To Catastrophe SG – CATF(E),
National Association of Insurance Commissioners
David Altmaier, chairperson

RE: CATASTROPHE RISK CHARGE IN THE P/C NAIC RISK-BASED CAPITAL REQUIREMENTS

In response to the request for comment on the calculation of catastrophe risk capital charges in the P/C Risk-Based Capital currently being tested by the National Association of Insurance Commissioners (NAIC), below we provide observations and recommendations that we hope you will find useful.

While these comments discuss the particular difficulty encountered in the practical implementation of the catastrophe risk charge calculation, and the possible unintentional ambiguity in the instructions, they also address issues that are broader in scope. We do not comment on the specific calculations, the appropriateness of the assumptions, or the correctness of the calculations in the example provided in the exposed documents or the relevance of the example to the main issue being considered. We do not comment directly on all of the conclusions reached by the interested party based on this example or other considerations. We do note, however, that the author of the example has raised an important point about different interpretations of the instructions related to the calculation of the catastrophe charges in the NAIC P/C Risk-Based Capital formula.

The comments comprise four main parts:

1. A brief description of the current approach and various interpretations of the instructions that are being debated, with a critique of some of the interpretations and noting biases that may exist in all of them to various degrees.

2. A description of the *theoretically correct* (within the currently chosen framework) *calculation of the catastrophe risk charges that is different from any of the options being discussed*, one that avoids the potential inaccuracies and biases associated with these other options.[1]

3. Practical recommendations of ways to improve the calculation of the catastrophe risk charges, taking into account the need to balance the search for precision with considerations such as limitations on data availability and the unavoidable uncertainty associated with catastrophe modeling results.

4. Notes on the preference for the risk charge calculation framework that could be used with only limited modifications if additional catastrophe risk charges, such as those for tornado or cyber risk, are introduced in the future.

[1] The label "theoretically correct" corresponds to a specific calculation framework and does not necessarily imply that such an approach is practical or preferable to others.

The current framework for calculating catastrophe risk charges[2]

The approach currently used calls for calculating the catastrophe risk charge as the sum of the following two components:

(1) net catastrophe loss, and
(2) additional component intended to address the risk of ceded reinsurance being uncollectible,

for the worst year in 100.

The same approach is used for the calculation of the earthquake catastrophe charge, R6, and the hurricane catastrophe charge, R7.

For example, for the risk of hurricanes, the calculation of the charge is as follows:

R7 = Net Catastrophic Loss + Risk Factor x Ceded Reinsurance Amounts,[3]
calculated based on "worst year in 100" modeled losses.

Described in simple terms, a large number of scenarios (simulated years) are generated by catastrophe modeling software, each of them showing catastrophe insurance losses realized in that year. These losses are then aggregated to calculate the totals for each of the simulated years (scenarios[4]). This permits the calculation of the "worst year in 100" figures (99th percentile) generally consistent with the intended calibration level of the NAIC P/C RBC formula.[5]

All losses are calculated using one of the approved models, or are based on a combination of two or more models intended to be consistent with the way this type of modeling is done in the company's own internal catastrophe risk management process.[6]

Potential ambiguity in the instructions on how to calculate catastrophe risk charges

It has been pointed out that the current instructions are not sufficiently precise in explaining how exactly the risk charges are to be calculated. The second component of the risk charge is calculated in the RBC report as the difference between gross[7] and net losses. Even though this difference is intended to represent the amount of ceded losses, the RBC instructions allow more than one interpretation of which values

[2] Used for Information Purposes Only in the NAIC P/C RBC Report while the charge is still being calibrated and the ability of the insurance companies to provide the necessary data is being tested.

[3] Per the NAIC P/C RBC Instructions, the ceded amounts in the calculation exclude the amounts ceded to entities that are not subject to the NAIC RBC ("Ceded Amounts with Zero Credit Risk Charge")—that is, modeled catastrophe losses that would be ceded to the categories of reinsurers that are not subject to the RBC credit risk charge (i.e., U.S. affiliates and mandatory pools, whether authorized, unauthorized, or certified).

[4] The term *scenario* is often used in other contexts as well, such as to refer to simulated individual catastrophic events rather than simulated years that may include more than one catastrophic event affecting an insurance company. For consistency with the general RBC framework, simulated years as opposed to events are used in the calculations. That is why the NAIC Instructions are clear that using the worst year in 100 means that "aggregate losses from possible multiple events in one year should be modeled and input, not the worst single occurrence one-in-100 year event." This approach is consistent with the general goal of calculating capital margins needed to withstand the risk of catastrophic events for a whole period at a chosen safety level.

[5] The actual calibration of every individual component and the RBC in total is not necessarily established at this level. The safety margin is based on more than one risk measure (such as expected policyholder deficit) or even qualitative considerations for some of the components and for the total RBC.

[6] See "Attestation Re: Catastrophe Modeling Used in RBC Catastrophe Risk Charges," part of the NAIC RBC Report.

[7] Direct and Assumed.

should be chosen for the gross and net amounts. In the vast majority of the situations, the calculation is the same or the results are substantially the same regardless of which interpretation is followed. However, for some catastrophic exposures and certain reinsurance structures, there could be a significant difference in the value of the catastrophe charge depending on the interpretation chosen.

The difference is clearly demonstrated in situations where catastrophe modeling results at the tail of the distribution (such as the worst year in a century) are driven by both frequency and severity of catastrophic losses and where sessions to affiliates are non-negligible. Where modeling results are dominated by extremely large rare events (severity only), with the probability of more than one catastrophic loss in a year being very low, the difference in the interpretation of the instructions usually does not matter, and the resulting catastrophe charge is the same or substantially the same regardless of which interpretation is chosen.

The instructions require that for the "worst year in 100" the following three categories of modeled losses be shown and used in the calculations of catastrophe charges:[8]

(1) Direct and Assumed
(2) Net
(3) Ceded Amounts with Zero Credit Risk Charge

Questions have been raised about the interpretation of this part of the RBC instructions. It is possible to understand the instructions as requiring

(1) choosing the Net modeled loss for the scenario corresponding to the worst year in 100, and then using the Direct and Assumed loss and the Ceded Amounts with Zero Credit Risk Charge from the same simulated year;
(2) choosing the Net modeled loss for the scenario corresponding to the worst year in 100, and selecting Direct and Assumed loss from the scenario corresponding to the worst year in 100 based on the distribution of Direct and Assumed losses;
(3) choosing Net loss based on the worst year in 100 for Net losses, Direct and Assumed loss based on the worst year in 100 for Direct and Assumed Losses, and the Ceded Amounts with Zero Credit Risk Charge based on the worst year in 100 for these amounts.

The second option involves at least two sub-options based on how the Ceded amounts with Zero Credit Risk Charge are chosen. The second and third options could be criticized—correctly from the theoretical point of view—because they lead to the calculation of the credit risk component of the charge by applying a factor to an amount that may not be a ceded reinsurance amount under any of the scenarios (simulated years).

While the results of the calculations differ depending on numerous parameters such as the structure of the reinsurance programs (including those that transfer losses to affiliates), on average the second and the third options overestimate the risk charge. While in most cases there is little or no difference in the ultimate results whatever option is chosen, it is important to note that the averages are of less interest in the calculation of RBC charges than the more extreme cases.

Theoretically correct **RBC catastrophe charge within the current framework**

From the purely theoretical point of view, *within the current framework* all of the interpretations and ways to calculate the total catastrophe risk charge mentioned above are incorrect at least to some degree.

[8] The NAIC Instructions specify that data must be provided for the worst year in 50, 100, 250, and 500; however, only the worst year in 100 is used in the calculation of the catastrophe risk charge.

The theoretically correct risk charge calculation *within the current framework*[9] requires basing the catastrophe charge on the worst simulated year in 100, with the "worst" defined as having the highest value of the *sum* of its two components, the net loss component and the credit risk component. The charge is then calculated as the sum of these two components for the worst simulated year thus defined.

Since the total risk charge consists of two elements—the net loss charge component, and the component associated with the risk that ceded reinsurance amounts may be uncollectable—it is clear that both of the risks should be considered together, within the same scenario, and the scenario corresponding to the chosen safety margin should then be chosen. In this case, the safety margin is based on the worst year in 100 calibration level.

Within the current framework, the above two components should not be considered separately, such as when they are based on different scenarios (simulated years). To consider the two components separately is possible only as an approximation. The components are not independent and their calculation should not include elements taken from different simulated years.

The credit risk component of the charge is intended to be calculated as a percentage of the ceded reinsurance amount. This percentage factor is intended to account for the credit risk associated with potential inability to collect reinsurance recoverable in the case of losses. A ceded reinsurance amount is, by definition, calculated by using figures generated for the same simulated year (same modeled scenario). In other words, it should be based on losses incurred in one simulated year. Having the gross amount taken from one simulated year and the net amount from another produces a number that has little meaning, in the sense that it does not correspond to any of the modeled years (scenarios).

In the example exposed for comment, this approach would result in the value of the catastrophe risk charge that is between those based on "Option 1" and "Option 2" as defined in that example. However, no specific example is representative of the large universe of potential situations.[10]

Clearly defining the goal this way, we can then work on choosing the most appropriate practical way to calculate the catastrophe risk charge. This calculation may be a compromise between the theoretically correct approach and an approach dictated by practical limitations such as general data availability and the reliability of available data. In addition, seeking a high degree of precision in the calculations makes sense only where we can be relatively certain of the inputs. The inputs here are the outputs of catastrophe models. Precision is difficult to achieve in catastrophe modeling, in particular where significant latitude is permitted in the choice of catastrophe modeling software and the way the modeling software is used.

Based on the above considerations, the following are two examples of *theoretically* deficient approaches, both of which have apparently been used:[11]

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[9] A different choice of the calculation framework may result in another approach being preferable or "correct." The label "theoretically correct" does *not* by itself imply that an approach should be used or even could be used in a practical context.

[10] The example in the exposed document is important in that it demonstrates how different interpretations of the instructions could result in very different values of the catastrophe risk charge. We do not believe it is illustrative of any typical catastrophe exposure or reinsurance program.

[11] See footnote 8 above that emphasizes that "theoretically correct" is not always the best approach to use in a practical setting and that a change in the calculation framework of the catastrophe charge could easily result in the need to reevaluate what approaches are most appropriate from both the theoretical and the practical points of view.

- Calculating the total RBC catastrophe charge based on the worst year in 100 for net losses only, and adding to it the ceded amount for the same simulated year, times a specified factor. (In practice, this will often produce the right answer.)
- Calculating the total RBC catastrophe charge based on the worst year in 100 for net losses only, and adding to it a ceded amount based on the difference between the gross (direct plus assumed) loss for a simulated year (such as the worst year in 100 gross loss) and the net loss based on the worst-in-100 simulated year for net loss. These two scenarios—the worst year in 100 for gross losses scenario and the worst year in 100 for net losses scenario—may be different. In that case, the "ceded amount" does not make any practical sense because it may not correspond to the ceded amount in any of the modeled scenarios (simulated years).

  We note that in cases where both the gross and the net amounts correspond to the same scenario (same modeled year), the resulting charge may still be incorrect because it may not be based on the scenario that produces theoretically correct results. It's not enough to be consistent and use the same scenario for all the inputs; it should also be the right scenario. The theoretically correct scenario (modeled year) is the one based on the distribution of the sum of the net loss and the credit risk components, as opposed to the distribution of net losses, distribution of gross losses, or some mixture of the two. However, the current instructions do not seem to allow this theoretically correct treatment.

These two approaches and the various "sub-approaches" are the ones being discussed right now. Both could conceivably be seen as the interpretation of the current RBC instructions. It appears that the industry has not been uniform in the interpretation of the instructions for calculating the R6 and R7 catastrophe risk charges.

Difference between a theoretically correct approach and a reasonable practical approximation

The goal of developing the best way to calculate catastrophe risk charges for RBC is not to arrive at the perfect, theoretically correct result. The primary goal is to develop a reasonable approximation that captures catastrophe risk exposure and establishes corresponding capital charges in a way that (1) reflects true catastrophe risk exposure; (2) establishes risk capital charges corresponding to this risk exposure, to address potential insolvency risk or the risk of other dangerous developments related to capital adequacy; (3) is consistent, within reasonable margins, with the level of risk to which other capital charges are calibrated and that reflects the overall safety level chosen in the development of the RBC requirements; and (4) does not impose unnecessary requirements on insurance companies or force them to incur unjustifiable expenses to calculate the charges.

Other risk charges in RBC include numerous approximations and may not always be calibrated to the same safety level. The current framework for the calculation of the catastrophe risk charge in RBC explicitly and implicitly includes a number of simplifying assumptions. The presence of these assumptions and other approximations in the framework makes it even clearer that looking for a perfectly accurate calculation within this framework is both unnecessary and unwarranted. *The only goal is to develop an approximation that meets the requirements* mentioned in the previous paragraph.

An observation has been made above that taking the difference between gross loss from one simulated (modeled) year and net loss from another simulated year and using it as a measure of potentially uncollectible reinsurance recoverable amounts in the calculation of the charge is nonsensical from the theoretical point of view. While the observation is correct, it is possible that at least in the short term, data availability issues may make such an approach necessary.

Recommendations

- *Clear guidance* should be provided to the industry on the calculation of catastrophe risk charges in the NAIC P/C RBC.

- We recommend that the near-term approach not change from that for the previous year. Even though it is open to more than one interpretation, at this point it may be too late to provide clarifications and modification to the instructions. While the approach based on taking the Net Loss for the simulated worst year in 100 and calculating the Ceded Amounts based on the same simulated year appears preferable to the other approach currently discussed, there are companies that may not have the necessary data and do not anticipate the need to obtain these modeling outputs.

- It is quite possible that within the current framework, the proper calculation of the catastrophe risk charge is *not* a significant challenge and the data is available or could be made available without great difficulty for the great majority of insurance companies. We described this approach above as the theoretically correct approach within the current calculation framework. Major catastrophe modeling firms would find it easy to incorporate the required data into their standard reports.

  We recommend that this option be explored because it may offer a simple solution to the issue under consideration and improve the accuracy of the calculation, as long as the industry is given advanced notice what type of modeling data will be needed for the calculation. Having only the general output reports with the gross and net loss exceedance curves does not provide sufficient data for this calculation.

- It may be beneficial to survey the industry to understand the difficulty and possible expense some companies may have in obtaining modeling outputs needed for performing more precise calculations—rather than simply taking several data points from standard reports on gross and net losses produced by consultants or reinsurance brokers. On the other hand, the companies that do not have adequate information on their catastrophe exposure may need to be encouraged to improve their ability to analyze catastrophe risk, and the extra expense then should not be a reason to allow them to unreasonably simplify calculations of the catastrophe risk charge.

- A critical consideration and area for potential improvement is the way an individual company chooses to model its catastrophe exposure. The differences among the allowed catastrophe models and the ability of the user to use models from the same provider in ways that produce very different results is an obvious concern. While the regulators have chosen the correct approach of allowing some flexibility in this area during the initial stages, in the future this issue will have to be reexamined. It may be addressed, even if only partially, through ORSA and the standard examinations of the companies. Part of the concern is to avoid the situation where risk-based capital requirements create a significant incentive for companies to understate their real catastrophe exposure for RBC purposes and also internally (ORSA and general Enterprise risk management).

- Even though values of gross and net losses are shown for more than one safety level in the NAIC RBC Report, only the worst-year-in-100 values are used in the calculations. It has been pointed out that this choice may result in "instability" and also that the cliff effect may distort the catastrophe charges based on this calculation. There are ways to "smooth" the results, such as by incorporating in the calculations modeling results corresponding to more than one point on the aggregate exceedance probability (AEP) curve. We caution against such artificial smoothing and ad-hoc adjustments. An alternative approach would be to change the risk measure to CVaR (TVaR). We do not see advantages in this change and are concerned that it may create its own complications due to limits on catastrophe modeling accuracy and unusual effects observed in modeling extremely rare events, far in the tail of the probability distribution.

- Decision on the appropriate value of the *risk factor applicable to ceded amounts* should be made.
  a. In some cases, the catastrophe risk charge may be highly sensitive to this value.
  b. As the first step, it may be helpful to acknowledge, should the regulators agree with this opinion, that the value of this factor should be reduced.
  c. A strong argument could be made that this value should be lower than that of the "R3 factor" that is applied to estimates of reinsurance recoverables for losses that have already occurred, as opposed to reinsurance recoverables for potential catastrophic events known to be extremely rare.
  d. An argument can also be made for not reducing the factor to too low a level, because extreme catastrophes may increase the solvency risk of reinsurance companies.
  e. In the future, it may become possible to have this factor vary by a number of other considerations, such as: the financial stability (or claims-paying ability) of reinsurers, taking into account the unusual systemic risk related to solvency if a very large catastrophic event were to happen; dependence of the risk on the size of catastrophic events; and type of reinsurer, taking into account that certain specialist reinsurers may have greater or lower exposure to catastrophic events in general or catastrophic events of a certain type. We do not propose that any of these improvements be made now.
- The issue of collateral should be explicitly considered. While this may not be the next step in the work on improving the calculation of the catastrophe risk factor, it is important to recognize that catastrophe reinsurance is increasingly collateralized. This collateralization is different from the one often seen in traditional reinsurance. In catastrophe reinsurance, the full contract limit is often collateralized from inception, before any losses occur.

- In the future, the issue of reinstatement premiums has to be explicitly addressed. Reinstatement premiums are a potential additional expense that may need to be incorporated in the calculation of the catastrophe risk factors.

- Some of the issues mentioned above may depend on the ongoing activities aimed at improving other areas of the NAIC RBC. These activities, while appearing independent, may have an impact on the catastrophe risk charges. There is a possibility that the catastrophe risk charges may have an impact on these other areas as well, perhaps in indirect ways if, for example, methodologically inconsistent treatment of various risk elements is implemented.

- While there are a number of additional issues that should be considered, it is appropriate to postpone their consideration until a later date (unless other decisions are made that may complicate such a delay).

It is preferable to build a framework that can in the future be applied, with necessary modifications, to other types of catastrophe risk that the regulators may decide to address through risk-based capital requirements. These are expected to include tornado as an important natural catastrophe risk that has not been included in the current proposal because of the unresolved question of model credibility for tornado risk.

Ideally, the same general framework will be applicable, with only limited modifications, to the calculation of capital charges for risks such as terrorism or cyber risk that can result in catastrophic insurance losses when included in insurance coverage. If catastrophe charges for these two risks are included in risk-based capital requirements in the future, it may also be necessary to reexamine the current assumption of independence and lack of overlap of catastrophic events, in order to take into account the growing risk of events such as those that can result from cyber terrorism.

Please note that these comments and recommendations represent my personal views and are not intended to reflect the position of the P/C Risk-Based Capital Committee of the American Academy of Actuaries, which I chaired until earlier this year, or the CAS Task Force on Cyber Risk, which I currently chair. These personal views should not be seen as a public policy statement nor as a position taken by any of these two organizations.

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