**Eladio M. Knipping, Electric Power Research Institute (Slide 1: Title Slide)**

I would like to thank the CASAC Review Panel for the opportunity to provide comments on the Policy Assessment Document for the Secondary NAAQS for SOx and NOx. Although the PAD contains additional material related to several of the issues raised earlier by CASAC and the public, the document still fails to adequately address a number of key scientific issues of concern. I can only summarize some of these items. Additional details and a full critique can be found in the handouts provided to the panel. I urge the CASAC Review Panel to include these items in their discussions today:

**Regionalization: Aggregation, Data Representativeness and Percentile of Protection**

The PAD continues to assert that Omernik Level III ecoregions can be used to spatially aggregate water bodies for the purposes of this standard. As stated in our earlier comments, these regions are disparate and emphasize vegetation differences and **not** key water quality variables. Ultimately, EPA's methodology leads to low critical loads because, in fact, ecoregions are a **mix** of non-sensitive and very sensitive areas, as shown in **Slide 2.** Here we observe that the Southern Appalachians are an interspersion of siliclastic, granitic and basaltic watersheds with a huge diversity of elevations; these and other parameters, such as watershed area and forestry, influence the acid sensitivity of a waterbody.

This heterogeneity in ecoregions leads to a second observation. Water bodies that are actively sampled in the U.S. are often preferentially located in the more sensitive spots, as can be seen in **Slide 3**, leading to a **skewed** representation of the waterbodies within a region. Let us compare the **stream number distribution** in the Southern Appalachian to **the stream length distribution**, as shown on **Slide 4**: although there are many stations in acid sensitive **"segments"**, the predominance of stream length has non-acidic condition (applying the non-acidic threshold for the Shenandoah region of ANC greater than 50 μeq $L^{-1}$, shown on **Slide 5**). The PAD should contain a table, as shown on **Slide 6**, allowing one to determine the representative nature of the waterbodies with data in the region. This issue is critical to defining a key aspect of the standard: the percentile of protection.

**Critical Load Calculations**

EPA is proposing to calculate critical loads using an equation based on the conceptual model of steady-state water chemistry. I focus now on EPA's methodologies for calculating a particular input to that model, the pre-acidification base cation concentrations and its two calculation methods: the F-factor and the MAGIC model. In deriving the values for the F-factor, EPA is proposing to use data from Norwegian systems. This leads to F-factor values in the Adirondacks that are in the range of 0.2 to 0.4, whereas actual data from the Adirondacks (as shown on **Slide 7**) shows that the distribution is much broader, with a mode near 0.6. In **Slide 8**, we show how the average F-factor calculated during a 9-year period compares to the average F-factor calculated for the subsequent 9-year period **at individual lake watersheds** in the Adirondacks. Over time scales of a decade, the F-factor exhibited diverse behavior with lakes seeing large decreases, small decreases, negligible change, small increases and large increases. There is no predominant pattern in either direction or magnitude. This underscores the scientific fact that these systems are not in steady state and are not showing a trend towards steady-state equilibrium (as EPA suggests may ultimately be attained).

EPA has not provided a robust evaluation of the other method to calculate pre-acidification base cation levels, the MAGIC model. Outside of the calibration period, the REA document shows model performance for only **two** Adirondack lakes and **two** Shenandoah streams from a population of 104 waterbodies in the combined dataset. As illustrated in **Slide 9**, the aggregate model performance for the 44 Adirondack lakes is actually quite poor. In spite of its deficiencies, EPA indicates that the MAGIC model is preferred over the F-factor approach. However, it appears that EPA is data-limited and will be relying on the F-factor approach in most regions of the U.S. This is of concern since the F-factor approach has consistently shown to yield critical loads that are twice as stringent as the critical loads calculated by MAGIC, as shown on **Slide 10**.

**Ecological Indicators: ANC, pH and $Al_{im}$**

**Slide 11** shows a figure from the PAD illustrating the true sensitivity of aquatic species to inorganic monomeric aluminum ($Al_{im}$). The bioavailability of aluminum is determined by the pH of the water. If the relationship between ANC and pH were universal **AND** aluminum in all waterbodies existed in equal concentrations, then ANC alone would be an appropriate indicator of aquatic acidification effects. However, neither of these two is true. In **Slide 12**, we show that the **relationship between ANC and pH is not universal**; whereas the figure from the PAD on the left shows theoretical and measured curves of pH vs ANC for a solution of Gibbsite in equilibrium with ambient $CO_2$, the figure on the right shows data obtained from over 1400 waterbodies illustrating the deviation from this curve. This spread in the data reflects the broad distributions of dissolved organic carbon (DOC), dissolved $CO_2$ and dissolved aluminum in real waters.

It is also important is to note that the amount of aluminum in solution is paramount. In **Slide 13**, the relationship of fish species to pH is less sensitive in Florida than elsewhere as these waters are low in aluminum; although these waters are characterized by low ANC and low pH (and have low, not high, DOC), the scarcity of aluminum results in thriving fish habitats.

The relationship between ANC and pH and the levels of aluminum is also brought out by this earlier slide, repeated as **Slide 14**, illustrating that in the Shenandoah National Park, aquatic habitats for *brook trout* are considered non-acidic starting at ANC values of 50 μeq $L^{-1}$. **Slide 15** shows that for populations of *blacknose dace*, the "Shenandoah National Park: Fish in Sensitive Habitats" study found the highest fish density in streamwaters with ANC near 20 μeq $L^{-1}$.

**Uncertainty Analysis**

We note the large discrepancy between EPA's uncertainty analysis and the analysis that we have performed. Due to my limited time and the complexity of this issue, I will note that the uncertainty discussion is unclear. However, we present the conceptual basis and all the parameters that we employed in our analysis in the handouts.

In concluding, I note that we have additional analysis that we would like to perform once the databases, modeling files and models have been released to the public. We hope these comments are useful to the CASAC Review Panel in their discussions today and I would be glad to answer any questions. Thank you.

(**Slide 16: Contact Information**)