage arising, directly or indirectly, out of an explosion, however caused, of an atomic weapon." Insurance for this hazard is simply not available.

(e) War.

(f) Property damage to any facility, except to vehicles used in connection with it. The property pools stand ready to insure this hazard, for the owner. The best a supplier can do is to persuade the reactor owner to execute a hold harmless agreement in his favor. Also, you will recall that the nuclear property policy waives the right of subrogation acquired against any party furnishing services, materials, parts, etc., with respect to the nuclear energy hazard only.

(g) Property damage to nuclear material in the course of transportation by or on behalf of the named insured. As we have already noted such coverage may be purchased from the property pools.

(h) Bodily injury or property damage arising out of:

1. Nuclear material outside of the U.S.A. The three-mile limit is considered the dividing line. *Comment:* Both NELIA and MAELU, however, have a Foreign Form and write considerable overseas coverage.

2. Nuclear-powered vesels, if the pools have issued a Marine Form policy on the vessel. No Marine Form policy has yet been issued, so this exclusion presently has no force.

3. A nuclear facility owned or operated by the named insured. The Facility Form policy is available for that.

4. Nuclear material in the course of transportation to or from a nuclear facility owned by the insured. Again, nuclear property or cargo insurance is available both to the owner and to the transporter.

5. This exclusion, formerly "the disposal of waste," is now deleted.

6. "Any radioactive isotope while away from any nuclear facility." This exclusion (h) 6 is removable, for a premium, although (as mentioned) the pools prefer to see the hazard remain under con-

ventional liability policies. When (h) 6 is deleted, another exclusion is introduced — the familiar automobile exclusion with respect to damage to property owned by, rented to, in charge of or transported by or on behalf of the named insured. However, for a truckman this second exclusion may be modified so that the policy affords coverage for damage to companion cargo. The example that comes to mind is the shipment of a load of camera film along with some high energy isotope in a leaky container.

(i) Any loss with respect to which (1) any person or organization is required to maintain financial protection, or (2) the insured is entitled to indemnity from the government. Division 2 of the exclusion may be eliminated, for an extra premium, which means the policy will perform in the area of government indemnity. The insurance companies may take pride in the fact that some large policyholders prefer the prompt and reliable response of private insurance to the uncertainties of government indemnity, and purchase this protection even when the latter is available to them.

These admittedly brief remarks conclude the discussion of the policy forms issued by the nuclear pools. In the interest of simplicity and clarity, much of the complexity actually contained in the policies has been omitted, and the actual document should be consulted for complete accuracy. The curious student, in so doing, will be rewarded by a look-see at one of the most unique and unusual of all contracts in the history of casualty insurance.

Nuclear Energy Liability Rates and Premiums

NELIA and MAELU use identical premium structures. The mutuals pay no dividends on this insurance. NELIA's rates are established by the Insurance Rating Board (formerly the National Bureau of Casualty Underwriters), and MAELU's by the Mutual Insurance Rating Bureau. There is no manual of rates as such; rather each risk is processed in accordance with the (a)-rating procedure of the applicable state. In actual practice, committees and subcommittees of the two bureaus sit jointly in making rates, and their sessions are usually attended by pool personnel. The underwriters are frequently assisted by nuclear engineers and claims people, who operate under a committee system themselves.

Now, how does one make rates for this brand new hazard? The early ratemakers faced a formidable task. Th only "experience" was that of the government, and that was a very good record. While a great deal of material

had been declassified, i.e., no longer made secret, only a few engineers and university experts knew anything of this strange new source of energy. Clearly, the making of rates here would involve much improvisation and a great deal of judgment.

The problem was compounded by the limits of liability involved. Even if it is felt that the proper premium for a policy of $1 million insurance has been established, what's the rate for $60 million? In partial answer to this question, it was decided that the premium base would be the amount of insurance. The basic unit would be the premium for the first million. Succeeding millions would cost less and less. The following table was evolved for reactors:

Layer of Limit of Liability	*% of Premium for the First Million*
1st million	100%
next 4 million	50%, each
next 5 million	20%, each
next 10 million	10%, each
next 20 million	5%, each
next 20 million	2.5%, each
next 14 million	2.0%, each

Thus it can be shown that if, for a power reactor, the premium for the first $1 million for a Facility Form policy is $50,000, the premium at the full pool capacity is $339,000. All premiums are annual.

Even ten years ago it appeared that power reactors would eventually comprise the greater part of the premium income of the pools. Thus the power reactor was deemed to be the standard exposure, and all other nuclear exposures were more or less related to it. So the problem boiled down to — what is a proper premium for the first $1,000,000 of coverage for a typical power reactor?

A formula eventually was set up, very much like the "value units" approach we have already seen in connection with property insurance. Five factors are considered: type, use, size, location and containment, with units set up in accordance with the physical characteristics of the reactor under consideration. The values for the five factors are determined, and compared

to those established for a theoretical typical reactor, and the premium is thus obtained.

There are many other premium schedules used by NELIA and MAELU. For example, factors in rating fuel fabricators include rural or urban, how much nuclear material is present, presence of plutonium, etc. The cost for subsequent millions is somewhat simpler, as follows:

Amount of Insurance	*Premium*
First million	Base premium
Second million	50% of base premium
Each additional million	$500 per million

Limits of liability less than $1 million are available as follows:

Limit	*Premium*
$250,000	50% of base premium
500,000	75% of base premium
750,000	90% of base premium

Minimum premiums frequently come into play. $1,000 is the least for which the pools will write the first million for any power reactor, and this minimum applies per million right up through the 74th million, regardless of size of the reactor. All other reactors have a $1,000 minimum premium for the first million ($1,500 for universities) but only $500 minimum for each additional million. The minimum premium for virtually all other kinds of coverage which the pools will issue is $500 for the first million and $250 for each subsequent million.

Even if the hazard is so remote as to be non-existent, the pool companies must get a meaningful return when issuing policies with unusually high limits. The last minimums quoted produce, for $74 million limit, a premium of $18,750, or 0.253% of the insurance. This compares favorably with what a commercial bank charges a customer for standby money. For one-quarter to one-half percent, the bank agrees to be ready to loan money to its customer; that is, the money will be there when he needs it. When actually borrowed, the usual rate of interest is paid. You can see that the insurance is much more risky than a standby loan, yet the minimum rates are about the same or less.

The pools have premium schedules for package reactors, university reactors, and critical facilities, and for a whole variety of miscellaneous nuclear exposures. For example, for firms specializing in the storage and disposal of low-level waste on land, the pools quote a premium of $1,000 for the first million, and $500 for each additional million. There are special rates for decontamination laundries, laboratory operations, scrap recovery, etc. As for Supplier's and Transporter's Form policies, the folowing schedule is generally applied to truckmen and railroads:

1st million	$750
Next 9 million	375 each million
Over 10 million	250 each million

All other S. & T. policies carry premiums of at least $1,000 for the first million.

To wind up this section on premiums, it probably is fair to say that NELIA and MAELU still do not know if the premiums being charged are about right. A great deal of attention is devoted to adjusting rates so that risks with about the same hazard get the same charge. But whether the premium level as a whole is too high or too low is simply not known yet. Very few losses have in fact emerged. If the premium level has been pitched too low, there is grief ahead for the insurance companies. If too high, the companies have two defenses. First, the rate level has not been increased since the start; in fact it has been lowered somewhat for power reactors. N. E. Masterson in his paper "Economic Factors in Liability and Property Insurance Claim Costs," presented to the Casualty Actuarial Society in May, 1968, sets forth indexes which show that bodily injury claim costs have increased about 63% in the last decade, while property damage liability claim costs have trended up about 45%. The pool rates have not been increased.

More important, if the liability premiums prove to be too high, there is an automatic correction through the Industry Credit Rating Plan, a kind of retrospective rating or premium return plan which applies to all domestic risks.

Industry Credit Rating Plan

Every policy issued by NELIA or MAELU on risks in the U.S.A. is subject to the Industry Credit Rating Plan, and carries an endorsement to

that effect. The plan provides that to the extent that expected losses or loss expense fail to emerge, the policyholders will be refunded premium, dollar for dollar. The expected loss and loss expense ratio has worked out to be just about 70% for the last eleven years. Thus about 70% of all NELIA-MAELU premiums has been set aside in special reserve funds, to be paid out as loss or loss expense, or to be refunded to policyholders.

It is a revolving ten-year plan. It applies to all the policies as a whole, and not individually to each policy. Thus a loss suffered by one will affect premium returns to all by the same percentage. At the end of the first ten years, the policyholders in the first year get a return premium in proportion to their first-year premium (if incurred losses are low). A return was actually made in 1967 to 1957 policyholders (1957 was the first year the pools operated). A further return was made in 1968.

Let us look at the mechanics of the 1968 returns (NELIA and MAELU combined):

Computation of Industry Reserve Premium Refund

Calendar Year 1958

Industry reserve premiums	1957–67	$11,959,906.99
Less incurred losses	1957–67	112,377.75
Less prior refunds (1957 refund)		46,436.22
Reserve fund at 12-31-67		$11,801,093.02

The formula for the return premium is:

$$\frac{\text{Industry reserve premium 1958}}{\text{Industry reserve premium 1958–1967}} \times \text{reserve fund at 12-31-67}$$

or

$$\frac{\$243{,}479.51}{\$11{,}912{,}200.16} \times \$11{,}801{,}093.02 = \underline{\$241{,}208.52}$$

The denominator above is less than the 1957–67 reserve premiums because this year the 1957 reserve premium, $47,706.83, is omitted. The ten-year period is moving along.

The standard premium for 1958 was $357,465.01, so that over 68% of it went into the reserve fund. It is seen that about 99% of this 68% has been refunded to the policyholders. The same was true for the 1957 refund.

The refund is distributed to the policyholders of a calendar year in proportion to their relative contributions to the standard premiums in that year. Facility Form policyholders and S. & T. Form policyholders are considered alike, but all foreign insurance is excluded.

To assist in the accounting, every policy is given a rating anniversary of January 1. A policy may take effect at any time during the year, but its initial premium is pro-rated to year-end. Thus, like Massachusetts statutory automobile bodily injury premium, all nuclear energy liability premium is earned at year-end.

The Plan is a credit plan only; no policyholder is ever required to pay a surcharge for poor experience. If, through misfortune, the entire reserve fund is used up for losses and loss expense, the individual pool members must be assessed to make up the needed difference.

The money in the reserve funds, separately for NELIA and MAELU, can never come back to the companies. It has formally been set up in special accounts, to go out either as actual loss or loss expense to claimants, or as premium refunds to policyholders. The beauty of the Plan is not only that it largely corrects for redundant premiums, if they are redundant, but also permits the pools to build a tax-free cushion against future loss. Money flowing into the funds is considered unearned premium, and the companies pay no Federal tax on it. They do, of course, pay full tax on any investment income derived from the fund. As we have seen, the combined reserve funds for NELIA-MAELU at December 31, 1967 was $11.8 million. With the influx of 1968 advance premiums ,the funds now stand at nearly $14 million. This will help defray a pretty large loss, and makes it increasingly attractive for an insurance company to support the pools, since brand new pool members get the same protection from the reserve funds as companies that were in from the start.

The future of the reserve funds has been the subject of some debate. Its growth, all admit, has been much slower than its originators had in mind. But the nuclear industry is now burgeoning and by 1980 will be much larger than anyone had dreamed. Under the circumstances, there is a strong argument that the funds should grow sufficiently large to pay off one total loss, i.e., $74 million. Not unnaturally, the bigger policyholders, largely the utilities, take the other view, not liking to see such substantial chunks of their money tied up for ten years. They urge a lesser figure, or a reduction in the plan period from ten years to something less. However, it is likely no changes will be considered until the premium volume (presently about $3 million annually) and the trust funds grow much larger.

Nuclear Liability Insurance Losses

It is a fact that NELIA and MAELU have been very fortunate. The total 10 year losses and loss expense incurred has been only $112,000. There have been only two large claims. One arose from a Rhode Island accident in 1964 at a fuel fabrication plant, involving an unintended criticality and the death of an employee. The on-site workmen's compensation exclusion was not effective in this case; Rhode Island is a state which permits fellow-employee actions, and suit was brought against a supervisor and others. The other is a disputed bodily injury case, the plaintiff alleging that radiation of an employee caused a child to be born a mongoloid. All other claims have been very minor spillages, mostly of nuclear materials in transit. It is a great credit to the insurance industry, the nuclear industry, and to the Atomic Energy Commission that the safety record has been so fine. But the magnitude of possible loss is such that the pressure for continued safety must be unremitting.

The Future of Nuclear Energy

It is a fact that the utilities generating electricity must double their output every ten years just to stay even with America's insatiable demand for electric power. Coal and oil reserves are not inexhaustible, and hydroelectric power can be increased only very slowly. Nuclear energy is the answer.

At the end of 1966 the liability pools insured seven relatively small power reactors, having a combined output of 1564 thermal megawatts. In 1967 three new reactors became operational, with 2,935 megawatts. By the end of 1969 four large plants go into operation, producing over 8,000 megawatts of power. Thus in only three years power output will have increased eight-fold.

But that is only the beginning. Nuclear power has now been demonstrated to be at least as economical as oil or coal-fired plants in almost all parts of the country. Orders for nuclear plants have nearly overwhelmed the manufacturers and are spaced out in the future up to 1975. Twenty-one power reactors are presently under construction, totalling about 40,000 megawatts. And an additional fifty-seven reactors are proposed or planned, providing another 110,000 megawatts. By 1980 the AEC estimates that one-third of all electrical power generated in this country will be from nuclear stations. The trend line goes right off the chart.

Nuclear energy insurance will likewise grow in volume and importance, at last justifying the lavish care and attention given to it in its early years.