Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

Green and Sustainable Remediation Analysis: Coal Ash Surface Impoundment Closure

Ali Boroumand, Ph.D. (aboroumand@gradientcorp.com) and Kurt Herman, M.Eng., P.G. (kherman@gradientcorp.com) (Gradient, Cambridge, MA, USA)

Background/Objectives. For decades, coal combustion residuals (CCRs) from coal-fired power plants were disposed of in lined or unlined surface impoundments (SIs). In recent years, increasing pressure from the public, advocacy groups, and regulatory bodies has led the coal power industry to close existing unlined SIs. The two primary closure options are closure-in-place (CIP), which involves dewatering, capping, and engineering controls, and closure-by-removal (CBR), which includes excavation, transportation, and redisposal in a lined landfill. Whereas the positive environmental impacts of SI closures are more perceivable, the adverse impacts of the closure options may remain overlooked. To fully understand the potential human health and environmental impacts associated with these closure options, a comprehensive green and sustainable remediation (GSR) approach is needed to consider a wide range of life-cycle externalities, including worker and community safety, energy consumption, greenhouse gas emissions, and environmental justice factors associated with each alternative.

Approach/Activities. We developed a GSR analysis framework, as part of a broader SI closure analysis, that evaluates other environmental impacts. The GSR analysis framework quantitatively evaluates the impacts of closure scenarios by estimating five categories of metrics: air emissions (i.e., NOx, SOx, green house gas, PM_{10}); energy consumption; resource consumption (e.g., soil, water); worker safety risks (number of injuries and fatalities); and community safety risks (number of community-involved accidents, injuries, and fatalities). These metrics are evaluated for a full lifecycle, meaning that the cumulative amounts from day one of implication of the closure scenario to the last day of operation are estimated and compared for different closure alternatives. The level of complexity and effort that goes into the estimation of site activities, labor, and material needs associated with each closure remediation varies with the level of assessment required by the user. We designed three different assessment levels, from a simple screening-level analysis with many simplifying assumptions to a customized analysis level with more complicated and detailed site-specific estimations.

Results/Lessons Learned. We applied the methods developed in the framework to a hypothetical case study site to analyze the benefit and impacts associated with CIP and CBR options. These closure options were compared against a baseline no action scenario, which consisted of continued use of the SI for CCR disposal. All GSR metrics reflected a negative impact compared to the baseline. NOx emission and total energy used were amongst the largest negative impacts. For all metrics, except safety metrics, the negative impacts of CBR were about 10-fold greater than those for CIP. The adverse impacts of CBR were about 2- and 20-fold greater than those for CIP for on-site and off-site safety metrics, respectively. These results and ratios are site-specific and may vary depending on the site and closure parameters. A sensitivity analysis showed that the hauling distances between the SI, landfill, and material sources are the most important factors that can change the relative impacts of closure scenarios.