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37-23341-01
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August 7, 2002

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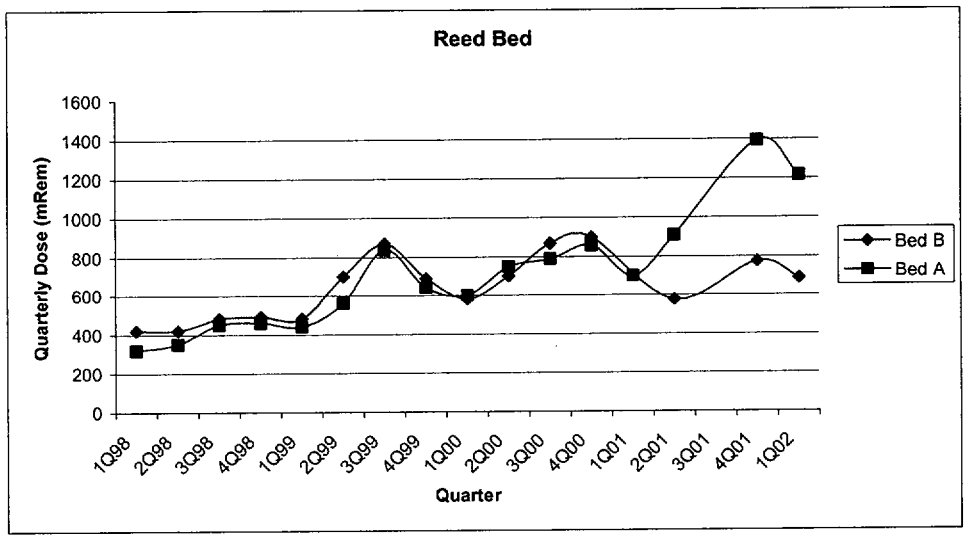
2002 AUG 12 PM 2:31

Mr. John D. Kinneman, Chief
Nuclear Materials Safety Branch 2
US Nuclear regulatory Commission, Region 1
475 Allendale Road
King of Prussia, PA 19406-1415

RE: NRC Letter dated June 14, 2002

Dear Mr. Kinneman:

This is in response to a question you raised regarding the increasing trend in dose rates measured at the Royersford Wastewater Treatment Facility (RWTF). Summarized in the following paragraphs is a description of our ongoing investigation into possible causes of the increasing dose rates at the RWTF. So far, we have not determined that any cause attributable to our operation has precipitated any change at the RWTF, however, we are still investigating and we will follow-up with further information as it becomes available. A graph approximating the dose rate trend for the two reed beds over the past few years is shown below.



It is our understanding that the reed beds are rectangular concrete pits into which liquid sludge from the waste treatment process is periodically added and allowed to air dry. Reeds are grown in the pits and the reeds are periodically harvested, but no sludge is removed from either of the pits until a pit is filled to capacity. Neither of the pits has been filled to capacity during the period under observation. The TLDs are located at a height above the pits adjacent to one edge of each pit. The TLDs are not relocated as the planar surface of the sludge rises in the pits. As can be seen from the above graph, there is an obvious saw-tooth trend to the quarterly TLD data as well as an overall increasing trend.

NMSS/RGNI MATERIALS-002

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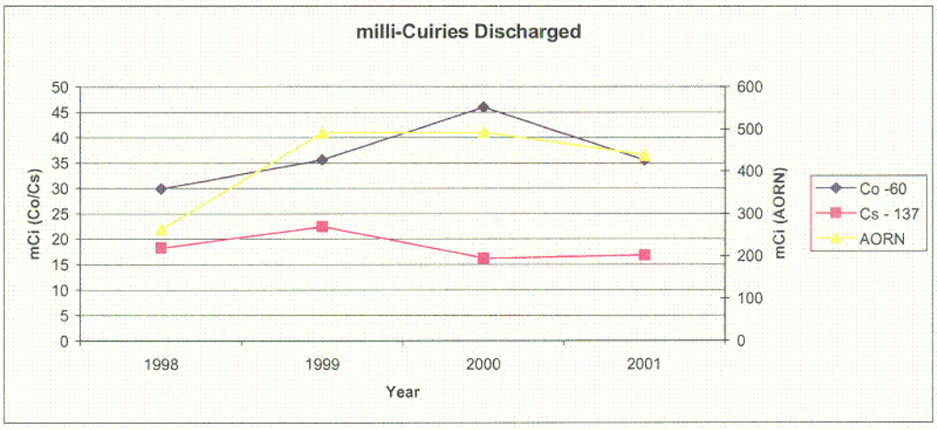
The major contributors to the gamma dose are Co-60 and Cs-137. The total number of milli-Curies of Co-60, & Cs-137, along with the total amount of All Other Radio Nuclides (AORN) over the period from 1998 to 2001, is shown in the following graph:



As can be seen, the amount of radioactivity discharged by UniTech during the period has shown an increasing trend overall, but shows a slightly decreasing trend as of late. The activity discharged is determined by creating a composite sample composed of aliquots from each tank of water discharged during the year and analyzing the sample by gamma ray spectroscopy, for Co-60, Cs-137, and other gamma emitters, and by various other techniques for the hard to measure radionuclides. Gamma spectroscopy is performed in UniTech's gamma spec lab which is located in Springfield, MA. UniTech's lab participates in a DOE sponsored cross comparison program and operates under UniTech's ISO-9002 quality management system. A chain of custody record is maintained for all composite samples. Hard to measure radionuclides are determined by Thermo NuTech, which is located in Oak Ridge, TN. The accuracy with which Co-60 and Cs-137 concentrations can be measured in water is quite good. Furthermore, the volume of water discharged from the plant is measured in full tanks, the volume of which is fixed and well known. Since the total amount of water and the concentration of Co-60 and Cs-137 are accurately determined, UniTech has a high degree of confidence in the determination of total activity of these radionuclides discharged to the RWTF.

It would be expected that the trends in activity discharged in water would correlate favorably with trends in the amount of radioactive material coming into the plant on laundry. We are currently in the process of reviewing incoming shipping paperwork to accumulate that data and we expect to provide that information shortly. It should be cautioned however, that the estimates of activity on laundry are normally made by conservative methods which tend to overestimate the amount of radioactive material while the determination of radioactivity discharged from the plant which is based on a rather precise measurement of water samples.

UniTech has evaluated the operation of its waste water treatment system since 1998 and determined that the system has been continuously operated in accordance with UniTech's procedures and that there is nothing in the operation of the filtration system to suggest anything

that would affect the RWTF. In particular, we have evaluated the total amount of sludge produced by the in-plant waste processing system, we have tracked the amount of treatment chemicals added over the past 4 years, and we have mechanically inspected the system.

Flocculent and Coagulant work together to make particles which normally would remain suspended in solution agglomerate (stick together) creating heavier particles that settle more readily and are then removed by the system. Their presence or absence in the waste stream could affect the amount of precipitation of solids occurring in the RWTF. Furthermore, they affect the amount of sludge produced and separated from the waste stream by the in-plant waste processing system. The amount of flocculent and coagulant that a result in ideal settling conditions is determined periodically by performing a jar test. Any significant change in the particulate removal efficiency of the in-plant system would likely affect the radioactivity concentrations in wastewater.

Other factors affecting the generation of sludge in the in-plant system, are 1) the kind of laundry being processed (lint producing cotton garments produce more sludge than non-lint producing man made fabrics like nylon, and polyester); 2) the amount of soil on the laundered items; and 3) the wash chemistry – more aggressive chemicals remove more soil.

Waste Water Treatment System Key Parameters.

YEAR	1999	2000	2001	2002[1]
FLOC[2] (gallons)	2860	2860	2860	1430
COAG (gallons)	680	660	450	150
SLUDGE (pounds)	4615	3200	3699	1872

The overall trend in chemical use and sludge production has been downward. Recognizing that treatment chemicals account for at least part of the sludge volume, it is possible that the reduced amount of sludge collected in 2001 compared to 1999 is the result of the reduction in treatment chemicals.

In April of 1999, as part of a company-wide program to assure the proper operation of our wastewater treatment systems, we performed an in-depth evaluation of the Royersford in-plant waste water system. The evaluation included opening the pressurized sand filter vessels, inspecting the media, and performing all of the routine maintenance items as recommended by the manufacturer. In addition, our Corporate Engineer trained the plant maintenance and operations personnel on proper maintenance and operation of the system. Annually, or more often if needed, the sand filter vessels are opened and inspected to ensure the media is at the

[1] Through end of June, 2002.
[2] Flocculent is mixed from concentrate. The system operator estimates one 55 gallon drum of dilute solution per week is added to the system. Coagulant is calculated from purchasing records and the amount of sludge is recorded routinely in radwaste inventory records.

proper level and is not fouled. The most recent such inspection revealed no abnormal problems with the filters or any of the associated controls.

Nothing we evaluated in terms of the plant's operation and the maintenance or operation of the plant's waste treatment system indicates any change that would cause an unexpected increasing trend in radiation levels at the RWTF. Therefore, In addition to looking at factors within the plant that could affect the concentration of radionuclides at the RWTF, we examined factors outside the plant that might have an effect.

It should be noted that the RWTF although small, takes in considerably more water than the amount discharged by UniTech. The RWTF has a capacity of about 500,000 gallons per day. UniTech typically discharges about 50,000 gallons per day or about one tenth of the RWTF's capacity. Non-radioactive water from other sources constitute the balance of water feeding the RWTF. The amount of non-radioactive water flowing through the RWTF along with UniTech's discharges impacts both the concentration of radioactivity within the RWTF and also the extent to which radioactivity discharged to the sewer passes through the RWTF into the Schuykill River. It would seem reasonable, that when the RWTF is processing more water from other sources, concentrations of radioactivity in the RWTF are lower, and less of the radioactivity discharged by UniTech is retained in the RWTF.

One of the other sources of water processed in the POTW is water from rainfall. Although Royersford has a split (storm/septic) system, some rainwater does find its way to the RWTF – enough to significantly impact the daily amounts of water processed. The following table shows rainfall amounts in Royersford over the past several years:

Royersford Annual Rainfall Amounts through July 2002 (inches):

1997	1998	1999	2000	2001	2002
32	31	48	44	31	18

Although the amount of rainfall in 2001, and thus far in 2002 is less than 1999 and 2000, similar amounts were recorded in 1997, and 1998. Thus, rainfall does not appear to have a predictable impact on reed bed dose rates. Looking at the concentrations of radioactivity in secondary digester sludge as reported in your letter of June 14, 2002, the concentrations appear to vary roughly inversely to rainfall, with the lowest concentrations occurring in the year with the highest rainfall amount - 1999.

In addition to rainfall, the RWTF receives water from other domestic and industrial sources. We are currently obtaining information on the total amount of water processed each year from the Borough and will forward the information when it becomes available.

Lastly, we return to a discussion of the reed beds themselves. The radioactive material deposited in the reed beds has four removal mechanisms. The most obvious one is mechanical cleaning. As far as we know, no mechanical cleaning has ever been necessary. Another mechanism is evaporation. Only the volatile radionuclides would tend to be removed by this mechanism, tritium is probably the chief such radionuclide, and its impact on dose as measured by TLD is

negligible. A third removal mechanism is the growth and harvesting of reeds from the reed beds. Given the increasing trend in dose rates around the reed beds, it can be assumed that this removal mechanism is somewhat ineffective in removing the radioactivity, although the annual growth and harvesting of the reeds could help to explain the saw tooth nature of the dose rate curve. The fourth removal mechanism is radioactive decay. For radioisotopes like Co-60 and Cs-137, the half lives are long enough to preclude a significant reduction over a five year period during which new material is constantly being added.

To state the obvious, the build up in dose rates in the reed bed can be attributed chiefly to the fact that material is being continuously added to the reed beds, and is not removed at a rate equivalent to or greater than the addition rate. This leads to a buildup in the total amount of radioactivity in the reed beds and a consequent increase in quarterly TLD readings. As the level of sludge in the reed beds has risen, the plane of the sludge has probably moved closer to the TLDs resulting in a corresponding increase in TLD efficiency. Thus the increase in TLD readings is also affected by the positioning of the TLDs with respect to the reed bed.

After examining our processes, maintenance practices, operating procedures and the parameters affecting our discharges to the RWTF we have concluded no changes have occurred in our handling of wastewater that would explain an unexpected buildup in the dose rates at the RWTF. We will continue to monitor our operations and to collect data to determine if changes to our operations have caused any change in RWTF dose rates, and to determine if changes to our operations are warranted. As discussed in our previous correspondence, we expect to discontinue discharging radioactive water to the POTW soon. Following that time, a reduction in dose rates will accordingly occur.

We trust the information provided in this letter and that will be provided as earlier indicated will be sufficient, however if you have further question or need any other information regarding this matter, please feel free to contact me.

Sincerely,

Michael R. Fuller
Manager, Health Physics and Engineering,
UniTech Services Group, Inc.

cc: Dan Neely, UniTech Plant Manager
Glenn Roberts, UniTech CHP
Betsey Ulrich, USNRC
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