WSRC-RP-92-349

TWO ITEMS: TRANSCRIPTION OF A PRESENTATION BY DR. E. L. ALBENESIUS, "SRS BURIAL GROUND OPERATION FROM AN HISTORICAL PERSPECTIVE" ; VIDEO TAPE ENTITLED "BURIAL GROUND OPERATION" (U)

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Environmental Restoration
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WSRC-RP-92-349

February 14, 1992

TO: DISTRIBUTION

FROM: H. PERRY HOLCOMB, MLB, 821-7970

Transcription of a Presentation by Dr. E. L. Albenesius, "SRS Burial Ground Operation From an Historical Perspective" (U)

Summary

On February 6, 1992, approximately 35 SRS personnel from DOE, WSRC, and Dames & Moore attended a very informative talk given by Dr. E. L. Albenesius who discussed the operation of the SRS Burial Ground from an historical perspective. Dr. Albenesius, a Du Pont retiree, has recently been active in the site's university relations program. He formerly served as research manager of SRL's Environmental Effects and Solid Waste Management Technology Divisions among other assignments.

One notable point Dr. Albenesius made was in answer to a question concerning what was the most important thing that could be done to reduce the hazard to man from buried waste. His response was to remove as much plutonium as practical prior to closure.

In order to preserve this valuable information for the record, the program was audiotaped from which a point-by-point chronological transcription, with minor editing, was prepared. It follows. The audiotapes are available for loan from the author.

(NOTE: Please keep in mind that burial ground management policies and philosophies described are those considered to be state-of-the-art in earlier times. They do not reflect the more conservative waste management practices of today.)

Dr. Albenesius' Presentation

Burial Ground Videotape

In 1982 Dick Hawkins made a videotape summarizing burial ground practices. The tape was originally made for internal training purposes for personnel coming into waste management. Items noted from the tape soundtrack follow.

Burial ground consists of 195 acres centrally located between F&H separations areas and 6 miles from nearest plant boundary.

76 acres made up the "old" burial ground which was in operation from the beginning of solid waste burial in 1953 until it was filled in 1972.

119 acres of "new" burial ground began use in 1972 and was projected to last until 1990.

Burial ground soils range from clayey sands to sandy clays. Kaolinite is the predominant clay mineral which exhibits ion exchange properties that "captures" most of the radioactive cationic materials associated with the waste.

Beneath the burial ground is almost 1000 ft of soil and unconsolidated sediments resting on a metamorphic rock of precambrian age.

The average groundwater depth below the burial ground is 40 feet. Buried waste is placed at least 10 feet above the groundwater. Rainfall averages approximately 45 inches/yr. Water is the principal means by which radionuclides can migrate from buried radioactive waste. Solubilized radionuclides migrate downward until the water path meets groundwater at which point migration becomes mostly horizontal.

Groundwater wells are used to check on radioactivity in the subterranean water. Only tritium exhibits substantial migration. Other radionuclides have been detected in only trace quantities within the facility.

Groundwater under the burial ground flows slowly toward the southwest to an outcrop at Four Mile Creek. a distance of about 1/2 mile. Its average travel time is 50 years. Under these conditions, only some 6% of the tritium that initially enters the groundwater will outcrop at Four Mile Creek.

The groundwater under a small portion of the burial ground in the extreme northwest corner flows slowly towards the north to Upper Three Runs.

(Note: Later studies indicate that the entire burial ground complex resides on a groundwater divide with groundwater flowing northwest to Upper Three Runs and southwest to Four Mile Creek.)

A suspended Ge-Li detector was used for several years to monitor all offsite and some onsite shipments to the burial ground

Handling and storage of solid waste depends on the nature of the waste and the kinds and concentrations of radionuclides the waste contains. Three categories of waste account for more than 90% of the total volume and total curies in the burial ground:

low-level beta gamma
intermediate level beta-gamma
low level alpha

All three are stored in the same manner; i. e., by direct burial in earth trenches. However each category is kept separate in a trench designated only for that category. Low level beta-gamma accounts for some 80% of the total volume but only 20% of the radioactivity. This waste consists mainly of paper, plastic, rubber, and cotton materials.

A computer record is kept of the location in the burial ground where each shipment is stored. The locations are based on a surveyed grid system within a 20' X 20' grid block.

Offsite and onsite wastes are kept segregated from each other by burying in separate, designated trenches.

Some pieces of equipment, such as jumpers, require special handling to prevent contamination from becoming airborne. Jumpers are surrounded by canvass and transported in a steel box. At the burial ground, the box is opened and the canvass-lined jumpers removed with a minimum of handling. They are placed on 6' of backfill to prevent contact with any accumulations of water in the trench and immediately backfilled.

Transuranic (TRU) wastes are stored retrievably in 55-gal drums or in equipment boxes on a ground-level concrete pad and covered with an earth mound. Waste drums that contain more than 0.5 curie of TRU are classified as high-level and are sealed inside a concrete culvert on the pad. Waste drums containing less than 0.5 curie of TRU are classified as intermediate-level and stored directly on the pad. Waste too large for 55-gal drums are placed in steel boxes on the pad. For moisture protection, the drums are covered with a plastic bag prior to soil being mounded over them.

As the pad is being filled, the drums and boxes are covered with a 3' layer of sandy soil. To protect from high winds prior to soil cover, a tornado net is kept over all exposed containers at the working face of the pad.

When the pad is full, a sheet of PVC is placed over the mound to exclude rainwater. To complete the mound, a final 1' of soil is placed over the plastic follow by an asphalt emulsion treatment to prevent erosion until grass can be established. Rainwater that reaches the concrete pad drains to a sump where it is sampled and analyzed for radionuclides. TRU waste stored in this manner is destined for a TRU repository not yet designated.

The burial ground has been used since 1973 for long-term field studies of radionuclidic migration from different kinds of real buried waste under actual burial conditions. Lysimeters are used to house the waste under 4' of soil and to collect and sample natural rainwater that infiltrates the soil and leaches radionuclides from the waste. Fifty-six lysimeters are in operation containing 8 kinds of SRP waste and 5 different forms of radioactive waste from power reactors.

In the mid-1970s a study began to determine the potential dose to man from the SRS burial ground following its decommissioning in the future. The study deals with various events that could take place including the improbable case that food crops or lumber could someday be grown there.

Pensacola bahia grass is maintained on inactive trenches in the old burial ground to minimize soil erosion. Bahia provides a tough soil cover with resistance to drought and cold along with a shallow root system that does not penetrate to the depth of buried waste. (Tape narrative ends.)

Following the tape, a couple of questions arose that concerned the crop plantings to study uptake of radionuclides. Elmer Wilhite replied that the open plantings of corn, wheat, etc., were for just one season. However, for those plantings in lysimeters, saltstone included, several successive crop plantings have been made.

Bibliography of Radionuclidic Migration Studies

Dr. Albenesius brought a 1984 bibliography concerning studies of radionuclidic migration in the burial ground. A copy is attached as an appendix.

Comments by Dr. Albenesius

Comment on Video

When the video was showing the burial process for jumpers, several neatly-stacked pieces of equipment resembling "bases for rockets" were shown in the background. These were offsite reactor core barrels that the Navy had emplaced in the burial ground. These were not buried, but were mounded over.

Philosophy of Burial Ground Operation

At SRP startup, time-tested and valid sanitary landfill principles were adapted for the disposal of low-level radioactive solid waste. If you limited radioactivity in the waste to a level that would decay in a reasonable period of time (decades, a century or so), the landfill principle at a well-managed, properly selected site was applicable to radioactive waste handling as well. At the beginning there was not much concern about groundwater contamination because at that point no one really thought about groundwater. However, the Savannah River was considered. Our charge was to protect it.

Also in the early days, disposal of solid radioactive waste was considered a necessary means to keep the radiation zones of the plant as clean as possible. Therefore, probably at least one of just about anything that has passed through the contaminated areas of the plant can be found in the burial ground - vehicles, cranes, buildings, parts of buildings, ventilation systems - an amazing array of miscellaneous stuff, most of which was not contaminated, only suspected to be.

By the time the first decade of operation had passed, we began to look at what we were doing, to learn from what we were doing, and to see what kind of assurances we could give that the sanitary landfill method was doing what it should supposed to do.

Advent of SRS Migration Studies

The first scientific study of radionuclidic migration was done in a section of trench that received low level beta-gamma waste from 1953 to 1963. Jim Fenimore drilled a series of cores in waste trenches to examine the radionuclidic content of the soil not only within the trench but underneath as well. In 1964, the results of this study appeared in the Heath Physics Society journal. Followups were done in 1965, 1969, 1973, &1977. These showed that most of the radionuclides were within about 2 feet of their original location and 7 feet away at the maximum. The system was working as it should with the soil minimizing migration of radionuclides. So, the principle of sanitary landfill was valid operationally and economically.

Operational Difficulties and Philosophy Changes

In 1965, cracks began to appear in the principle of solid waste disposal. The first was in Idaho where monitoring wells showed evidence of plutonium. Maxey Flats had problems with water filling trenches resulting in plutonium migrating. Oak Ridge had similar problems with radioactivity appearing in outcrops of water that had infiltrated solid waste trenches. West Valley had capped their trenches without consolidating the waste first. This resulted in collapse of the caps and filling of the trenches with water. Sheffield had a small amount of buried waste from which tritium migrated outside its boundaries. Sheffield was closed after only operating a short time. Beatty, Nevada had problems with materials from its burial ground being used in building activities.in the community All of this happened within a 5-6 year period resulting in a great decline in the credibility of shallow land burial for solid radioactive waste.

Beginning in the early 1970s, growing public interest in SRP fostered increasing public suspicion and reaction. This, along with a desire to better define operational impact, resulted in the beginning of an intense study of the migration of radionuclides in the burial ground. Among the first efforts were establishing groundwater wells which were to be routinely sampled for radionuclides. Directly-buried tritium crucibles gave rise to tritium in groundwater, and the 66 wells in the old burial ground confirmed this.

Organic solvent also appeared in burial ground groundwater because of spills from disposing of 350,000 gallons solvent by burning in an open pan. Airborne contamination was no problem since the activity remained in the pan residue. However, in operation solvent spills directly to the soil occurred. The pan residue, not a solid in actuality, was also buried. Residues of solvent containing traces of plutonium and beta-gamma activity were found in a 12-acre portion of the burial ground, generally in the middle of the old site. Solvent burning was stopped in 1972 because of air quality standards, not because of radioactivity concerns. Solvent was then stored in underground tanks until the beta-gamma incinerator came into operation and worked off almost all of the solvent inventory.

Quantifying the Effect of Radionuclidic Migration

Studies using lysimeters were also begun to examine the behavior of radionuclides in different forms and in differing forms of waste. These were controlled experiments to determine how the radioactivity, once buried, behaved and involved some 60 different emplacements.

During the middle 1970s, the first model of the burial ground was developed by Elmer Wilhite who developed the Dose-To-Man study. The intent was to determine the population effects from it following its decommissioning

Plutonium Storage

For some years now, plutonium has been stored at the burial ground in a retrievable mode. However, in earlier days of operation, plutonium was buried by encapsulating the primary container in a concrete pour producing a buried monolith. It is hoped that plutonium buried in culverts can and will be retrieved; retrieving all of the monoliths is most unlikely. Unretrieved plutonium and the longer-lived beta-gamma activities need to be fully evaluated in any decommissioning plan.

Burial Ground Site History

A study by a professor of history at the University of South Carolina was commissioned to detail use of the area prior to its becoming a burial ground. The purpose of this was to provide guidance in developing a decommissioning plan. The results of the study said that the 400-odd acres where the burial ground sits was pretty good land. Most of this was in subsistence farms, but there was one commercial farm directly on the site that was a model farm during the 1930s. The land went through cycles being owned by few people, then several, then few again as economic conditions changed. The result of the study suggests that future land use would be successional, commercial, forests, subsistence, and lastly commercial farms. Use as the latter would be discouraged because the rich topsoil layer has been covered over by the much poorer subsoil in trenching operations.

Exhumation Experiments

Four exhumation studies were done:

In 1972, Henry Horton, now deceased, used Gradall equipment to remove the soil overlying a 20' X 20' low-level beta-gamma trench located in the far western side of the old burial ground. This waste, buried some 14 years, came from raw materials' fabrication. Much of this mainly cloth, paper, and plastic waste was undecomposed. This study showed what an effort it was be to recover and remove waste buried in cardboard boxes/cartons or directly in the soil trenches..There is a film of this project. Elmer Wilhite has a copy.

In 1976, Perry Holcomb exhumed a feed adjustment tank from the Purex process some eighteen years following its burial. This tank was located just to the west of the entrance roadway close to where it exits the old burial ground. The tank was found to contain only 7 mg Pu-239 making the tank itself less than 10 nCi TRU/g. Details of this work are published in DP-1446.

Dick Hawkins exhumed a series of buried jumpers. The jumpers were sectioned, analyzed and found not to be TRU waste. Some of these were eventually used in lysimeter studies.

Some TRU waste was placed in bags and boxes in concrete culverts prior to the use of drums In the early 1970s, Henry Horton and Art Barab dug up one of these culverts. Their basic findings:

o the culvert was one-third filled with water;

o there was no activity on the outside of the culvert;

o digging up the waste and repackaging it multiplied the waste volume by about a factor of 4;

o radioactivity found in the water was basically the Am-241 daughter of Pu-241 beta decay;

o hydrogen was a component of the gas inside the culvert; and

o such a TRU waste reclamation and repackaging job was a very difficult thing to do, especially in the out-of-doors. The original intent of this exhumation was not really fulfilled in that it did not answer the question of how to repackage the waste in order to send it to a repository if such ever had to be the case.

The first three exhumation experiments are well-documented. Details of the TRU culvert work would have to be gotten from monthly reports.

Public Interest and Involvement

Site operations and practices prior to public involvement were much more simple than those of today that are governed by the plethora of environmental laws and regulations that we now must abide by. Public involvement was really joined in 1983 when it was announced that the groundwater beneath M Area was chemically contaminated. From that point on, site operational philosophy has changed considerably to include the protection and cleanup of groundwater as prime foci. Since shallow land burial of low-level waste does not protect groundwater from potential contamination, vaulting, solidification, and other isolation treatments of such waste is clearly the wave of the future to drive toward ensuring zero contamination of groundwater.

QUESTION AND ANSWER SESSION

C-14 is a component of spent resin from the reactor areas buried in the old burial ground. How difficult would that be to find and if found to retrieve prior to closure? I think it would be very hard to locate them, very hard. Studies are not complete, as yet, as to C-14 impact. Also, most of the resin is buried in stainless steel vessels except for one period when the resin was placed directly in trenches. The long half-life, 5000 yrs., is a problem, but then there is a great deal of dilution available in the environment for carbon. A study could resolve this. Lysimeter data is also available. We had 4 lysimeters in which spent reactor resin was placed directly. Finding the resin would be the main problem. Locating any single or any collection of small things in the burial ground down to less than 20' X 20' dimensions is virtually impossible.

You didn't mention the mercury. Ten tons of mercury estimated to be there from mostly tritium facilities, vacuum pump oil slightly contaminated with tritium. Studies have been done on the fate of that mercury on conditions of burial and they are sort of reassuring. But talk about difficult to find, those would be because they are very small containers, a whole bunch of very small containers. That practice was stopped in 1968. There is not much mercury to speak of in the upper burial tract. Most is in the 76 acres. Seepage basins contain about 16 tons.

Do you know of any offsite shipments to the burial ground that might contain fuel elements such as the reactor vessel burials? No, I don't know of any like that, and I think the Naval Core barrels did not have any.

Are there any items in the burial ground or in the general separations areas that should be recovered for economic or environmental reasons? Not for economical reasons, absolutely not, even if it were platinum! But for environmental reason, yes the plutonium, as much as possible, practical, or reasonable. - the culverts, drums, steel boxes on the pads, for sure, the culverts in trenches for sure. There is some waffling on the latter, but I don't think there should be waffling. Those are findable and not difficult to locate. They initially were not put in to be retrievable, but as soon as we starting looking at the long term destiny of the plutonium, we focused on those and said that yes, they are retrievable.

Was any TRU waste buried after the pads were established? Yes, there is still a suspect level of TRU waste put there, less than 100 nCi/g, coming from B-Lines. This would not legally be TRU waste, but would contain Pu in only truly trace amounts. If I had to put a number on that, I would say a curie per year.

What about the concrete monoliths? Has any of those gone out since the pads started (in 1972)? No, but one or two pads contain a rather large quantity of offsite (TRU) waste.

Is there a source that will tell us what that offsite waste is? Oh yes, there is superb document by Oscar Towler that describes Pu waste from Mound Lab and, I guess, from Los Alamos, but the Mound waste I do remember, in great detail down to what's in individual culverts. [Comment by Elmer Wilhite: There are classified documents describing DOD waste. Doug Wyatt (ER) has been compiling a list of these.] While I am thinking about it, there is a site in the upper 120 acres where offsite tritium waste is buried and a rather large amount of it which ought to be though of as a very special case prior to decommissioning because this represents 1.5 million curies of tritium in one spot. This is well documented.

Prior to being used by SRS, the burial ground site supposedly had some farmer's wells. Do you know if they've been capped? I would think that all those have been obliterated in the process of using the burial ground if for no other reason. I don't have the right answer for your question, but I think those of the "old oaken bucket" type have been obliterated. That's a 40' water table there, and they shouldn't have been much deeper than that.

As far as the solvent burning area is concerned, were there any other components other than the kerosene and tributyl phosphate that you know of? No, except degradation products from the breaking down of those.

You didn't mention the solvent down the wells. No, I didn't as a matter of fact. To get the solvent out to the storage tanks once we stopped burning it employed the solvent trailer. One fellow out there mistook one of the wells for the solvent tank and pumped some 60 gallons of spent solvent down it, or enough to fill up the well until it overflowed.. That is well documented. Not much activity in this solvent, but once the solvent reached the top of the groundwater, and there is not much to stop it from doing that, the solvent spreads on the groundwater surface just like a lake. So, we had a 12-acre lake with a very, very thin solvent layer on top.

Do you know anything about a drain field under the trenches (or perched water - Elmer Wilhite)? No, but I do recall there was drainage trenching done that relieved perched water. *(Another comment: there is some evidence that in the northeast area, there was perched water and there was the possibility that this area was fitted with a drainage system or an underdrain.)* I've never heard of anything like that, because that does the reverse of what you're trying to do since it provides a fast pipeline. I have no recollection of this and I don't think anything like that was ever done.

Another thing we learned in the work Oblath was doing with saltstone was that unsaturated conditions in the burial ground are just as effective for getting activity moving as are saturated and that was a real shock to us. I don't think the scientific community at large has really tumbled to the significance of that yet. You don't want your waste sitting in water since that provides a fast track for migration, but activity leaves the waste at the same speed, or rate, even in unsaturated conditions

There are some minor solvent spills connected with solvent burning. Is there the possibility that there are some major spills that we might want to look for?. I think they're well written up in a document Elmer (Wilhite) produced. The top number that I remember is about 600 gallons, total, for a number of events. There was a pretty good track, even back to the early days, of incident reports. At the Atlanta meeting, Will Cornman gave a talk on all the unusual events that took place up until 1975 in the burial ground. There were some 108 of them including 8 small fires. These should also be in Durant's data bank of incidents.

If you were going to close the burial ground, how would you do it? The common sense thing we worked out at the time we were studying the burial ground (70s) was clay-cap selected areas like that tritium site, and put a 10-foot soil cover over it. Prior to that, remove as much plutonium as possible. The reason for the final soil cover is vegetation uptake, very significant. Lysimeter tests showed that there is as much migration upwards as downwards. And upwards is much more immediate in so far as effect on the public is concerned. Capillary migration is indeed a significant pathway. Saltstone modeling said that. We estimated at that time that it would take 2 million dollars per year to decommission, i. e., each year's increment of waste would cost you about 2 million dollars.

When you said to clay-cap selected areas, did you mean cap those areas that were in the worst shape? No, not so much as in the worst shape sense, but cap those areas that had the most potential for contamination of groundwater under the site. We thought it would be difficult to completely cap the 200 acres.

Comment on the Idaho experiment. They did a several year extended study under a bubble building over old plutonium trenches digging up old drums and repackaging. They were dealing with vastly different conditions that what we deal with since it's relatively dry there, except for their snow melts. Some of their drums, containing Rocky Flats waste primarily, were breached. The experiment is well-documented.

What effect would dynamic compacting have since it could have an effect on the integrity of the containers in there and would that change your thinking on what we should do? I would say that the containers that are there are short-lived relatively speaking, except for the culverts which I hope you'll retrieve. It's good to mash them down for the simple reason that they are half-filled with air. (Comment by Elmer Wilhite: Keep in mind that in the old burial ground there are no B-25 boxes)

What about mercury in bottles in the case of compaction? Well, of course, the bottles will depolymerize and fracture anyhow. I wouldn't let a little mercury stand in the way of common sense.

Can you think of anything that SRS has failed to monitor for or to investigate in the burial ground that might be pointed out? Specific parameters such as groundwater? I can't think of any. There are some things (radionuclides) on the long-lived table there that we recognized and planned to look at, but we didn't get around to it. There is a lot of nickel, relatively long-lived, out there. Fortunately, it's in very durable form, such as stainless steel. Technetium and I-129 are others that we didn't finish. These are more than "Mickey Mouse" because questions keep coming up. We know the importance of the technetium and iodine for both of these have migrated beyond the perimeter of the fence. The other thing to always keep in mind is that there is probably in the burial ground a fraction of anything that has ever been handled at the site. You asked me about military fuel elements being out there. Well, I don't think those are, but the potential is great for shards of our own fuel being there as result of waste from high level cave studies in SRL. There is also something like 20,000 curies of curium out there from high level caves work.

I noticed in one slide that said something like 1E05 of Ni-63 was out there. Is that grams? That's curies. And the C-14 is 1E04 curies and I-129 is 10 curies. There is a document that states the numbers for these longer-lived materials. There will be a lot more technetium in the saltstone than there is in the burial ground.

In your opinion, what is the greatest hazard or threat to human health or to the environment that we must assess in our characterization and assessment program for the burial ground? The plutonium waste. Elmer Wilhite then commented that the greatest risk to human health would be if you had to go in and dig the waste up. ELA- There is a National Academy of Science panel that clearly recommended that we not do that. Audience comment: It sounds like we have a threat in the ground and a threat if we do anything about it. ELA- If I had to exhume anything out there, it would be the Pu-containing culverts. That's a nice waste form to start with. I sure would go after that plutonium, though. Audience comment- RCRA wants us to cap and cover these things and CERCLA comes along behind RCRA and asks if you thought about digging up the F&H seepage basins sediments, why didn't you, and have you ruled out going back and doing that. That same question is going to come up on the burial ground. ELA- But you ought to position yourself to defend that point really strongly. But on the plutonium, you really don't have a good defense because the total curies are "enormous". I once did a back-of-the-envelope calculation that said if you did not decommission and just walked off and left those mounds sitting there and they erode and animals and/or people start digging, you are going to have plutonium spread all over the surface of that part of SC. We're talking about a staggering amount of plutonium - 3/4 million curies is my recollection! And you just don't want to leave that legacy unsecured or unretrieved.

What about the "midnight" burials that are rumored? The classified burials? The only midnight story I have for you is burning the solvent. People started worrying about the smoke even before the regulations came into effect, so, they were inclined to burn at night because nobody saw the smoke and complained. We're talking about people onsite.

You mentioned about some of the culverts containing material that was not packaged in drums. What is your opinion of doing dynamic compaction nearby? Would it cause significant damage? I think that the critical component here is the culvert. If the culvert will stand it, it'll stand it whether it has rags inside or whether it has drums inside. (Elmer Wilhite - There should be a commitment as to getting those culverts out of there.) I think so, too.

You said that the one culvert that was retrieved contained water. Yes, it contained water and was also sitting in water. The water it was sitting in had no activity in it. The water inside did.

Do you think there is enough enriched uranium in any of the trenches to cause a criticality problem if dynamic compaction were done? I think you should calculate this. I don't think, though, that there is much enriched uranium out there. (Audience comment: Naval Fuel waste.) It needs to be determined, but there should be a good handle on that.

What did you mean by the vessel that Perry (Holcomb) retrieved being "highly radioactive" when it was buried, but only "mildly radioactive" when it was dug up? This was a feed adjustment tank that was exposed to Zr-Nb, 35 day half-life, 65 day half-life, and 1 year Ru, so most of that activity had decayed in the 14-year timeframe between burial and recovery. The activity did not "flee" or migrate from the tank but rather decayed.

Consideration must be given to how well equipment was decontaminated prior to sending to burial ground. Canyon decontamination facilities worked to get things clean, but they had a very practical point to stop at. They would get them clean enough to be able to put the equipment on a flat car in order to get them to the burial ground. Sometimes, they could not do anything because of circumstances, like an evaporator that failed with a charge in it. There is one burial that contains 3000 curies of cesium at one spot. That is well documented.

Attachment

TECHNICAL DIVISION
SAVANNAH RIVER LABORATORY

cc: W. R. Stevens, III, 773-A
G. T. Wright, 773-A
C. M. King, 773-42A
LLW Group (13)

December 28, 1984

M E M O R A N D U M

TO: E. L. ALBENESIUS, 773-A

FROM: J. A. STONE, 773-A *JAS*

BIBLIOGRAPHY - RADIONUCLIDE MIGRATION AT THE SRP BURIAL GROUND

Attached is a current list of references to studies of radionuclide migration at the SRP burial ground for solid low-level waste. This list was prepared in response to a verbal request from DOE-SR for information to be provided to the GAO. The scope of this bibliography is limited as follows:

1. Migration of radionuclides only
2. Studies related to the SRP burial ground only
3. Studies performed by WDTD or its predecessors only
4. Publications in the open literature or assigned formal document numbers

Within these constraints, the list is believed to be comprehensive. Most of the work on this subject has occurred during the past ten years. Examples of topics not included are: mercury migration; special wasteform lysimeters; seepage basins; HP studies; and informal memos.

The citations marked with an asterisk (*) have been released by DOE and are in the public domain.

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Burial Ground

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