December 11, 1996

Mr. Clyde Shelton
President
Shelwell Services, Inc.
447 Lakeshore Drive, West
Hebron, OH 43025

SUBJECT: FINAL SURVEY PLAN FOR SHELWELL SERVICES, INC., SUBMITTED BY LETTER DATED OCTOBER 14, 1996

Dear Mr. Shelton:

We have reviewed your proposed final survey plan submitted by letter dated October 14, 1996. With a few modifications and clarifications as described below, we believe the plan will achieve successful remediation of the site.

1. The direct survey will encompass 100 percent of the floor and lower walls, and 25 percent of the upper walls, in the affected area.

2. A 50 percent walk-over scan of the driveway from building 2 to the road will be conducted.

3. The Region III mobile laboratory will be provided for analysis of soil and water samples, but other NRC equipment and instrumentation will not be furnished for your use; you or your consultant will need your own equipment.

4. Adverse weather conditions may necessitate schedule changes, but the scope of the plan may not be reduced further, even due to weather.

5. A written final survey report will be needed, including maps with the appropriate measurements as stated in the plan, along with identifying information on the instruments used and verification of calibration and testing.

6. Several items involving the remediation of the drain line need to be addressed, because we believe the contaminant may be in a non-soluble form. We have recently located an analysis performed by Argonne National Laboratory, subsequent to the 1983 event at Shelwell, which concluded that the cesium was in the form of a non-soluble cesium-aluminum-silicate of 5-100 microns in diameter. In addition, dose assessments of the exposed workers by the University of Cincinnati Medical Center also concluded that the cesium was mostly non-soluble. Therefore, any water derived from the drain remediation will have to be filtered, in order to comply with 10 CFR Part 20.2003. NRC Information Notice 94-07, "Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20," is attached for your reference.

It may prove difficult in the field to filter the water generated from high-pressure flushing of the sewer pipe. Should you choose to pursue the high-pressure flushing approach, you will need to consider the following.

a. In addition to the measurements performed at the established boreholes, the interior of the drain line will need to be surveyed from the lift station to as far back as reasonably possible. Unrestricted release will require the measurements to be less than our derived limits of 4 microRoentgen per hour above background in the last borehole and 40,000 dpm/100 square centimeters on the inside surface of the pipe.

b. Because it is unknown where the contamination begins, it will be necessary to have the high pressure wand penetrate several feet past the last borehole, and several feet past any elevated readings identified by surveying the interior of the line as described in item a. above.

c. An acceptable method for filtering the water prior to release is needed, as is a sampling protocol. A 0.45 micron standard should be used as the final filter size unless the water shows no detectable activity with a rougher filter or without filtration. Your proposal, for collection, sampling and release in 3-5 gallon increments will result in an unnecessarily large number of samples. If the water is placed in a single reservoir and a few samples show it is sufficiently clean, it can be released. Any contaminated filters will be disposed of as solid radioactive waste.

d. NRC's unrestricted use guidelines for the Cs-137 in the water and/or sludge removed from the lift station are: water - the 10 CFR Part 20 Table 3 monthly limit for release to sewers of 1×10^{-5} μCi/ml; and, sludge - 15 pCi/gram.

If the samples indicate the water exceeds the limit, an assessment will be made as to the best action to take. This could include, for example, determining the solubility of the cesium in the water, refiltering the water, or retaining the water for future processing.

The above items were discussed with your consultant, Mr. Keith Moon, during telephone calls with Messrs. Lambert and Jorgensen of my staff on November 15, 1996, and with Mr. Jorgensen on December 4, 1996.

After the wastes from the source rupture incident are disposed of, a license amendment removing loose cesium-137 from the license may be issued upon your request.

We desire to proceed with final disposition of this issue at the earliest reasonable opportunity, and request that you respond to this letter within 60 days of receipt to acknowledge your understanding of our position and to provide an ammended final remediation plan. If you have any additional questions, we will gladly discuss them with you or your consultant.

Sincerely,

Original Signed by

Cynthia D. Pederson, Director
Division of Nuclear Materials Safety

License No. 34-10445-01
Docket No. 030-05798

Attachment: NRC Information Notice 94-07

cc w/att: K. E. Moon, Support Consultants

bcc: N. Stablein, EDO
B. Burgess, RIII
Public (IE07)

DOCUMENT NAME: A:\SHELWELL.RSP

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

January 28, 1994

NRC INFORMATION NOTICE 94-07: SOLUBILITY CRITERIA FOR LIQUID EFFLUENT RELEASES TO SANITARY SEWERAGE UNDER THE REVISED 10 CFR PART 20

Addressees

All byproduct material and fuel cycle licensees with the exception of licensees authorized solely for sealed sources.

Purpose

The U.S. Nuclear Regulatory Commission is issuing this information notice to emphasize the changes in 10 CFR Part 20 with respect to liquid effluent releases to sanitary sewerage and to encourage you to prepare for these revisions. It is expected that licensees will review this information for applicability to their operations, distribute it to appropriate staff, and consider actions to prepare for, and incorporate, these changes. Suggestions contained in this information notice are only recommendations; therefore, no specific action nor written response is required.

Background

On December 21, 1984, NRC released an information notice documenting several instances of reconcentration of radionuclides released to sanitary sewerage (IN No. 84-94, "Reconcentration of Radionuclides Involving Discharges into Sanitary Sewage Systems Permitted under 10 CFR 20.303"). Several other instances have since occurred in Portland, Oregon; Ann Arbor, Michigan; Erwin, Tennessee; and Cleveland, Ohio. The primary contributors, in some of these cases, appear to have been insoluble materials released as dispersible particulates or flakes. This issue was addressed again on May 21, 1991, by NRC, when it published its revision of Part 20 in the Federal Register (56 FR 23360), which removed insoluble non-biological material from the types of material that may be released to sanitary sewerage. Relative to this issue, the NRC Office of Nuclear Regulatory Research is conducting a study to clarify the mechanisms underlying reconcentration in sanitary sewerage and sewage treatment facilities.

Sanitary sewerage is defined by 10 CFR 20.1003 as "a system of *public sewers* for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee [emphasis added]."

Description of Circumstances

To help prevent further reconcentration incidents at public sewage treatment facilities, 10 CFR 20.2003(a)(1), effective January 1, 1994, was written as follows:

> §20.2003 Disposal by release into sanitary sewerage
> (a) A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:
> (1) The material is readily soluble (or is readily dispersible biological material) in water; and...

However, this revision to Part 20 did not contain an operational definition of solubility, and this precipitated many questions, from licensees, concerning how the solubility of a material may be demonstrated. Without the ability to demonstrate compliance, these licensees were unable to determine whether new procedures should be developed, new treatment systems installed, or whether they should apply for an exemption, based on the principle of maintaining all doses as low as is reasonably achievable (ALARA).

Discussion

In some of the known reconcentration incidents, the greatest reconcentrations appear to have been due to compounds released to sanitary sewerage that were not soluble. There are many approaches that may be used to determine a chemical compound's solubility in water. The following discusses two of the more common approaches:

1. Direct Determination of Compound Solubility Class, Formal Solubility, or Solubility Product (K_{sp})

   This approach would be applicable whenever there is sufficient knowledge of the chemical form of all materials contained in the liquid effluent at the point of release. With this knowledge, it would be possible to use one (or more) of the following methods:

   (a) Solubility Class Determination:

   The solubility class of the compound to be released could be determined directly from common literature data (e.g., *Handbook of Chemistry and Physics* - CRC Press, and *Lange's Handbook of Chemistry* - McGraw- Hill Book Company). If a compound is classified as "v s" (very soluble) or "s" (soluble), this would indicate the compound is "readily soluble." On the other hand, if it is classified as "i" (insoluble), "sl s" (slightly soluble), or "v sl s" (very slightly soluble), this would indicate materials that are "not readily soluble." Certain compounds are designated as class "d" (decompose). If the decomposed species of these compounds are classified as either "v s" or "s," this would indicate that the parent compound is "readily soluble." If these decomposed species are simple ions, such compounds (class "d") should be considered "readily soluble."

(b) Solubility Product (K_{sp}) Determination:

The solubility product constant of the compound could also be used to determine if a compound is readily soluble in water. The solubility product constant, K_{sp}, for a strong electrolyte M_mA_a, is expressed as:

$$K_{sp} = [M]^m [A]^a$$

where [M] and "m" are the ionic concentration (mole/liter) and the number of moles, respectively, of the dissolved cation; and [A] and "a" are the ionic concentration and the number of moles, respectively, of the dissolved anion.

For a simple electrolytic compound, with one mole of a dissolved cation species and one mole of a dissolved anion species, a K_{sp} greater than 1.00 E-05 $mole^2/liter^2$ would indicate that a compound is "readily soluble." For other compounds with more complex dissolution reactions (i.e., more than one mole dissolved for each species and/or more anionic or cationic species present in the dissolved products), the K_{sp} constant would increase exponentially, based on the number of moles and/or the number of dissociated species. For example, if three moles are present (two for the anion and one for the cation), the unit of K_{sp} would be $mole^3/liter^3$, and the corresponding K_{sp} would be $(1\ E\text{-}05)^{3/2}$ or 3.2 E-08 $mole^3/liter^3$; the same principle could be applied for more complex dissolution reactions.

(c) Formal Solubility Determination:

Compound solubilities (g/100 ml or mole fraction per 100 ml) are also listed in the chemical literature. From a review of general scientific literature, "formal solubilities"** greater than 0.003 mole/liter would indicate that a compound is "readily soluble."

** The general relation between the formal solubility, S_f, and the solubility product, K_{sp}, of a strong electrolyte M_mA_a in water is given by:

$$S_f = \sqrt[m+a]{\frac{K_{sp}}{m^m a^a}},$$

where K_{sp} is the solubility product, [M] is the molar concentration of the metal ion (cation), [A] is the molar concentration of the anion, "m" is the number of moles of dissolved cation per mole of dissolved substance, and "a" is the number of moles of the dissolved anion per mole of dissolved substance.

For further discussion on the determination of solubility products and formal solubility, refer to Chapter 6, "Precipitation and Dilution," from Water Chemistry, by Vernon L. Snoeyink and David Jenkins (John Wiley and Sons: 1983) or texts relating to physical and/or analytical chemistry.

Formal solubilities less than 0.003 mole/liter would indicate compounds that are "not readily soluble."

It should be pointed out that all values mentioned above (e.g., solubility class, formal solubility, and solubility product) correspond to measurements taken under standard conditions (e.g., 25°C, 101.3 kPa, pH of 7, and E_h of 0.

2. Filtration and Radiometric Analysis of Suspended Solids

This approach may be used if knowledge of the chemical form of all materials contained in the liquid effluent at the point of release is incomplete. It is most applicable when releases are made in a batch mode. This approach involves the use of standard laboratory procedures to test representative samples of the waste stream for the presence of suspended radioactive material.

The following two laboratory procedures were developed specifically to determine the suspended solids content of water: ASTM Method D 1888-78, "Standard Test Methods for Particulate and Dissolved Matter, Solids, or Residue in Water," and the American Public Health Association's Method 7110, "Gross Alpha and Gross Beta Radioactivity (Total, Suspended, and Dissolved)" from Standard Methods for the Examination of Water and Wastewater. It should be noted that ASTM Method D 1888-78 was developed to measure the total suspended solids content of water, not just the radioactive portion. In either case, activity in the suspended solids portion of effluent greater than that found in similarly processed background water samples would indicate the presence of insoluble radioactive material.

Whether one of the above approaches or a self-developed alternative is used, it is a good health physics practice to document this approach in the form of a procedure. Procedures such as these usually include provisions for the documentation of any models, calculations, analytical measurements, and/or quality control measures used. This information is usually maintained with the applicable release records, to demonstrate that the developed procedure will ensure compliance with the regulations.

If material to be released would not qualify as being "readily soluble," 10 CFR 20.2003(a)(1) would prohibit release to sanitary sewerage unless an exemption has been granted. Exemptions will be judged on a case-by-case basis, when it is demonstrated that release to sanitary sewerage is in accordance with the ALARA principle, consistent with applicable regulations, and in the public interest.

It is expected that licensees will review this information for applicability to their operations, and consider actions, as appropriate to their licensed activities. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action nor written response is required.

If you have any questions about the information in this information notice, please contact one of the technical contacts listed below or the appropriate regional office.

Robert F. Burnett, Director
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material
Safety and Safeguards

Carl J. Paperiello, Director
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Office of Nuclear Material
Safety and Safeguards

Technical contacts: Rateb (Boby) Abu-Eid, NMSS
(301) 504-3446

Cynthia G. Jones, NMSS
(301) 504-2629

Attachments:
1. List of References
2. List of Recently Issued NMSS Information Notices
3. List of Recently Issued NRC Information Notices