Jelly
Jim Tucker
Drey #5 - Answers

Department of Energy
Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
7295 Highway 94 South
St. Charles, Missouri 63304

November 22, 1991

Mrs. Kay Drey
515 West Point Avenue
University City, Missouri 63130

Dear Kay:

Reference: Letter from Kay Drey to Stephen McCracken, dated October 9, 1991

Letter from Kay Drey to Stephen McCracken date November 21, 1991

Your comments in the opening paragraph of your October 9th letter imply that you aren't getting straight answers about our work.

In response to those comments I would like to clarify a few points. You indicate that I directed you to Mr. Krywucki to answer your questions about the quarry water treatment plant. Your statement is correct. However, it seems to me that it would have been fair to also explain in your letter that I gave you Mr. Krywucki's name at your request for Hydro-Pure's telephone number. (Mr. Krywucki is the general manager of Hydro-Pure). You did not share with me the questions that you wanted to ask. Had I known what questions you wanted to ask I would have told you that many of them were beyond the scope of our contract with Mr. Krywucki's company and that he would not be in a position to answer them. I would suggest that if your purpose in raising questions is to get full and complete answers, then one way to accomplish that purpose would be to coordinate them through my office.

Enclosed you will find answers to questions that Mr. Krywucki was not in a position to answer. I apologize for the delay, however your list was long. Regarding the other two questions in the body of your letter: the system will be housed in a heated facility; and the data on Actinium, Polonium and radon is not yet available. When it is available I will see that you get it.

Sincerely,

Stephen H. McCracken
Project Manager
Weldon Spring Site
Remedial Action Project

Enclosures:
As stated

cc w/enclosure:
Dave Bedan, MDNR
Dan Wall, EPA

RESPONSES TO KAY DREY'S QUESTIONS
ON THE QUARRY WATER TREATMENT PLANT

November 22, 1991

1. At what location(s) other than Weldon Spring (W.S.) has Hydro-Pure designed and built a water treatment plant for water containing mixed radioactive and hazardous wastes?

The subcontractor, Hydro-Pure Systems (HPS), submitted with their proposal a list of previous relevant process systems which they have built. We are not at liberty, per HPS request, to reveal the names of their clients. HPS qualifications included previous experience with mixed waste stream treatment.

a. **location(s)? Date(s)?**

The systems referred to above are all located in the U.S. and were built within the last ten years.

b. **Was this for the Department of Energy (DOE)?**

No.

c. **to treat how many gallons per day? W.S.=115,200 gpd**

Equal to or exceeding the design requirements at WSSRAP.

d. **to discharge into what body of water?**

Not known.

2. Regarding the Weldon Spring Quarry plant: what document describes where <u>within the plant</u> monitors are located for sampling the process water (the quarry water being treated) for radioactive and hazardous contaminants?

Several monitors are located within the plant for measuring and displaying process parameters, including flow rate and totalization, pH, electrolytic conductivity, differential pressure, and turbidity. Hazardous and radioactive contaminants will be sampled and analyzed in a laboratory on a routine basis.

a. **For example, referring to the "Proposed Treatment Train" flow chart (Figure 4.3-1--p.28), are radiation monitors located:**

Refer to the above answer.

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DOCUMENT NUMBER: I-1600-1607-1.07

(1) **after the sedimentation [chemical precipitation/coagulation/clarification] processes—to determine if the filtrate (the liquid that has been press-filtered out of the sedimentation sludge) has to be recycled back into the chemical precipitation unit? This repeated treatment is described as "theoretically possible" in the flow chart. (See also secs. 4.3.6 and 4.4--pp.20-22.)**

The filtrate will be returned to the equalization basin for retreatment. The stream could have been discharged to the effluent ponds or to some other appropriate point in the process system. In the interest of a conservative design, this stream is being retreated.

(2) **after the granular activated carbon process--to determine if the ion exchange process is to be bypassed?**

At this point there are no plans to bypass the ion-exchange system.

b. **For which radionuclides will you monitor within the plant?**

Samples will be taken from the influent, the surge tank, and before and after the ion-exchange unit and analyzed for total uranium.

c. **For which hazardous chemicals—arsenic, manganese, 2,4-DNT?**

Samples will be taken and analyzed for these and other constituents at various points in the system.

3. **What type(s) of monitoring instruments are you planning to use for uranium and the other radioactive materials?**

Samples will be analyzed using EPA 908.1 (Uranium by Fluorometry) or EPA 200.8 (Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry) to determine if the uranium levels in the effluent ponds are below the required NPDES permit levels. In addition, we are using a Kinetic Phosphorescence Analyzer (KPA) analyzer for process monitoring analyses for total uranium.

a. **Have you performed tests of the monitors using quarry water samples? If so, do you have a copy of the report(s) you could send me?**

The methods previously described have been routinely used during environmental monitoring of all surface water including the quarry water. The results are presented in the quarterly environmental data summaries and the *Annual Site Environmental Report*.

b. **Recognizing the fact that radioactive alpha particles will not even penetrate a piece of Kleenex, are you expecting to experience any specific difficulties in monitoring for alpha emitters in water?**

No. Standard analytical methods approved by the EPA exist for detecting gross alpha particles (EPA 600/4-80-032) and alpha emitting elements, such as radium-226 (EPA 903.1), radium-228 (EPA 904), and isotopic thorium (EPA 600/4-80-032).

4. **What would the uranium concentration level have to be for the plant operator(s) to decide that a treated batch of water should not be released into the Missouri River -- that is, would have to be run through the plant treatment train again?**

Plant operators will not make this decision. The NPDES permit lists a discharge limit for total uranium of 100 pCi/l, and no water with higher levels will be released.

a. **That is, what is the permissible uranium discharge limit for release to the environment? 30 picocuries per liter? 100? or the DOE's Derived Concentration Guide [for uranium to surface water] of 600 pCi/L (Table 4.3-1 and Sec. 5.10 -- pp. 25, 46)**

Under the NPDES permit, the permissible discharge limit is 100 pCi/l.

b. **What other radioactive materials are to be tested in each batch before the decision is made to release a given batch to the river? What is the maximum permissible concentration of each?**

The monitoring requirements and discharge limits in the NPDES permit will be met.

c. **For which hazardous chemicals is each batch to be assayed before release to the river?**

The monitoring requirements and discharge limits in the NPDES permit will be met.

5. **According to Dow Chemical Co., the DOWEX ion exchange resins designed to remove uranium will not work in the presence of organic materials. Do you expect to monitor the process stream for organics after the granular activated carbon process, and before the ion exchange process? If so, is there a contingency plan to recycle the stream back through the carbon?**

This question may be the result of a misinterpretation of the information provided by Dow Chemical Company. In support of the answer previously provided by HPS, the following information is offered. The ability of the resin to remove uranyl salts is very dependent upon the type and concentration of the organics present. Significant levels of organics of a particular size and charge could result in an increasingly shortened service cycle, and consequently, a need for an increased frequency of regeneration.

It is important to realize that this is a gradual phenomenon, not a sudden loss of efficiency, and would be detected long before a complete loss of capability occurred. Sampling for total uranium before and after the ion exchange contactor, TOC before and after the upstream carbon contactor, and pH measurements, all taken and analyzed on a daily basis would indicate operational trends toward resin fouling.

If a loss in removal capacity is indicated by the total uranium analysis, and possibly indicated by a slight pH depression across the contactor, a small sample of resin will be withdrawn from the unit and analyzed under a microscope to confirm organic fouling. If fouling has occurred, a resin defouling procedure will be initiated. If this cleaning procedure is unsuccessful, resin replacement will be conducted.

As of now, all recycling of the process stream would be through the entire treatment process by returning the contents of an effluent pond to the equalization basin.

6. **According to the HPS report, the ion exchange resin process is to be bypassed "if uranium levels are acceptable." (Sec. 5.10.2.2 --p. 48)**

Section 5.10.4 states that the ion exchange contactor can be bypassed if upstream uranium levels are acceptable. Currently, there are no plans for doing this.

a. **At which monitor location will this determination be made? What concentration level of uranium is to be "acceptable" at that point?**

If this determination is made, it will be made as described above during routine operational sampling and analysis for total uranium before and after the ion-exchange contactor.

b. **During what percent of the operation of the plant do you expect to bypass this process?**

We do not expect to bypass the unit.

7. **Historic documents show that significant amounts of thorium residues were dumped into the quarry from 1959 through 1969. (DOE: Engineering Evaluation/Cost Analysis, 1989, p.9)**

   a. **According to a publication of the U.S. Agency for Toxic Substances and Disease Registry, if chloride, fluoride, nitrate or sulfate salts are present, soluble thorium compounds can form. (Toxicological Profile for Thorium, 1990, p. 55) Do you expect to be able to remove soluble thorium that may be present? If so, how?**

   Historical data do not indicate the presence of significant amounts of soluble thorium or its salts. Therefore, the DOE does not expect that it will be necessary to reduce the influent concentration. In the unlikely event that soluble thorium should appear, several processes are available for its removal. The most likely mechanism for removal in the existing system is in the lime/precipitation clarifier. Most of any incoming soluble thorium salts would be converted to either thorium dioxide or thorium hydroxide, both of which are insoluble in water, will be removed at this point. This phase change will allow satisfactory precipitation and removal.

   b. **Since the DOWEX 21K resins are designed to remove uranium, but will not remove thorium and some of the other radioactive materials in the quarry, what other removal processes are you planning to use if needed?**

   Radionuclide removals will be affected as described above.

8. **As I understand it, the sludge that is removed from the quarry water by the sedimentation processes is to be transported via a tanker truck to a sludge holding tank, and is then to be transported to a filter press for dewatering. (Sec. 5.2, 5.4, 5.5, 8.1.1, and 8.1.2 -- pp. 35-38, 52)**

The original plan (at the time that the EDR was written) was that the sediment removed by the sedimentation clarifier would be pumped automatically to a sediment storage tank. This sediment would have then been removed periodically via a tanker truck to the temporary storage area at the chemical plant site where the quarry bulk waste will be stored after sorting. The purpose of the sedimentation clarifier is only to remove settleable solids to minimize buildup of silt in the equalization basin. There are no chemical additions to that point in the process; therefore, the settled solids removed will be the same as the muds and sediments removed with the bulk waste. There was never any intention to dewater these solids in the treatment plant filter press.

After publication of the EDR and during final design, it was concluded that a more efficient approach would be to pump these solids back to the quarry sump and remove them along with the quarry bulk waste. The volume of these returned solids is expected to constitute a very low percentage of the total solids in the quarry.

The EDR sections referenced (5.2, 5.4, 5.5, 5.8, 8.1.1, and 8.1.2) refer to several different pieces of the system equipment: the sedimentation clarifier, the sediment storage tank (deleted from the system), the system clarifier (for phase change precipitation), the sludge thickener (to receive, store, and thicken solids from the system clarifier) and the filter press (for dewatering solids held in the thickener).

a. **Although Hydro-Pure is apparently not responsible for removing the sludge from the holding tank, do you know if it has been decided who is to do this? (Secs. 5.2.1 and 8.1.1 --pp. 35, 52) Do you expect the tank to have to be emptied every five days, as per Sec. 5.4.2.2 (p. 38)?**

Section 5.2.1 and 8.1.1 refer to the sedimentation storage tank system which has been deleted.

Section 5.4.2.2 refers to the system clarifier (precipitation unit) and the sludge thickener. The sludge thickener has a five day storage capacity for solids removed in the system clarifier at maximum design levels. This does not mean that the thickener will be emptied every five days. Incremental amounts will be pumped from the thickener to the filter press for dewatering on an as-needed basis. Likewise, incremental amounts will be pumped into the thickener from the system clarifier as necessary to maintain an optimum operating sludge level in the system clarifier sump. The thickener will be completely emptied only prior to extended system shutdowns.

b. **After the sludge has been dewatered via the filter press, where are the waste removal drums containing the compressed filter cakes to be transported? Although Hydro-Pure is not responsible for the removal of the filter cakes, do you know who is? (Secs. 5.5 and 8.1.2 pp. 38, 39, 52) In what and where are the cakes to be stored?**

The DOE no longer plans to use drums to store the filter cake. Specially constructed roll-off type containers with a capacity of 10-20 cubic yards will be used to collect, transport, and store the fiter cake. During plant operation, a container will be transported via the dedicated quarry haul road once every 10 - 50 days depending on the rate of solids generation in the system clarifier. The container will be transported to, and stored at, the temporary storage area (TSA), a specially constructed storage facility at the main site. A subcontractor will be selected to transport the waste to the TSA. The plant operations subcontractor will be responsible for emptying the filter press into the container. The subcontractor will operate under the oversight of MK-Ferguson Company.

(1) **How often do you expect the filter cakes to have to be replaced?**

The filter press is expected to be operated one cycle (fill, dewater, and empty 15 cubic feet of filter cake) once every two or three days under normal operating conditions. Under maximum plant design conditions, approximately 1½ cycles per day will be required.

(2) **The report calls for the saturated filter cakes to be removed from the press manually. (Sec. 8.1.2—p. 52) What do you expect the radiation field to be at the filter press during this manual operation — that is, to what level of radiation will the worker(s) be exposed when replacing the filter cakes?**

The filter press is manual in the sense that an operator must be present to control the automatic features on the filter press. The filter press is completely shrouded and enclosed. It is equipped with view ports and internal lighting to allow the operator to monitor operations. Since the concentrations of beta and gamma emitters will be very low, the primary risk to the operator will be via inhalation of alpha emitting particles. This exposure is minimized or precluded by the shroud and enclosure as well as by operating procedures.

The annual dosage expected for an operator of this equipment under normal operating conditions is 5 mrem/year. By way of comparison, normal background radiation is 300 mrem/yr.

9. **How did you arrive at the conclusion that the spent carbon could not be cleaned and reused (regenerated) "because of its radioactive character" (Sec. 4.3.5—p. 20), but that the spent ion-exchange resins could be (Secs. 5.10.1, 8.13, and 9.1—pp. 46, 53, 55)?**

Facilities for regenerating spent activated carbon are operated by several groups including the manufacturers of activated carbon media. Generally, it is economical to regenerate carbon only if very large volumes are being used. The WSSRAP will not be using large volumes. The low cost of the media, the relatively small volume to be used, the cost of storage and disposal, and the cost of thermal regeneration equipment were factors in the decision not to regenerate this media.

On the other hand, even the smallest volumes of ion exchange resins are routinely and normally regenerated quite easily. The regeneration is typically conducted in the same vessels as the contactor, or in similar vessels, with common chemicals. The process is well documented in many systems around the world.

a. **What are you expecting the uranium concentration levels to be, in picocuries per gram, of the spent carbon? Of the resins?**

When an activated carbon unit is rebedded, the worst case radionuclide concentrations in the carbon media are expected to be approximately 1,517 pCi/g of media. Actual concentrations will be measured and are expected to be much less than this.

The spent ion-exchange resin uranium levels will be extremely low because the resin will be replaced only when it loses its ability to remove uranium from the process stream. Additionally, the resin will undergo a multiple regeneration prior to disposal. This will remove all but trace amounts of uranium from the resin.

b. **On what basis did you decide that "the volume of [resin] residual removal... is considered non-hazardous as related to uranium levels"? (Sec. 8.1.3—p.53)**

Assuming worst case conditions (maximum influent uranium concentrations, highest theoretical resin capacity, and most efficient theoretical resin regeneration), and applying mass balance, the highest achievable uranium concentration in the regenerant can be predicted accurately.

Note that this regeneration waste will be returned to the equalization basin for subsequent treatment and removal in the precipitation process rather than stored in drums as was considered at the time that the EDR was written. This decision was predicated on process capability and the desire to minimize the types of waste to be dealt with.

c. **How much 96% sulfuric acid do you to use to regenerate the ion exchange resins -- that is, to remove the uranium? (Sec. 5.10.1 and .2—pp. 46, 47) Have you considered whether the sulfuric acid might mix or react with nitrogen-containing compounds or other compounds present, producing violent reactions or more corrosive materials, which could challenge the integrity of the 55-gallon metal drums in which the ion exchange regeneration waste is to be stored? (Sec. 8.1.3—p. 53)**

Section 5.10.2 provides the correct acid requirement: 5 gallons of 96% sulfuric acid per regeneration of each 4.5 cubic foot resin regeneration load. The 96% acid will be diluted to approximately 13% concentration in the regeneration process. This will result in approximately 62 gallons of 13% sulfuric acid regenerant actually contacting the resin.

The possibility of undesirable reactions between the regenerant solution, the process stream, and the ion-exchange resin has been considered, and no undesirable reactions are expected to occur.

d. **To what off-site location do you expect to transport the regenerant resin wastes for storage? (Sec. 5.10.1—p.46)**

If necessary, resin which has deteriorated to an unacceptable level will be removed and stored in materially compatible containers at the chemical plant temporary storage area until final remedial action decisions are made.

10. **In what publication did the paper in Appendix 2, "The Laboratory Evaluation of Granular Activated Carbon for Liquid Phase Applications," appear? (Sec. 4.3.5 and App.2—pp. 19, 66)**

This question was previously answered by Hydro-Pure Systems.

11. **According to Sec. 5.7.2.1 (p. 40), Hydro-Pure is the manufacturer of the <u>pressure</u> filter equipment which is designed to remove suspended solids from the main process stream after sedimentation. (also: Secs. 4.3.2 and 4.4—pp. 18, 22)**

a. **Do you also manufacture the filter press equipment that is to be used to dewater the sludge after sedimentation?**

b. **Do you manufacture tubular membrane filtration equipment – such as was used at the DOE uranium cleanup sites in Canonsburg (PA), Lakeview (OR), and Salt Lake City? (DOE: EE/CA, 1989, p. 127) Will you be using this at Weldon Spring?**

These questions have been answered by Hydro-Pure Systems.

12. **The report describes the evaluation of the laboratory bench scale studies for the individual unit operations. It also says that a bench scale study was made of the "systems performance"—that is, to evaluate the processing of a combined water/sediment sample after "the entire <u>treatment train</u> was assembled"? (Section 4.3—p. 16)**

a. **Did Envirodyne Engineers (now TCT-St. Louis) perform this analysis and the rest of the "analytical and bench study work," as per Sec. 4.4? (p. 22)**

TCT of St. Louis (formerly Envirodyne Engineers) performed all bench testing procedures.

b. **Was a report on the evaluation of the bench-scale treatment train submitted to the DOE, and if so, what are the title and date?**

The bench testing procedure, results, and conclusions are presented in the EDR. This document was thoroughly reviewed prior to approval by MK-Ferguson, the prime contractor. This document was submitted to the DOE on October 26, 1990.

c. **To what process does the "D" refer in the performance data table and flow chart? (Table and Figure 4.3.1—pp. 25, 28)**

This question was answered by Hydro-Pure Systems. D is not relevant.

d. **To quote from Shreve's Chemical Process Industries, 5th Ed., G.T. Austin, editor (New York: McGraw-Hill, 1984, pp. 8-9):**

Pilot plants are small-scale units designed to allow experiments that obtain design data for larger plants...It is also much cheaper to correct errors in judgment by experimentation in the pilot plant. It is extremely expensive to experiment with plant-scale processing. Corrosion data from the pilot plant are much more reliable than small scale tests with pure chemicals....

Thorough bench-scale tests were conducted to confirm process capabilities and to develop process parameters. The process equipment being utilized in the quarry water treatment plant has been used extensively around the world for many years, and the design parameters have been well documented. Therefore, it was concluded that the benefits to be derived from pilot-scale testing would be minimal. Often, pilot scale testing is used to optimize the design in order to minimize equipment cost. In our case, however, it was decided to design the equipment to handle "worst case" conditions. All of these considerations have allowed us to proceed with design and construction of full-scale equipment with a very high level of confidence. Further, given the batch discharge aspect of the design, if, in the unlikely event that the system did not work either initially or due to equipment failure, improperly treated water will not be discharged to the river.

13. **If HPS has designed, built and operated a treatment plant for mixed-waste water elsewhere, was a pilot plant built first to test the treatment train of technologies and the monitoring instruments?**

We do not know if pilot plants were built for other mixed waste treatment systems built by the subcontractor. However, we can safely say that many systems utilizing the processes incorporated in the quarry system have been built and successfully operated without pilot plants.