WRI 50: Mine Water for Power Plant Cooling

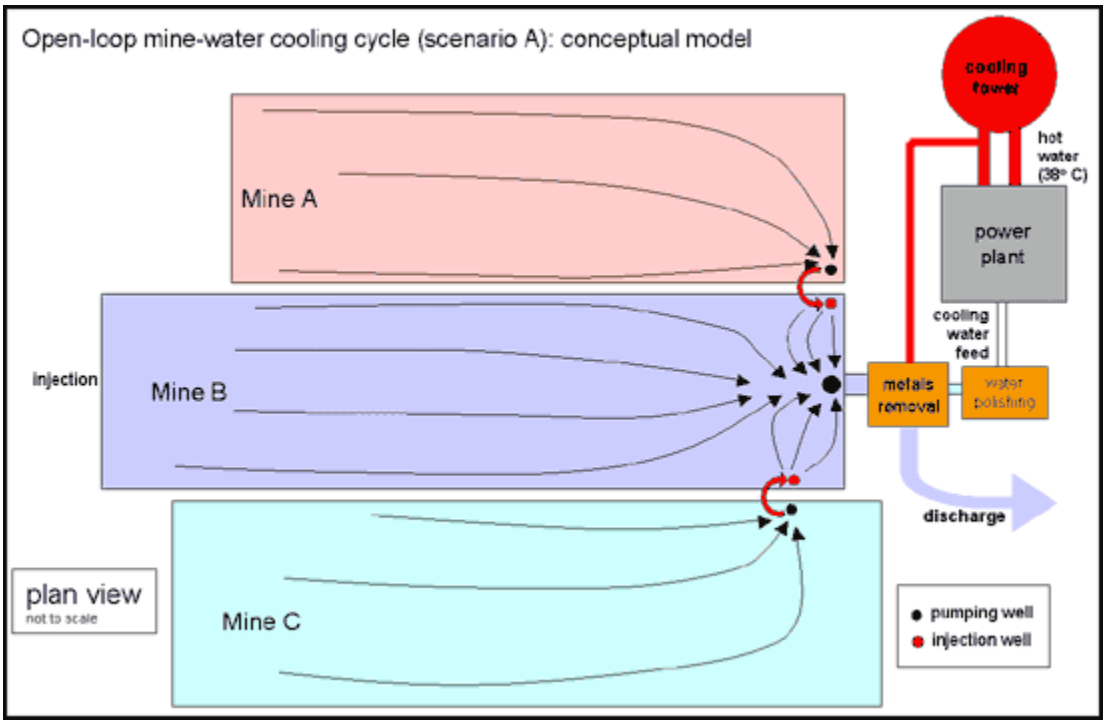
Scope of work

The work will be conducted in two parallel tracks referred to as scenario A and scenario B. Under scenario A, a conceptual engineering design will be applied to the knowledge of mine hydrology developed in DOE # DE-AM26_99FT40463 to identify mine water reservoirs of sufficient water flow to provide cooling water for a 600 mega watt coal fired power plant. The costs and feasibility of obtaining, treating and utilizing this water will be compared to the costs and feasibility of obtaining sufficient water from a surface water source. Cost savings are anticipated in the volume of water required, the avoided cost of the water intake structure and its attendant environmental issues, and the size of the cooling tower. Environmental benefits are anticipated through the utilization of acid mine drainage that would otherwise contaminate surface waters, as well as avoiding the consumptive use of existing surface water resources. Under scenario B, the ability of abandoned coal mines to serve as a heat sink will be investigated. Individual coal mines underlie many square miles in West Virginia and western Pennsylvania.

Both scenario A and B require mines that (1) have sufficient annual recharge to be a suitable source of water, (2) are sufficiently deep that their water is below surface drainage elevation, and (3) are in proximity to areas of current thermal coal production. The analysis will focus on an area where a large number of such flooded mines exist, in the Pittsburgh coal basin of the Appalachian bituminous coalfields (Figure 1). This would be one of, but not the only, region where the results of this proposal might be applied. It should be noted that the mine-water availability and chemistry of flooded mines could vary considerably from area to area and will strongly affect the feasibility in any specific location. While we focus on Pittsburgh basin flooded mines, the principles employed in this work will be transferable to other locations, even if the mine and mine-water parameters differ.

Scenario A *(open-cycle cooling)*

Scenario A is based upon extracting sufficient water from the mines to operate an open evaporative cooling-tower cycle, similar to current practice employing surface-water sources. This scenario differs from current practice in that (a) it requires identification of an adequate supply of mine water, (b) it requires installation of a collection system, and (c) it requires pre-treatment of mine water to make it suitable for cooling. Feasibility, therefore, is concerned primarily with source water availability and chemistry, the costs to gather, and treat this water, and environmental factors.



Scenario B *(earth-radiation cooling)*

Scenario B is based upon not only obtaining an adequate supply for cooling, but injecting the fully-heated cooling water directly into an underground mine. This cooling cycle is a “closed loop”, in that no cooling tower is employed and little waste heat is discharged at the plant site. Instead, heat is dissipated by radiation from water within the underground mines to the rocks surrounding and above the mine. There is no cooling tower, limited steam evolution, and little evaporative concentration of cooling water. Also, loss of heat from the plant process is accomplished by conduction only, not by loss of the heat of vaporization as for cooling towers. Therefore, the water needs are significantly greater in quantity than for Scenario A. Feasibility will be based on the availability of water in the mine-water reservoir; the practicality of cooling by earth radiation; and environmental factors.