Electric Power Research Institute (EPRI)
Comments to CASAC Review Panel on the Secondary NAAQS for SOx and NOx

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I am Dr. Eladio M. Knipping, a Senior Technical Manager in the Environment Sector of the Electric Power Research Institute (EPRI). EPRI is independent, nonprofit organization that conducts research relating to the generation, delivery and use of electricity for the benefit of the public.

As the emphasis of the PAD is on the protection of sensitive surface waters, my comments today are focused on the science underlying the Atmospheric Acidification Potential Index and the results of an uncertainty analysis showing the impact on SOx and NOx concentrations required to show attainment.

The primary concern is that the uncertainty associated with EPA's approach to estimating critical loads and mapping those to atmospheric concentrations is so large that its use in defining the requisite level of a standard is questionable. EPA cites this uncertainty as very small; our computations show otherwise.

Some of the key points contained in our comments are as follows:

[PRE-INDUSTRIAL BASE CATION CONCENTRATION: BC_0] Determination of the critical deposition load is highly dependent upon historical values of pre-industrial base cation concentrations in 1850-1860. Those values were never measured.

> EPA proposes to estimate those values using "hindcasting" with the MAGIC model or using an "F" factor approach. The latter method was developed for Scandinavian countries that have much less diverse bedrock and soils than in the United States.
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> **[HINDCASTING WITH THE MAGIC MODEL]** Testing of the MAGIC model going forward in time raises doubts about its ability to simulate from far back in the past.

The EPA should consider that both deposition and surface water data are available for the last 20-30 years, a period with decreasing SOx and NOx deposition. This period must be simulated accurately to gain confidence in the models; only then can one move forward in time with the models to develop an approach for evaluating sensitivities to deposition, rather than trying to hindcast conditions from over 150 years ago that were never measured.

> **[CATION EXCHANGE]** Cation exchange is missing completely from the processes leading to the AAPI equation. Moreover, surface water pH is largely determined by the fraction of precipitation that flows laterally through deeper soil horizons and cation exchange in these soils.
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> In the Adirondacks, surface water sulfate concentrations have decreased with decreasing SOx deposition. Surface water nitrate concentrations have also decreased, though to a lesser degree.

Note the ANC increased only slightly. This is because the base cation concentration, being largely induced by the strong acids, also decreased. Thus, the predicted increase in ANC by the MAGIC model did not materialize.

[BASE CATION WEATHERING] Base cation weathering inputs play a critical role in SSWC applications, but are likely to be highly uncertain due to the use of hindcasting and the under-constrained nature of the weathering formulations used in the MAGIC model.

[ATMOSPHERIC TRANSFER FUNCTIONS (VSOx and VNOy) AND REDUCED N LOAD LNHx] VSOx and VNOy are atmospheric deposition transfer functions calculated from model simulations.

The choice of the simulation year, the atmospheric model, and the model configuration (such as the grid resolution) can make a large difference in the calculated VSOx and VNOy parameters. This introduces uncertainty in the definition of a secondary NAAQS using EPA's proposed approach.

A full discussion on these topics and other concerns are described in our full comments and will be covered in a forthcoming report to be submitted before the filing deadline. At this moment, I would like to illustrate the combined impact of all these issues on the levels of a proposed standard.

[UNCERTAINTY ANALYSIS] We have conducted uncertainty analyses using EPA's equations and models by applying the Monte Carlo technique, as well as other methods, with a combination of our and EPA's estimates of uncertainty in the individual terms for an example in the Adirondacks.

Note that values plotted are within ± 1.5 standard deviations from the mode of the probability distribution (representing an 87% confidence interval). These results also do not include the LNHx term and its associated uncertainties. These results are for a single lake; multiple lake results (and results in other regions with less available data) will have wider variances and confidence limits.

In every case, we found large overall uncertainties that compromise the practical usefulness of the equations and models in helping define the requisite level of any standard.

In the proposed approach, whatever standard is established will be based on highly uncertain methods, including under-constrained estimates of pre-industrial conditions. However, the best evidence available regarding how surface waters will respond to changes in acidic deposition is the change measured in response to decreased deposition over the past two decades.

Only mechanistic models that can accurately represent this observed response can build confidence in the ability to predict responses to future changes in deposition. Establishment of a standard requires a technically rigorous basis and must not ignore high-quality research regarding the response of surface waters to changes in deposition.