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Mr. Robert Evers  
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Subject: Dye Tracer Plan and Projected Schedule

Dear Mr. Evers:

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At the request of Entergy, GZA GeoEnvironmental Inc. (GZA) has prepared this plan to assess the impact of the selected organic tracer dyes on the cation exchange media used to treat radioisotope contaminated water in the Unit 1 Fuel Storage Building (IP1-FSB as well as assess the absorption rate of the selected organic dye on activated carbon in anticipation of introducing dye into the IP1-Transfer Pool. In addition, we have provided a tentative schedule for introducing dye at the remaining three injection locations and a selected dye for the injection into the old Unit 1 piping system.

### **Impacts on Cation Exchange Medium**

Based upon preliminary discussions with Ozark Underground Laboratories and the chemistry of the dyes, we do not anticipate that the organic dyes, which are anionic dyes, will have a significant impact on the cation exchange medium. However, we propose that a series of bench-scale and pilot-scale tests be conducted to assess the impact of the dye on the cation exchange medium.

The first test will consist of adding a known concentration of dye to a known volume of the cation exchange medium. The sample will then be agitated and left in contact with the medium for a period of time. The concentration of the dye will then be measured to assess whether absorption or chemical reactions have resulted in loss of dye, and thus presumably impact to the medium. The results of this preliminary bench-scale test will be used to assess if the more definitive pilot-scale test is worth running.

The second test will be designed as more of a field pilot test. In the pilot test, we propose to provide ABS Engineering with a quantity of dye to use in their mobile pilot treatment unit. The unit will be filled with the cation exchange medium. Contaminated water from either a fuel pool or the north curtain drain would be cycled through the medium until breakthrough is achieved. The mass/activity of the adsorbed radionucleides would be computed by both: 1) measurement of the activity of the input water and output water and the volume of water passed through the medium



prior to breakthrough; and 2) direct measurement of representative samples of the medium before and after adsorption from the water. A mass balance would then be performed. The test would then be repeated with the same source of water, this time adding dye at a similar concentration as will be used in the IPI-Transfer Pool. The same sampling would be performed and the results compared to that of the first test. In addition, the rate at which break through is achieved will be compared with the original test.

In order to perform the first bench-scale test, we will require a small quantity of the cation exchange medium. Additional medium would also be required by ABS.

### **Carbon Absorption**

In order to assess the amount of carbon and residence time that would be required to remove the dye from the water, we will perform a bench scale test consisting of adding known concentrations of dye at known volumes to known volumes of activated carbon. The samples will then be agitated and left in contact with the carbon for a period of time. The concentrations of the dye will then be measured to assess the absorption rates. This information can then be used to size a carbon unit.

However, it should be noted that if the dye impacted water from the fuel pool is released, following treatment for radioisotopes, to the discharge canal at relatively small rates over time, then it will be sufficiently dilute in the discharge canal water and not cause a visual impact to the Hudson River. In addition, the dyes we have selected are not toxic.

### **Dye Selection for the Abandoned Unit 1 Piping System**

Based upon discussions with Ozark Underground Laboratories, we recommend using fluorescein for the injection in the former Unit 1 piping system. This is the same dye we used in the Unit 2 injection conducted on February 8, 2007. Although there are concerns regarding mixing of these dyes in the waterfront wells, we believe we can design the injections in a way to allow separation of the dye fronts. We have ruled out the use of other dyes based upon either their toxicity (Health and Safety issues) or the inability to resolve the peaks from other dyes being used on-site with the current analytical methods.

In order to be able to resolve the two dye fronts at the water front, we propose to allow a sufficient time for the Unit 2 dye front to flush through the bedrock fractures so that non-detect to minimal amounts of injected fluorescein remain in the groundwater during the second injection. In addition, we can increase the concentration of the dye injected into the Unit 1 piping system so that a more concentrated dye front moves through the bedrock and we will be able to see the second front pass the monitoring wells. We will have a good estimate at the rate the dye is moving through the groundwater in a few weeks. At this point we have already

seen visible dye enter the top zone of MW-31 and in less than a week move through the zone so that no visible dye remains in the top zone of MW-31.

### Remaining Dye Injection Schedule

Given the amount of labor involved in sampling the monitoring networks during a dye introduction period, GZA proposes to conduct the dye injections at TI-U1-1, the transfer pool, and the former Unit 1 Piping network over a period of time as close to each other as possible so that we are monitoring all three injections at the same time. Therefore, prior to injection the following must be achieved:

- Complete the bench scale tests on activated carbon and the cation exchange medium;
- Complete the pilot scale test using ABS Engineering's mobile treatment system;
- Order and install carbon treatment vessels to treat the dyed water in the transfer pool following the tracer test, if deemed necessary;
- Allow sufficient time for the dye front from the Unit 2 injection to flush through the system;
- Complete the testing and analysis of the ongoing piping investigation;
- Determine the most practical and effective points to inject dye in the Unit 1 piping system; and
- Isolate components of the piping system to control the path the dye takes after injection.

At this time we believe that an injection date of March 26 or April 2, 2007 would be practical.

If you have any questions please do not hesitate to contact David or Matthew.

Sincerely,  
GZA GEOENVIRONMENTAL INC.



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