EFFLUENT RELEASE PERFORMANCE INDICATORS - AN INSURER'S PERSPECTIVE

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ABSTRACT

American Nuclear Insurers' (ANI) Engineering Rating Factor (ERF) measures and evaluates individual nuclear plant performance based on select engineering plant performance indicators on a comparative basis. The ERF is used to redistribute a portion of total power reactor nuclear liability insurance premium based on the results of those performance indicators. This paper presents an overview of the ANI - ERF program and a detailed description of each performance indicator area and includes an evaluation of each indicator area with respect to industry performance, type of plant and class of plant. A primary focus will be related to airborne and gaseous effluent releases. Trends with respect to time are also presented.

INTRODUCTION

American Nuclear Insurers is an underwriting association or Pool of insurance companies that provides financial protection to the nuclear industry. ANI has substantial financial assets at risk. Through insurance, financial protection is provided to cover the third party nuclear liability and property damage exposures of nuclear utilities and other businesses that support nuclear utility operations. The policies issued by ANI provide broad coverage.

ANI provides nuclear liability insurance of US $200 million in financial protection to each US nuclear power plant. This protection covers the operators of nuclear facilities and their suppliers for liability for damages because of bodily injury or property damage caused by the nuclear energy hazard. Insurance losses can be of the catastrophic or non-catastrophic type. Expenses that might be paid under the nuclear liability policy include the payment of claims which are presented under the policy and the costs of defense of those claims. Often, these claims defense costs are a major portion of the expense of providing insurance to the nuclear industry, and may be reduced considerably when there is clearly-documented evidence of due care and proper operation of the insured facility. Indicators that are part of the ANI Engineering Rating Factor can be used to demonstrate such care.

Beginning in 1981, ANI implemented a program to monitor and evaluate industry and individual nuclear plant performance based on select engineering plant performance indicators. The program is also used to redistribute a portion of total power reactor nuclear liability insurance premium based on the results of the select engineering performance indicators. The program is referred to as the ANI Engineering Rating Factor (ERF).

ANI currently evaluates twelve areas of plant performance under the ERF Program. Based on aggregate plant performance, a portion of nuclear plant liability premium is redistributed. The best performers are eligible to receive a credit of up to 20 percent. Those plants with the highest perceived nuclear insurance risk can be assessed a surcharge of up to 30 percent. Performance information also plays an important part in the development of insurance risk profiles that support loss control strategies at each nuclear power plant facility.

ANI ENGINEERING RATING FACTOR

Historically, ANI's nuclear liability premium at nuclear power plant facilities was based on five components:

- û **Reactor Type**
- û **Reactor Use**
- û **Reactor Size**
- û **Reactor Location**
- û **Type of Containment**

In this regime, the operational performance of individual reactor plants was not differentiated between plants, consequently nuclear liability insurance premium for similar reactor sites was approximately the same. During the late 1970's, a combination of the nuclear industry's growth, more operating experience and state utility regulatory authorities, resulted in a collaborative effort between ANI and its insured reactor sites to develop a method that would recognize and differentiate varying levels of nuclear liability insurance risk based on operating performance which would then result in liability premium distribution based on performance.

This effort culminated in 1981 when a sixth rating component, the ANI Engineering Rating Factor (ERF), was introduced as the mechanism that would serve to achieve the goal of rating power reactor insureds on a comparative risk basis. The fundamental criteria for the ERF required that total ANI power reactor nuclear liability premium not change as a result of implementation. Initially, eight broad performance areas of perceived nuclear liability insurance risk were selected. When combined using statistical methods, a composite ERF value was produced which corresponded to an adjustment of nuclear liability insurance premium based on operational performance. The best performers were eligible to receive a credit of up to 20 percent and the highest insurance risk performers would be assessed a surcharge of up to 30 percent. The ERF is computed in the spring on a yearly basis.

ERF Performance Areas - The ERF has evolved since its introduction. Currently the ERF includes twelve measurable performance components in eight performance areas, which when viewed on a comparative basis, are reflective of relative nuclear liability insurance risk. Table I provides a summary of each performance area.

Table I - ANI ERF Performance Areas

Performance Area	Description
Environmental Releases **Noble Gases** **Airborne Iodine & Particulate** **Airborne Tritium** **Waterborne Mixed** **Waterborne Tritium**	This is the Environmental Performance Area is comprised of five components accounting for releases of radioactive material in the effluent streams. Effluent releases (airborne & waterborne) represent an increasing level of insurance exposure, which is proportional to the amount of activity (curies) released, the population density and distribution surrounding the insured, and the local environmental uses (drinking water, aquifers, fishing, etc.) of the surrounding properties. The amount of release to the environment can be controlled by actions such as proper chemistry control and by the proper design and operation of radioactive waste processing systems.

Performance Area	Description
Regulatory Performance NRC Violations	This subfactor is referred to as the Regulatory Performance Subfactor. The subfactor reflects the ability of the utility to operate within prescribed rules and regulations. Deviations from operational compliance may result in a higher nuclear liability exposure. The NRC Violations component includes only NRC violations that result in a fine that is paid by the utility. The worst performance is weighted 100 times more than the best performance.
ANI Liability Recommendations	ANI Liability recommendations that are not accommodated by the insured are candidates for inclusion into the ERF. Recommendations that fall into this category are reviewed and processed by the ANI Recommendation Review Committee for insurance risk significance and consistency.
Significant Events	This data is from the NRC's Performance Indicator Program. Events classified as "significant" include: - Degradation of important safety equipment - Unexpected plant response to a transient - Degradation of fuel integrity, primary coolant pressure boundary or important associated structures. - Scrams with complications - Unplanned releases of radioactivity - Operation outside the limits of technical specifications.
Radioactive Waste	Radioactive waste shipments represent an insurance exposure to the general population and property while in transit. The exposure is proportional to the volume, activity and distance shipped. Because of reporting inconsistencies, only activity (curies) shipped is included in the ERF.
Safety System Failures	Events or conditions that could prevent the fulfillment of the safety function of structures or systems are included. This data is from the NRC's Performance Indicator Program.
Unplanned Automatic Scrams	This subfactor monitors the number of unplanned automatic scrams that occurred while critical, such as those that resulted from unplanned transients, equipment failures, spurious signals or human error. Also included are those that occurred during the execution of procedures in which there was a chance of a scram occurring, but the occurrence of a scram was not planned. This data is from the NRC's Performance Indicator Program.
Safety System Actuations	This subfactor monitors automatic or manual safety system actuations of the logic or actual equipment of either certain Emergency Core Cooling Systems or in response to an actual low voltage on a vital bus. This data is from the NRC's Performance Indicator Program.

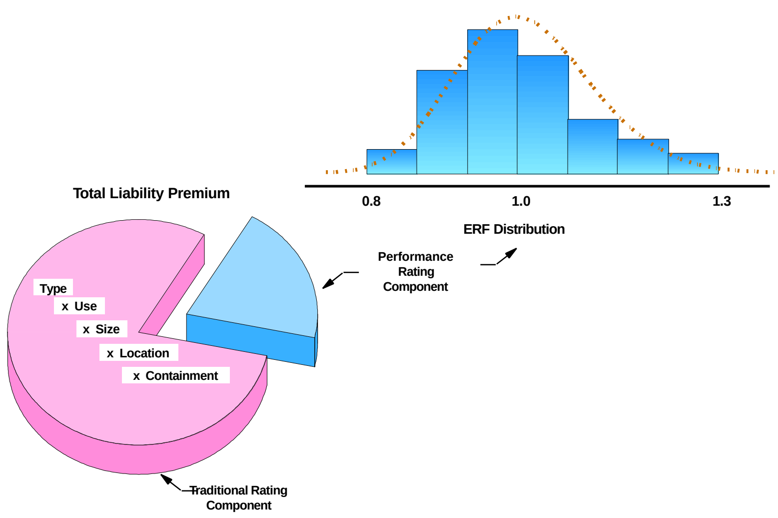
ERF Subfactors - The first step in developing a quantitative value to be used in a "subfactor" involves computing a moving three-year weighted average using the most recent data available in the public domain. The most recent year is weighted the highest at approximately 50%, with the following two years weighted at 33% and 17%, respectively. A moving three-year weighted average was selected to assuage the significance of excessive premium swings that might otherwise occur by using only a single year's operating history while remaining indicative of a trend.

For select performance areas, the data used in computing the moving three-year weighted average lags the current calculation year by one or more years. This situation is due to the unavailability of information at the time of the computation cycle. There has been concern that the use of past performance data might not necessarily be indicative of poor performance for the current year. From an insurer's view, performance (good or bad) over a given period of time is a reasonably fair indication of what the insurer can expect in the current calendar year. In any line of insurance, rates are based, in part, on past performance. Past performance can be either actual loss history or performance in areas which are considered to impact the likelihood of an insurance loss.

Following individual weighting, the three year weighted average performance data are linearly converted to a subfactor value which generally ranges between zero and 10, where zero corresponds to the best performance and 10 corresponds to the highest data value. Performance data beyond two standard deviations from the mean are generally treated as outliers.

The Engineering Rating Factor Value - Each of the twelve subfactors are then weighted to reflect ANI's assessment of relative impact on insurance risk and summed to provide a composite rating value. Currently all subfactors are weighted approximately equal. The composite rating values are subsequently statistically scaled to develop an ERF value with an approximate normal distribution with a range of 0.8 to 1.3. Figure 1 illustrates the concept of selecting a portion of the total nuclear liability premium and re-distributing that portion based on overall operating performance. Currently approximately 20% of total liability premium is redistributed using the ERF.

Figure 1- Typical ERF Distribution



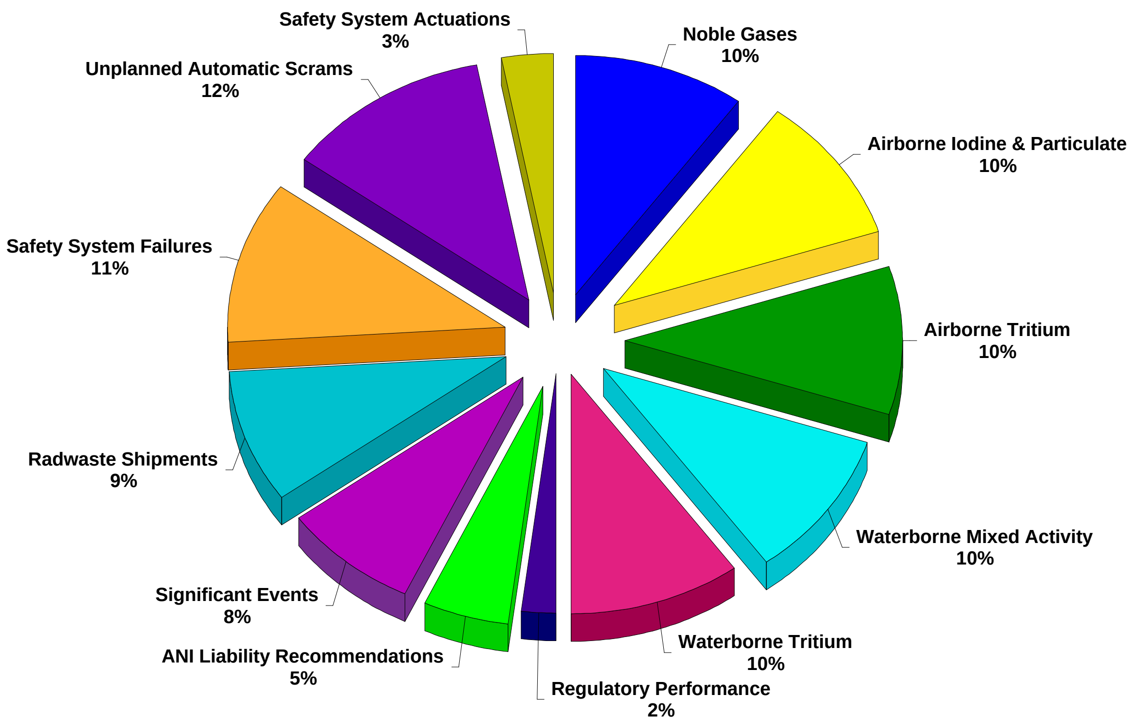
This ERF value is used as a multiplicative factor in computing the nuclear liability insurance premium. The value 0.8 represents a 20% reduction and the 1.3 represents a 30% increase in the base premium. Base premium is the amount of premium charged for the first US $1 million of insurance coverage. The total premium is then determined on a decreasing underwriting scale up to the total limit of liability, which is presently US $200 million at each operating power reactor facility.

For the current cycle, 103 plants were affected by the ERF. Fifty-two plants had ERF values less than 1.0 and were eligible for a reduction in liability premium. Four plants had an ERF value equal to 1.0, meaning no change in premium, and forty-seven plants had values greater than 1.0, which would correspond to an increase in liability insurance premium. The aggregate results are then tested to ensure that the net effect on the total of all nuclear liability insurance premiums for power reactor insureds that are eligible for the ERF is approximately zero.

As noted, the overall ERF value is a composite that represents overall performance. Poor performance in a particular area can be offset by good performance in other areas and vice versa.

ERF Subfactor Percent Contribution - The incremental change in nuclear liability premium resulting from each ERF subfactor is also provided and can provide incentive to improve performance in a particular area or combination of areas. The incremental change is characterized by a pie chart, commonly referred to as the Percent Contribution. Figure 2 provides an example of the relative percent contribution to the change in liability premium at a typical insured. The figure illustrates that half of the change in liability insurance premium for this plant is contributed by environmental releases.

Figure 2 - Subfactor Percent Contribution



PERFORMANCE COMPARISON

The information used in the ERF computations is also used in the development of individual plant performance trends and plant comparison evaluations. These evaluations are independent of the ERF and its effect on liability premium. In developing the comparisons, it is recognized that there are inherent differences in nuclear plant design and layout and that there may also be certain performance aspects that are simply the result of these differences. ANI developed correlations that are less sensitive to these inherent characteristics. Table II provides a summary of nine comparison categories that are reflective of these correlative evaluations for the most recent ERF cycle.

Table II

Power Reactor Performance Comparative Categories

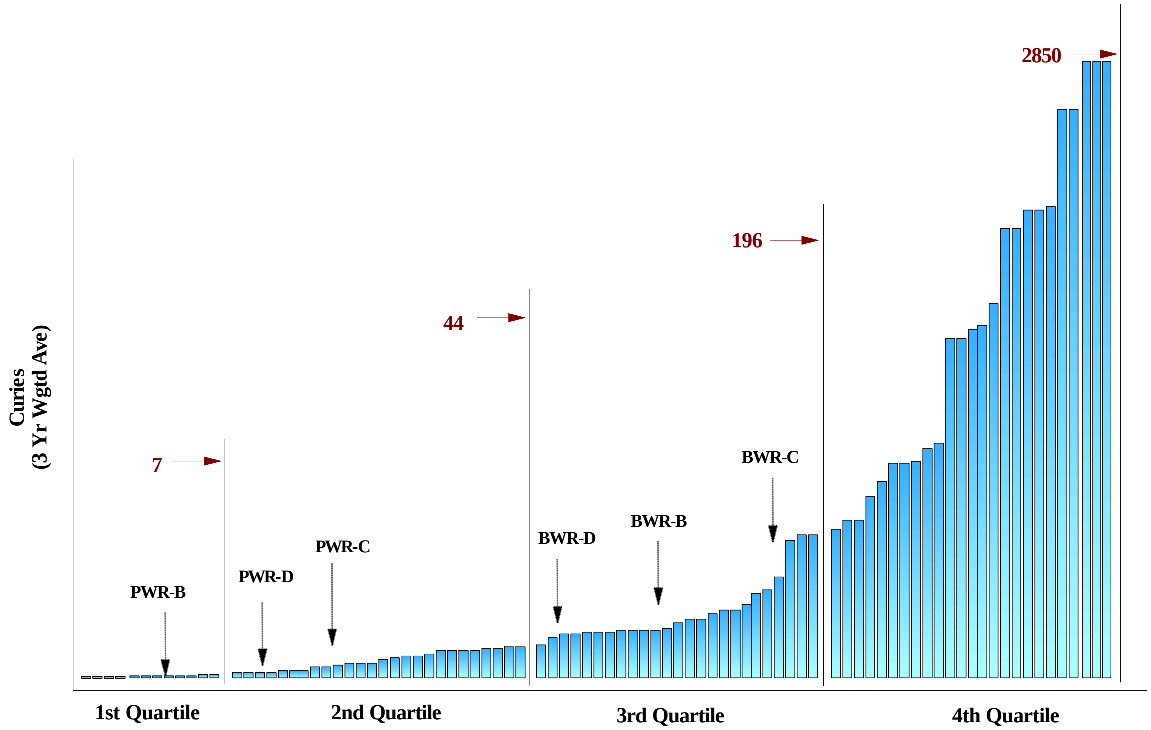
BWR's			**PWR's**		
Class	**MWth**	**Plants**	**Class**	**MWth**	**Plants**
BWR's	All	34	PWR's	All	69
BWR-B	1500 <2500	7	PWR-B	1500 <2500	10
BWR-C	2500 <3000	11	PWR-C	2500 <3000	24
BWR-D	>3000	16	PWR-D	>3000	35

The discussion that follows provides an example of the process used in development of a performance profile for an individual plant. The process begins with a comparative analysis with respect to all plants included in the ERF cycle. This is followed by a trend analysis comparing the plant to itself, to all plants in its class (BWR or PWR) and then finally to all plants within its peer category of type and size.

ANI routinely develops individual plant performance profiles for each of the seventeen performance areas. These profiles are formally presented to insured plant management and staff each year. The individual profiles are also used by ANI Account Engineers to develop insurance risk perspective and specific insurance loss control strategies in areas where warranted.

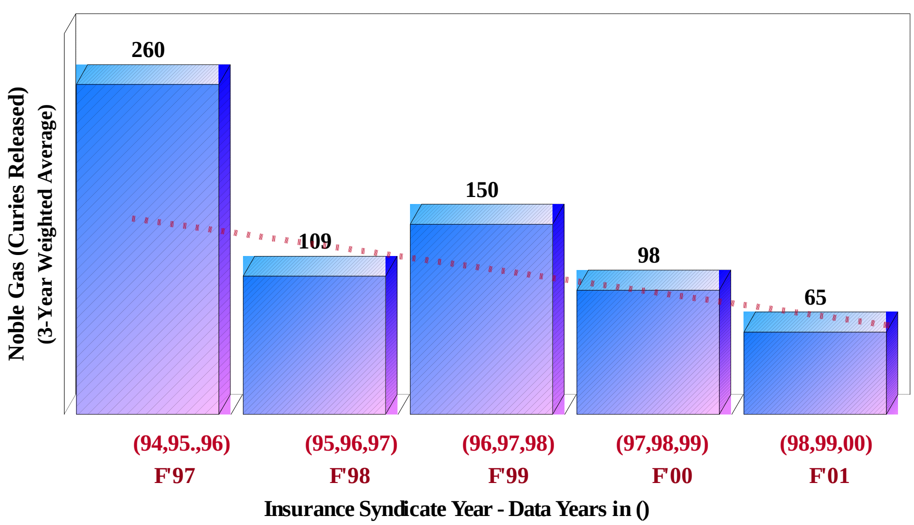
Quartile Ranking - The first performance comparison evaluated is an industry ranking of all plants eligible for ERF. Using the three year weighted averages discussed above, an industry quartile ranking is developed from which a relative ranking of an individual plant can be evaluated with respect to all the operating nuclear plants. This analysis is conducted for each of the seventeen performance categories. Figure 3 below (Subfactor 3a "Noble Gas Releases") provides an example of one such ranking. In the example, each of the bars represents an individual plant's ranking with respect to the aggregate. There were 103 plants eligible to participate in the ERF. Superimposed on the ranking are the mean three-year weighted averages for each of the six peer classes listed in Table II.

Figure 3 - Plant Quartile Ranking (Noble Gas Releases)
3-Year Weighted Average



Performance Trends - Trends of individual plant performance in each of the seventeen performance areas are also evaluated. In this instance, trend analyses are performed with respect to the industry and subsequently for each of the peer classes described in Table II. Figure 4 illustrates the results of a trend analysis for an individual plant trend with respect to itself for the five most recent insurance syndicate years for Subfactor 3d, "Waterborne Mixed Activity." For reference, five insurance syndicate years, as represented by F'xx, corresponds to seven operating years. Using a coarse least squares fit, the trend indicates slightly improving performance over the five insurance syndicate years period.

Figure 4 - Plant 5-Year Trend

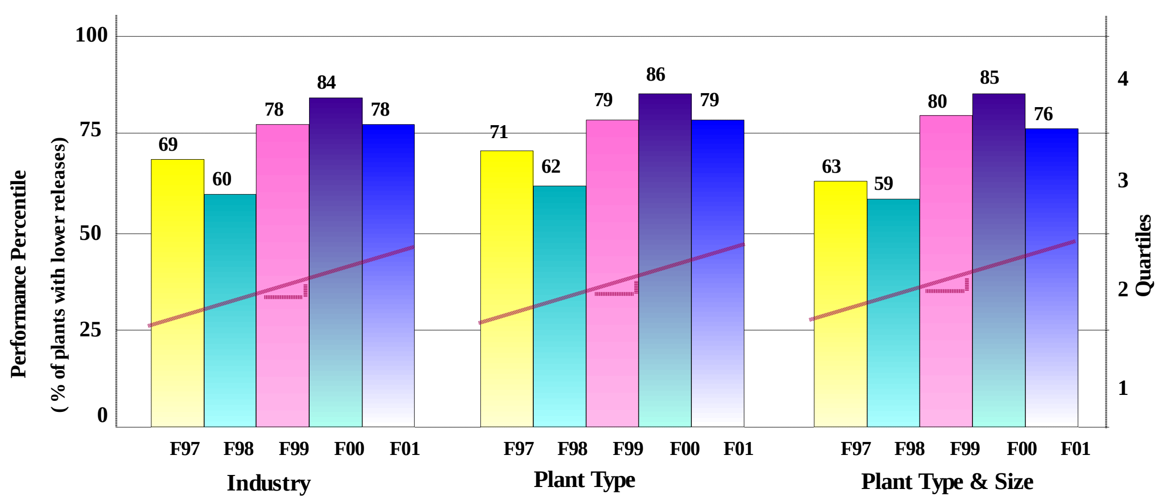


An additional five-year trend is performed with respect to each of the peer categories to provide a profile of an individual plant's performance relative to other plants of similar type and size. We have found it convenient to perform this type of evaluation by computing relative performance percentiles. Performance percentiles are computed using the floating three-year weighted average and are defined as the percentage of insured operating nuclear plants for which performance in that performance area is better. For example, a plant with a percentile of 88 in the performance area of Noble Gas Releases means that 88 percent of the other plants within the comparison had fewer unplanned automatic scrams or, in other words, had "better" performance.

Figure 5 illustrates a five-year trend of a plant with respect to each of three peer categories corresponding to the performance area illustrated in Figure 4. The first set of bars is a comparison of the plant with respect to the industry over a five-syndicate year period. The height of the individual bars represents the percentage of all plants in the industry that had fewer unplanned automatic scrams than this particular plant. The second set of bars profiles this plant with all PWRs. The third set compares the plant to all plants of the same type and size.

For the case illustrated, the profile indicates decreasing performance when this particular plant is compared to the entire industry, to all PWRs as well as to PWRs greater than 3000 MWth in size. Combined, Figures 4 and 5 illustrate two major points: (1) plant performance is improving with respect to itself and (2) the industry is also improving but at a slightly faster pace at the same time as evidenced by the fact that the plant's ranking tends to be consistently in the 3rd quartile.

Figure 5 – Noble Gas Releases - Five Year Trend



ERF Value Comparison - Table III summarizes the average ERF Values for the eight comparative categories. For the last two ERF cycles, boiling water reactor plant ERF values tend to be slightly higher than pressurized water reactor plant ERF values. Analysis reveals that, for the last two cycles, a combination of the frequency of significant events, safety system failures, unplanned automatic scrams and safety system actuations for the population of operating BWRs is slightly higher than for PWRs.

Table III

ERF Value Comparison by Plant Size and Class

BWR's				PWR's			
Class	**MWth**	**Plants**	**Ave ERF**	**Class**	**MWth**	**Plants**	**Ave ERF**
BWRs	All	34	1.04	PWRs	All	69	0.98
BWR-B	1500 <2500	7	1.02	PWR-B	1500 <2500	10	1.00
BWR-C	2500 <3000	11	1.06	PWR-C	2500 <3000	24	0.97
BWR-D	>3000	16	1.04	PWR-D	>3000	35	0.98

CONCLUSION

The methods and protocol used in the development and application of the ANI Engineering Rating Factor has been summarized. The ERF serves several purposes. Fundamentally, the ERF reflects the composite effect of varying performance between individual power reactor insured facilities and consequently nuclear liability insurance risk arising out of that performance. The ERF provides assistance in the exercise of underwriting judgment in developing nuclear liability insurance premiums that are consistent on a comparative insurance risk basis. The ERF is related to premium, not as a way to increase premium but rather as a mechanism to redistribute premium based on individual plant performance levels. The ERF performance and trend analyses serve as input for the identification of potential liability risk areas that warrant ANI loss control evaluations. And finally, the ERF provides a communication platform from which insured facilities can gain insight on plant performance with respect to industry and peer facilities.