# 3. MERCURY TECHNOLOGY EVALUATION

## 3.1. MERCURY EMISSIONS BACKGROUND

### 3.1.1. Mercury Speciation

Mercury (Hg) is contained in varying concentrations in different coal supplies. During combustion, Hg is released in the form of elemental Hg in the high temperature combustion zone of a boiler. As the combustion gases cool, a portion of the elemental Hg transforms or oxidizes to ionic Hg. However, the amount of elemental Hg that oxidizes is dependent on the cooling rate of the gas and the presence of halogens in the flue gas Ultimately, there are three possible forms of Hg:

- Elemental ($Hg^0$):
  - The conversion of elemental Hg to the other forms depends upon several factors including cooling rate of the gas, presence of halogens or sulfur trioxide ($SO_3$) in the flue gas, amount and composition of fly ash, presence of unburned carbon, and the installed APC equipment.
  - $Hg^0$ is insoluble in water and therefore removal requires injected sorbents or must be converted to another form to be captured, depending on the installed APC equipment.
- Ionic or Oxidized ($Hg^{++}$ or $Hg^{2+}$):
  - In contrast to elemental Hg, ionic Hg is highly water soluble, allowing for collection in water streams that may be utilized in certain APC equipment and subsequently leave the process with the solid by-product or as a constituent in the purge water.
- Particulate-bound:
  - Particulate-bound Hg typically is bound to fly ash or unburned carbon. Particulate-bound Hg is efficiently removed from the flue gas by the particulate control device, making it desirable to convert as much Hg as possible to particulate-bound Hg.
  - High $SO_3$ levels have been shown to inhibit the binding of ionic Hg to fly ash or Hg sorbents. The addition of halogens increase the conversion of elemental and ionic Hg to particulate-bound Hg.

The proportion of the various Hg forms is referred to as Hg speciation. As such, Hg speciation testing has indicated that the distribution of Hg species varies with coal type The effectiveness of post-combustion Hg control technologies is highly influenced by the Hg speciation in the flue gas, with gaseous oxidized (or ionic) Hg compounds (i.e. $HgCl_2$) being easier to capture by downstream APC equipment.

### 3.1.2. Lignite Coal Variability

Industry experience has shown that lignite coal deposits vary significantly in quality, including fuel combustion performance, mineral content, and Hg content, resulting in a coal that can change on a day-to-day basis depending on the coal seam being mined at the time. For example, during the 2005 Energy & Environmental Research Center (EERC) sixty (60) day testing on MRY Unit 2[2], the coal samples analyzed ranged from 6.22

[2] Refer to the EERC "Large-Scale Mercury Control Technology Testing for Lignite-Fired Utilities - Oxidation Systems for Wet FGD" report (Cooperative Agreement No. DE-FC26-03NT41991) dated March 2007 for further details on the testing completed from March 15, 2005 to May 15, 2005 on MRY Unit 2.