DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DEC 31 1992

Y/TS--827

DE93 005265

DISPOSAL OF UNITED NUCLEAR COMPANY MATERIALS AT THE Y-12 PLANT

December 19, 1983

T. R. Butz
H. H. Stoner

Health, Safety, and Environmental Affairs Division

Y-12 Plant

Operated by

UNION CARBIDE CORPORATION
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. W-7405-eng-26

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISPOSAL OF UNITED NUCLEAR COMPANY MATERIALS AT THE Y-12 PLANT

History of Waste/Waste Characterization

The UNC Recovery Systems Company, located at Wood River Junction, Rhode Island, was involved in the recovery of enriched uranium from scrap materials generated primarily in defense program activities of the DOE and its predecessor agencies. This recovery work was performed in UNC-owned facilities under contracts with the Schenectady Naval Reactors Office and the Oak Ridge Operations Office. Licensing for the uranium processing activities was handled under the auspices of the Nuclear Regulatory Commission (NRC). Following shutdown of the recovery operations in August 1980, UNC was required to decontaminate facilities and the associated waste lagoon systems and to remove the resultant low-level radioactive waste out of the state of Rhode Island. In view that the waste resulted from the processing of scrap materials generated in DOE Defense Programs activities and due to the lack of adequate capacity at commercial waste disposal facilities, DOE agreed to accept the waste for burial at the Y-12 Plant.

Review of operations at the UNC site indicates three processes which produced waste streams which went to the percolation ponds. The processes include uranium recovery, a plant laundry, and a plant laboratory.

Uranium recovery operations involved dissolution of scrap in acid and recovery of the uranium by liquid-liquid solvent extraction. A small amount of mercury was used on occasion as a catalyst to enhance dissolution of certain of the alloys. Acid raffinate was batch neutralized with lime and discharged to the ponds. The raffinate contained small quantities of radionuclides and other metals from dissolution of the fuel cladding.

Effluent from the plant laundry was discharged directly to the pond and consisted principally of water containing detergents with trace quantities of radionuclides, oil, and grease.

The plant laboratory was involved in measurement of uranium and metallic impurities. Lab drains which contained small quantities of chemicals in dilution water discharged to the ponds.

According to UNC personnel formerly associated with the facility, preliminary discussions with EPA officials at the advent of implementation of the RCRA lead the EPA to conclude, with qualification, that the UNC waste streams were not considered hazardous under the RCRA. No further discussions were held between UNC and EPA on the matter.

A sample of sludge and supernate from the pond was collected in August 1980, and results of analysis by UNC are presented in Table 1. The composition is representative of the material prior to any further treatment or fixation in concrete. The only discharge to the pond after that sampling was by the plant laundry.

On February 19, 1982, the Oak Ridge Y-12 Plant was directed by the Oak Ridge Operations Office of DOE to receive and bury the UNC contaminated wastes at the Y-12 facility. This work was performed under the Related Services Clause of Contract W-7405-eng-26, and UNC was cash billed for incurred cost on the basis of currently approved standard billing rates. Special Work Order No. 6169 was assigned to the activity. Consequently, a Purchase Order Agreement, RS 21371, between UNC and Y-12 was signed on March 15, 1982 and amended slightly on May 27, 1982.

Site Characterization

A subsurface investigation was performed to evaluate site suitability and provide data to be utilized in facility design. The investigation was performed by the GEOTEK Engineering Company. The results of their study are presented in Attachment I: Subsurface Investigation and Monitoring Wells for Proposed Waste Disposal Area, Y-12 Plant, Oak Ridge, Tennessee. The study evaluated the site's geotechnical characteristics of bearing capacity, settlement characteristics, slope stability, and soil permeability and thickness. A number of soils tests judged the structural bearing capacity to be adequate for the proposed loads. The minor amount of anticipated settlement between two (2) to six (6) inches is tolerable. The stability of the natural slope is adequate and should not cause any problems. Field tests for permeability measured an average of 10^{-4} cm/sec.

Great care was taken in the site selection and design of the facility to ensure that the uppermost aquifer would not be undesirably affected by the buried material. Based on groundwater monitoring wells, the bottom excavation level is nominally forty (40) feet above this aquifer. (Complete design and specifications for the facility are presented in Attachment II.) A facility sized for a minimum of 38,000 drums was opened, and three monitoring wells were installed to detect leakage from the site should such occur. A fourth monitoring well will be installed at the low point of the facility at the time of closure. (See Figure 1, page 6, for existing monitoring well locations.)

Repeated water table measurements made in the monitoring wells for a period in excess of a year establish the water table consistently below elevation 1055 ft. The lowest point in the pit is 1095 ft., leaving a minimum of a 40-ft. soil layer between the lowest point in the pit and the water table. This contradicts the GEOTEK report statement that the water table lays only 3 ft. below the planned low point of the pit. (See Attachment I.) In a telephone conversation, the author of the GEOTEK report concurred that the water table measurements made over a long period of time in properly designed wells were, no doubt, correct. The GEOTEK water level measurements were made from open, unlined, construction borings that probably held water from sources other than the water table. Moreover, findings of a thick unsaturated zone at the disposal pit is compatible with many other similar determinations along the higher elevations of the Knox Formation.

Sampling of the site monitoring wells was initiated in May 1982. No significant quantities of contaminants have been found. However, the data thus far obtained will be useful base information for comparison with future analytical results. (Analytical results of samples from the three active monitoring wells are shown in Tables 2, 3, and 4, pages 7, 8, and 9.)

As part of its stability analyses of Waste Disposal Facilities at the Y-12 Plant, the Law Engineering Testing Company reviewed the UNC waste disposal site. The pertinent sections, 2 and 6, of the Law Engineering Testing Company final report, Stability Analysis of Waste Disposal Facilities, Y-12 Plant, Oak Ridge, Tennessee, can be found in Attachment III. These findings indicate a very low probability of surface rupture due to faulting. Furthermore, their analysis of the disposal configuration of stacked barrels determined that a seismic-induced permanent displacement would not be an expected event.

One of the borings intersected a zone of low-penetration resistance below 50 feet in depth which was interpreted to be an indication of a weathered crevice. This evidence led to the conclusion that there is a possibility of future karst development near the UNC Disposal Site. However, there exists no surface or other evidence of active sink holes nearby.

Uranium Transfers/Disposals

To date, 496 trailer loads of material have been received, resulting in the stacking of 28,717 drums (55-gallon) and 288 boxes in the facility. Each load had a manifest which described in general the categories of waste. The order of placement of barrels is known with respect to the shipping manifests. Therefore, the approximate location of each shipment is known. The drums contain wastes fixed in concrete or contaminated soils. The boxes contain contaminated hoods, pipes, equipment, flooring, etc. The fission activity is so low that only a few of the loads had to be placarded as containing fissionable material. The uranium accountability transfers thus far amount to 17,772 grams U, 15,033 grams U-235. Most of the drums contain less than 1 gram U per 600- to 800-pound drum. A few drums contain up to 5 grams U. A few boxes contain greater amounts, but none more than 50 grams U. The average enrichment of the contained uranium is 85% U-235. What small traces of uranium that are present are in the form of highly insoluble uranium oxides.

To put these uranium contamination levels into perspective, the uranium content in the drums ranges from 0-15 ppm, whereas the naturally occurring uranium in the Oak Ridge area geological formations ranges from 0-60 ppm. It should be noted in this comparison that the waste contains uranium enriched to 85% U-235, whereas the naturally occurring uranium is only 0.7% U-235. Perhaps a more appropriate perspective is the 100 nCi/g upper limit for shallow land burial of low-level radioactive material set forth in the NRC Federal Regulations (10CFR61). The upper limit of the UNC waste would be about 3 nCi/g with most (>85%) being less than 0.06 nCi/g.

Future Plans

It is expected that the NRC will not define the final cleanup requirements at Wood River Junction before November 1984, which means the earliest closure date for the facility would be early in the year 1985. The site is draining well, a minimum amount of erosion of the soil is being encountered, and the packages appear stable; thus, impact of keeping the site open until early 1985 is anticipated to be minimal. (A critical path schedule of the planned activities leading to closure of the site is illustrated in Figure 2, page 10.)

Closure of the pit will be effected by covering with the soil that was removed for pit construction. The soil will be compacted over the top layer of drums to a minimum cap thickness of four feet. The cap will be mounded, graded, and seeded to cause surface drainage to flow away from the buried material, minimizing water infiltration. The drums are filled to the top with concrete or earth, leaving little void space. Therefore, there should be little volume shrinkage when the steel drums ultimately disintegrate. There is, however, void space between the drums which will ultimately fill up due to soil settling into the voids, causing slumping at the top surface. It is the general experience in burial areas that most of the slumping takes place during the first ten years. This will be compensated for by initial mounding of the cap and long-term custodial care. The burial site will be clearly marked with appropriate markers and located precisely on the Y-12 grid system.

The bottom of the pit is nominally 40 feet above the aquifer. The existing monitoring wells have been emplaced deeply enough to be in the water table and thus should be adequate to detect contaminants; however, contaminants are not expected. The monitoring well bottoming at the low-floor-point of the pit which will be left after closure should always be dry. The graded, compacted, and grassed soil cap will divert most of the rainwater away from the buried material, thus minimizing dissolution. Very slowly over time, measured in hundreds of years, the iron from the drums and calcium from the cement will dissolve, raising slightly the pH and the iron and calcium content of the rainwater that does infiltrate the waste. The highly insoluble uranium, too, will go into solution in almost immeasurably low concentrations. The 40-foot soil layer under the pit will absorb these elements, greatly attenuating their presence before reaching the underlying Knox aquifer.

On file are pertinent correspondence among UNC, DOE, and Y-12, the Related Services Clause work request received from the DOE, and the Purchase Order Contract between UNC and UCC-ND. Also available are information pertaining to radiological analyses of the wastes, descriptions of the waste sources, and agreements among DOE, UNC, and the state of Rhode Island.

Table 1. Analysis of sludge and supernate collected from acid waste pond in August 1980

	Sludge mg/L	Supernate mg/L
Cd	<0.001	0.002
F	0.7	1.3
Fe	<0.01	0.01
Pb	<0.001	<0.001
Hg	0.2	0.001
Mo	0.1	0.2
Ni	0.05	0.05
Zn	0.01	0.03
N-NO ₃	58,000	43,000
P (Total)	1.8	1.6
Oil and Grease	30	12
pH*	9.2	6.4

*Expressed in pH units.

EXPLANATION

WASTE DISPOSAL AREA

SUSPECT SINKS POSSIBLE SOLUTION FEATURES NOTED ON TOPOGRAPHIC MAPS OR AERIAL PHOTOGRAPHS

MONITORING WELL LOCATIONS
FIG. 1

Table 2
UNC Waste Disposal Site
Monitoring Well Y-GMW-24

	May 1982	Nov. 1982	Mar. 1983	May 1983	Aug. 1983
As		<0.005	<0.005	<0.005	<0.06*
Cd		0.002	<0.002	<0.002	<0.002
Cr		<0.01	<0.01	<0.01	<0.01
Hg		<0.001	<0.001	<0.001	<0.001
Pb		0.02	0.01	0.03	0.02
Se		<0.002	<0.002	<0.002	<0.02**
N-Kjeldahl	0.3	0.2	0.3	0.2	0.3
N-NO ₃	<0.1	0.1	1.1	<0.1	<0.1
N-Total	0.3	0.3	1.4	<0.3	0.3
PCB	<0.0005	<0.0005	<0.0005	<0.0005	<0.0006
pH std. pH units	7.5	8.0	7.5	7.5	7.4
TOC	92	36	29	41	80
Th	0.004	0.007	0.009	<0.02*	<0.02*
U	0.002	0.002	0.002	<0.001	<0.001
Alpha Activity pCi/ml	<0.2	<0.2	<0.2	<0.2	<0.2
Beta Activity pCi/ml	<0.4	<0.4	<0.4	<0.4	<0.4
Ag		<0.01	<0.01	<0.01	<0.01
Ba		<0.2	<0.2	<0.2	<0.2
Be	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Specific Conductance μ mhos/cm	450	470	480	470	430
Endrin		<0.00005	<0.00005	<0.00005	<0.00005
Lindane		<0.00001	<0.00001	<0.00001	<0.00001
Methoxychlor		<0.0002	<0.0002	<0.0002	<0.0002
Toxaphene		<0.0002	<0.0002	<0.0002	<0.0002
2, 4, 5 - TP Silvex		<0.00002	<0.00002	<0.00002	<0.00002
2, 4 - Dichlorophenoxyacetic acid		<0.0001	<0.0001	<0.0001	<0.0001
Chloroform	<0.01	<0.01	<0.01	0.04	<0.01
Methylbromide	<0.01	<0.01	<0.01	<0.01	<0.01
Methylchloride	<0.01	<0.01	<0.01	<0.01	<0.01
Methylenechloride	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane		<0.01	<0.01	<0.01	<0.01
Dichloroethane		<0.01	<0.01	<0.01	<0.01
Trichloroethane		<0.01	<0.01	<0.01	<0.01

Units: mg/Liter (ppm) unless otherwise noted.

* Analytical Method Change

** Lower Limit Revision

Table 3
UNC Waste Disposal Site
Monitoring Well Y-GMW-25

	<u>May 1982</u>	<u>Nov. 1982</u>	<u>Mar. 1983</u>	<u>May 1983</u>	<u>Aug. 1983</u>
As		0.078	0.009	0.008	<0.06*
Cd		<0.002	<0.002	<0.002	0.002
Cr		0.08	<0.01	<0.01	0.02
Hg		<0.001	<0.001	<0.001	<0.001
Pb		0.19	<0.01	0.02	0.08
Se		<0.002	<0.002	<0.002	<0.02**
N-Kjeldahl	0.5	0.4	0.2	<0.2	0.2
N-No ₃	0.9	8.4	1.1	0.4	0.4
N-Total	1.4	8.8	1.3	0.5	0.6
PCB	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
pH std. pH units	11	9.9	10	10	9.9
TOC	18	3	3	<2	6
Th	0.027	0.004	<0.002	<0.02*	<0.02*
U	0.004	<0.001	0.001	0.004	<0.001
Alpha Activity pCi/ml	<0.2	<0.2	<0.2	<0.2	<0.2
Beta Activity pCi/ml	<0.4	<0.4	<0.4	<0.4	<0.4
Ag		<0.01	<0.01	<0.01	<0.01
Ba		0.4	<0.2	<0.2	<0.2
Be	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Specific Conductance μ mhos/cm	260	100	140	110	110
Endrin		<0.00005	<0.00005	<0.00005	<0.00005
Lindane		<0.00001	<0.00001	<0.00001	<0.00001
Methoxychlor		<0.0002	<0.0002	<0.0002	<0.0002
Toxaphene		<0.0002	<0.0002	<0.0002	<0.0002
2, 4, 5 - TP Silvex		<0.00002	<0.00002	<0.00002	<0.00002
2, 4 - Dichlorophenoxyacetic acid		<0.0001	<0.0001	<0.0001	<0.0001
Chloroform	<0.01	0.66	<0.01	0.15	0.2
Methylbromide	<0.01	<0.01	<0.01	<0.01	<0.01
Methylchloride	<0.01	<0.01	<0.01	<0.01	<0.01
Methylenechloride	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane		<0.01	<0.01	<0.01	<0.01
Dichloroethane		<0.01	<0.01	<0.01	<0.01
Trichloroethane		<0.01	<0.01	<0.01	<0.01

Units: mg/Liter (ppm) unless otherwise noted.

* Analytical Method Change

** Lower Limit Revision

Table 4
UNC Waste Disposal Site
Monitoring Well Y-GMW-26

	May 1982	Nov. 1982	Mar. 1983	May 1983	Aug. 1983
As		<0.005	<0.005	<0.005	<0.06*
Cd		<0.002	<0.002	<0.002	0.006
Cr		<0.01	<0.01	<0.01	0.04
Hg		<0.001	<0.001	<0.001	<0.001
Pb		<0.01	<0.01	<0.01	0.06
Se		<0.002	<0.002	<0.002	<0.02**
N-Kjeldahl	0.2	<0.2	<0.2	<0.2	0.6
N-No ₃	<0.1	0.1	0.2	0.4	0.2
N-Total	0.2	<0.3	0.3	0.5	0.8
PCB	<0.0005	<0.0005	0.0009	<0.0005	<0.0005
pH std. pH units	6.4	6.8	7.2	7.0	7.3
TOC	4	3	3	3	15
Th	<0.002	0.005	0.004	<0.02*	<0.02*
U	0.002	<0.001	0.001	0.008	0.006
Alpha Activity pCi/ml	<0.2	<0.2	<0.2	1.5	<0.2
Beta Activity pCi/ml	<0.4	<0.4	<0.4	<0.4	<0.4
Ag		<0.01	<0.01	<0.01	<0.01
Ba		<0.2	<0.2	<0.2	<0.2
Be	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Specific Conductance μ mhos/cm	120	150	260	240	250
Endrin		<0.00005	<0.00005	<0.00005	<0.00005
Lindane		<0.00001	<0.00001	<0.00001	<0.00001
Methoxychlor		<0.0002	<0.0002	<0.0002	<0.0002
Toxaphene		<0.0002	<0.0002	<0.0002	<0.0002
2, 4, 5 - TP Silvex		<0.00002	<0.00002	<0.00002	<0.00002
2, 4 - Dichlorophenoxyacetic acid		<0.0001	<0.0001	<0.0001	<0.0001
Chloroform	<0.01	<0.01	<0.01	<0.01	<0.01
Methylbromide	<0.01	<0.01	<0.01	<0.01	<0.01
Methylchloride	<0.01	<0.01	<0.01	<0.01	<0.01
Methylenechloride	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane		<0.01	<0.01	<0.01	<0.01
Dichloroethane		<0.01	<0.01	<0.01	<0.01
Trichloroethane		<0.01	<0.01	<0.01	<0.01

Units: mg/Liter (ppm) unless otherwise noted.

* Analytical Method Change

** Lower Limit Revision

*The Oak Ridge Associated Universities is working under contract to the National Regulatory Commission (NRC) to evaluate clean-up at the United Nuclear Company Rhode Island facility.

ACTIVITIES SCHEDULE FOR UNC SITE CLOSURE
FIG. 2