CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Waste Management 97 (WM 97)
(20-5709-101, 20-8265-002, 20-5708-761)

DATE AND PLACE: March 1–5, 1997
Tucson, AZ

AUTHOR: Budhi Sagar

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PERSONS PRESENT:

Approximately 2,000 attended (attendee list available from the author).

BACKGROUND AND PURPOSE OF TRIP

This is a well attended nuclear (and mixed) waste management meeting that is held annually in Tucson, Arizona. The meeting consists of oral presentations in parallel sessions, poster paper sessions, short workshops on varied topics, and technical exhibits. This year's meeting included sessions on international high-level waste repository programs, uranium recovery facilities and waste, low-level waste, mixed waste, Hanford Tank waste, the Waste Isolation Pilot Plant project, and the U.S. Department of Energy (DOE) environmental restoration program, among many other topics. The proceedings of the meeting were not available at the meeting, but will be sent to the attendees in a few months. A copy of a booklet containing abstracts provided with the registration material is attached. Because many sessions of interest were run in parallel, I could only attend a few selected sessions, a brief summary of which is provided below.

SUMMARY OF PERTINENT POINTS:

Sunday, March 2: RADTRAN V Workshop. On Sunday, March 2 from 8 a.m. to 4 p.m., I attended the RADTRAN V workshop offered by Sandia National Laboratory. The instructors for the workshop were K. Sieglinde Neuhauser (primary person in charge of the code, telephone 505-845-8246), Francis L. Kanipe (scientific programmer), and Ruth F. Weiner (atmospheric dispersion component of the code). In RADTRAN V, most (but not all) of the variables that were hard wired (and there were a large number of these) have been put within the control of the user, that is, these can be changed as needed. Many of the parameter values hardwired into the previous versions of the code were based on U.S. averages. The attendees were warned that those values were perhaps the best values to be used and that any user preferred values should be carefully selected. A Latin Hypercube Sampling (LHS) outer shell is being created to run RADTRAN V in a stochastic mode. However, the LHS version is not yet available to the users. The downwind dose code TICLD, which was independent of the RADTRAN, has now been made an integral part of version V. Also, a new input file generator called RADDOG has also been created to make it easy for the users to create an input file. A new ingestion dose code (COMIDA) has not yet been finished, but will eventually become a part of RADTRAN. The RADTRAN code can be accessed at http:/ttd.sandia.gov/Radtran/radtran.html. A password is needed which can be obtained by calling Rick

Orzel at (505) 845-8094. Two computer discs were provided to the workshop attendees. One of the discs has the User's Manual on it and the other has the RADDOG code on it.

Monday, March 3: Multinational Repositories. David Pentz (Golder Associates International) was the first speaker in this session on multinational repositories. He estimated that from 300 to 500 million dollars were needed for the smallest repository program which countries with small nuclear programs (mainly for research and medical use) can not afford, hence the need for multinational repositories. Three factors for evaluating multinational repositories are: (i) safety—safety concerns of both the host and the client countries have to be honored as well as those of the international regulators [the sixth draft of the International Atomic Energy Agency (IAEA) convention on the safety of spent fuel management includes a section on multinational repositories], (ii) economics—public and political acceptance for the concept will be needed, and (iii) policy—environmental, nuclear and waste management policies of the client and host states have to permit such repositories. Many countries take for granted that each country must be self sufficient in nuclear waste management, but the reasons for this are not entirely clear especially when interdependence is accepted in relation to other economic activity.

Charles McCombie (Nagra - Switzerland) supported the concept of multinational repositories. Among the technical criteria for selecting a site for a multinational repository, he listed: (i) no relaxing of criteria, (ii) choice of simple geology, (iii) high technical know-how, and (iv) easy to monitor and safeguard. Among the economic factors, he cited the economy of scale. For example, a German repository, if shared, may cut the cost to Germany by one-third. There may be organizational issues also (e.g., who has the title to the waste, the client or the host state?), but IAEA has been working on such issues and many options to resolve these have been proposed. The only political reason is of self-sufficiency but there is no strong reason for it. As far as public acceptance is concerned, C. McCombie indicated that the idea of compensation for the host is now accepted. However, he conceded that public acceptance despite monetary inducement may be difficult to obtain. Some ethical issues also remain to be worked out.

John W. Bartlett (Sanford Cohen & Associates, Inc.) started his talk by saying that all services and technology are proven and available for undertaking a multinational repository project. Acceptable risk levels have been established and safety assessment methods have been formulated. He advocated that because of the long lead time required, the project should be started now. At present, about 200,000 MTHM is in storage in the world and about 10,000 MTHM is being added to it every year. He estimated that one multinational repository may be able to accommodate about 100,000 MTHM. The initiative for multinational repositories has to come from the political establishment. According to him, the U.S. will need another repository even if Yucca Mountain (YM) is found to be suitable for the first. He indicated that the present administration is not supportive of nuclear power and is not participating in formulating the international repository approach.

Monday, March 3 - Lunch Time Talk. Alvin L. Alm, Assistant Secretary for Environmental Management (DOE) spoke about the progress of environmental management at the DOE. The present plan is to clean the DOE sites in ten years by working smarter and thus reducing risks faster. The DOE intends to sell a vision of "completion" to the U.S. Congress. Of the money spent every year on clean up, 60 percent is fixed cost which has to be reduced and invested in the future (the term of art is 'reduce the mortgage'). Acceleration of cleanup at Hanford by one year can save 100 million dollars. He outlined the DOE ten year plan: (i) set efficiency goals—shift focus from support to accomplishing cleanup, (ii) agreement with the Corps of Engineers for a baseline and firm cost estimate, (iii) optimize schedules, (iv) plan intra-site transfer of waste management and disposal activities, (v) promote privatization—pay for products/services when delivered and not for level-of-effort, and (vi) use fixed price contracts. He emphasized that the ten year plan is critical as a mechanism for increasing efficiency and decreasing the mortgage. He promised that projects will have a beginning, middle, and an end.

Monday, March 3 - Uranium Recovery. Joseph J. Holonich [Nuclear Regulatory Commission (NRC)] was the opening speaker. He described the NRC program in uranium recovery management. The NRC deals with three types of facilities - solution mines, operating mills, and mills undergoing reclamation—and focused his presentation on the last item. The Uranium Mill Tailings Radiation Control Act (UMTRCA) provides the legislative authority for NRC actions regarding reclamation. Long-term stabilization of the site and cleanup of soil and groundwater are the main objectives of the act. The NRC's recently developed policy on soil cleanup lays emphasis on licensee plans and programs and relies on inspections supplemented by occasional confirmatory surveys. It is the DOE responsibility under Title I of UMTRCA to reclaim abandoned mills. There are a total of 19 such sites out of which reclamation of 7 sites has been completed and another 7 are planned to be completed in 1997. All sites are expected to be completed by 9/98. Sixteen commercial mill sites are undergoing reclamation under Title II of UMTRCA out of which NRC has completed action on one (Edgemont, ND) and another (ARCo Bluewater) is close to completion. For groundwater cleanup, three standards can be applied - background, maximum concentration limits (MCL), and alternate concentration limits (ACL). To date, NRC has accepted one ACL application. Concurrent jurisdiction with the states on groundwater cleanup raises some issues especially if the state standard is more stringent than the NRC standards.

Elaine S. Brummett (NRC) expanded on the NRC regulatory approach to soil cleanup. She indicated that the NRC emphasis is on inspecting licensee implementation of their decommissioning plan including QA/QC. The NRC staff has an inspection plan that it implements. In 1996, four sites were inspected in detail. The inspections pointed out weaknesses in licensee implementation. More recently, the NRC has approved an improved gamma survey procedure that requires fewer samples. Gamma surveys are the primary method for showing compliance with U.S. Environmental Protection Agency (EPA) regulations.

Mark A. Cummings [Los Alamos National Laboratory (LANL)], described a new method for soil cleanup. The method is being tested on a contaminated site at LANL. This site was contaminated in the 1940s when uranium slugs were fired into a hill site from a cannon. The site contains fragments from these shells. The baseline method of soil cleanup is to excavate the contaminated soil and transport it to a disposal site (e.g., to Envirocare site in Utah). The new method developed at LANL separates the contaminated soil into two piles based on some threshold gamma activity. An automated device to accomplish this has been developed. The contaminated pile, which is much smaller in volume than the total volume, is then cleaned by leaching and it is only the leachate that is then disposed. The cost of applying the new method is estimated to be about $55 per cubic yard of soil compared to $625 per cubic yard for the conventional strip and ship method. Taking into account the capital cost, the break even point is somewhere between 250 to 500 cubic yards.

Martin C. Duff (LANL) presented a comparison of acid and base leaching for removal of uranium from soils on 6 different sites ranging from sandy to clayey soils. Seven different leach solutions were used in batch experiments. After equilibration, the leachate was separated by centrifugation and tested for chemical content. It was observed that soil properties played a major role in leaching efficiency, so no generally applicable conclusion could be drawn. The China Lake acid (one of the seven solutions tested) was the most successful but it also co-leached more of the other metals. The presence of other metals in the leachate may create a mixed waste regulated under RCRA. Another observation was that the process of leaching can significantly alter soil properties.

Robert E. Cornish (DOE) presented two papers relating to DOE experience with surface reclamation of Title I sites. Surface cleanup of 20 out of 22 sites has been completed. About 5 million tons of tailings have been moved (about 15,000 tons/day) and this transport was subject to several U.S. Department of Transportation (DOT) regulations. The DOE asked for and received several exemptions from DOT (10 CFR Part 835). For example exemptions were granted from DOT regulations requiring that dose assessment from radon and radon daughters be done for each shipment, and that radiation be controlled at inaccessible spaces in vehicles as these were too difficult to implement for such a large project. Similarly, a variance was sought and granted by the EPA regarding measurement of radon flux from completed tailing cells. The EPA requires the radon flux to be measured 60 days after the emplacement of radon cap with no significant rain in this period. The moisture content in the cover effects the radon flux measurement. In contrast to the EPA, the NRC accepts a calculation that corrects the measured flux for effects of moisture content.

In his second paper, Mr. Cornish spoke about the cost effectiveness of surface reclamation in reducing health risks. Risks were estimated pre- and post-reclamation. In the pre-reclamation risk estimation, six sites were estimated to have higher risk if reclamation was done compared to no action. Because of congressional mandate, however, all six sites have been reclaimed. Contrary to pre-reclamation risk estimates, no loss of life occurred during this reclamation action. Risk per year is a function of time, it being the maximum during construction period and smallest after completion of construction. The data used for risk assessment was taken from existing Environmental Assessments (EA) and Environmental Impact Statements (EIS) for the various sites. Although the benefits of reclamation will extend forever in the future, the risk was calculated only for 100 years. Cornish noted that 300,000 tons of tailings were given away for construction in Grand Junction, Colorado. This caused 5,000 properties to be contaminated, 1151 of them in the interior. Cleanup was very labor intensive and the cost was $500 million (1/3 of total surface remediation cost for all sites). It is estimated that the cleanup will prevent 290 premature cancer deaths, yielding an estimated cost per life saved of $1.72 million. In Salt Lake City, Utah, an estimated 313 cancer deaths were prevented at a cost of $345.2 million ($1.1 million per life saved). In contrast, the cost for Slick Rock in Colorado works to be $18 billion per life saved because no significant population is expected to be at the site in the next 100 years. The speaker posed the question if the cost-benefit ratio should play a role in deciding which sites to remediate. Overall, for the surface reclamation project, it is estimated that 1,290 potential cancer deaths have been prevented at a cost of $1.5 billion. One death occurred in an accident during the reclamation project.

Tuesday, March 4 - Vitrification. In this session, three papers on the West Valley Demonstration Project (WPDP) and two on the Savannah River Vitrification Project were presented. Stephen Cowan (DOE) set the tone for the session by summarizing the vitrification activities in the U.S. He indicated that differences in the chemical and physical properties of waste in tanks has led to variations in melter design, glass forming chemicals, process control and waste qualification. However, both in the U.S. and abroad, borosilicate glass canistered in stainless steel (SS) is the choice for the final waste form. At both the West Valley and the Savannah River sites, operational readiness has been demonstrated through production of nonradioactive waste forms.

Paul J. Valenti (West Valley Nuclear Services, Inc.) presented the first two papers. He gave a brief history of the WVDP, which was constructed between 1962–66. From 1966 to 1972, Nuclear Fuel Services (NFS) operated this reprocessing plant, the only commercial fuel processing facility in the U.S., and processed 640 MT of spent fuel. In 1972 it was shut down for upgrades. The NFS estimated that it will cost more to respond to NRC concerns than was the original cost of the plant. The NFS took the option of walking away from the operation and the state of New York became the owner. WVDP is on a 228 acre rural site. It has four carbon steel HLW tanks in concrete vaults. Pumps are mounted on trusses erected over the tanks. Transfer of waste occurs through double walled pipes encased in concrete. Tank 8D-2 stores 660,000 gallons of Purex (alkaline) waste. For vitrification, this waste is mixed with Thorex (acidic) waste from Tank 8D-2. Cesium-137 is stripped from the waste by passing it through an ion exchanger (this reduces the number of glass logs that will be produced). Between 250 to 300 glass logs are expected to be produced by 1998; 70 have been produced to date. Glass formers and sucrose (for redox control—assists in avoiding heavy metals falling to the bottom of the melt) are added to the feed. A three joule heater is used in the melter which is fed from the top. The expected melter life is from 5–7 years which is sufficient to vitrify all of the West Valley waste. Melt is poured by gravity from the side of the melter. Feed chemistry is adjusted to eliminate foaming and minimize metal precipitation. Other features are melter pressure control through feed pump pulses, control of air leakage through quick-action air injection, off-gas jumper solids through periodic steam flushes, and cold cap coverage through melter viewing. Glass temperatures are measured with a minimum of ten thermocouples. Twenty remotely controlled TV cameras are mounted in the cell to monitor the processes. Infrared cameras are used to monitor the height of the pour into the cylinders. Cylinders are transported on a cart four at a time to the storage facility which has 22 canister storage racks. Cooling of storage racks is provided even though the fuel that was processed was 30 years old. About 300 different alarms are used for operational safety, only a few of which are classified as urgent requiring immediate action. The feed is prepared in a batch mode, but with pre-mixed feed, the cycling time has been reduced. In 1996, the maximum radiation dose to workers was 47 mrem. Down time in 1996 was 653 hours in 4467 operating hours. So far, 137,111 kg (70 logs) of glass have been produced at a cost of $1.4 billion (including capital cost). After completion of vitrification in 1998, the facility will be decommissioned.

David K. Ploetz (West Valley Nuclear Fuel Services, Inc.) talked about glass recipes. To produce target glass, there is a rather tight band of feed properties. At present, the acceptability of glass is based on the static PCT test. The WVDP glass performed an order of magnitude better on the PCT leach test than the acceptance limits. He explained the flow diagram for glass forming (these figures were not available at the meeting and will be included in the proceedings). The rate of glass production at the WVDP is 20–30 kg per hour. To check the quality of gas while pouring, glass shards are collected and tested. The melter is fed continuously but it requires 16 pores to fill one container. Some glass sticks to the wall of the melter. The final disposition of the melter will be worked out during decommissioning.

Joe T. Carter (Westinghouse Savannah River Company) related the last eight months experiences of vitrification at the Savannah River Defense Waste Processing Facility (DWPF). The DWPF is the world's largest HLW vitrification facility. It is far more complex than the WVDP plant. Three phases of non-radioactive testing have been completed. There are 50 tanks of radioactive waste at the Savannah River site. The supernatant in the tanks is turned into salt stone which will be disposed at the site. The sludge is used as the feed for vitrification. During the last eight months, several classes of problems were observed during operations. The first of these relates to feed preparation. So far 18 batches of radioactive feed have been prepared. There is a problem in maintaining homogeneity of this feed; three of the 18 batches required remediation. Lack of homogeneity can cause phase separation (it is not clear if such phase separation effects glass durability). Batch testing of glass shows that it is 16 times more durable than the EA glass. The present feed supply stock rate is not sufficient to meet the ten year goal for completing vitrification; canister production is taking twice the design time. The current production rate of 150 canisters per year will increase to 300.The second set of problems are related to melt pour system. There have been blockage problems with melter pouring. A tele-robotics manipulator is used to clean the melter pour sprout, which has had multiple failures (generally electric) during the year. The manipulator has a gripper with a camera; it can pick up about 40 kg load. The melter has four electrodes—the melt flows up a riser and then falls into the canister. The canister is 304 L SS. Infrared cameras are used to determine fill height (just as at West valley); so far there have been two failures of the cameras—the life expectancy is 3,000 hours. The canister temperatures are 800 °C. The third class of problems relate to process control, several of which are being worked out at this time. The system consists of very complex control systems with feed back loops. At present, the control valves are not functioning well and there have been fairly large down times. The system has a wet off-gas system with filters which is functioning well. The capital cost of the facility is $1.2 billion (not including pumping and transport of waste). Per year expenditure is estimated to be $140 million. William Kerley, a colleague of Mr. Carter, described the remote operations at the facility. The filled canisters are blasted with frit slurry to remove external contamination (an oxide layer forms during the pour process). A canister smear is taken to test that contamination levels are below acceptable level. A solid-state resistance welder is used which is different from the type used at West Valley. Leak tightness of the canisters is checked to ASME standards. The transporter is shielded; it transports the waste to an underground storage building.

Tuesday, March 4 - Radioactive Waste Management Policy. J-P Laurent (COGEMA - France) advocated a reprocessing, conditioning, and recycling (RCR) policy as appropriate for managing nuclear materials. The primary purpose of the RCR policy is to save uranium resources and to avoid disposing valuable materials contained in spent fuel; 96 percent of the material in spent fuel is recyclable. Recycling also reduces the toxicity of the ultimate waste; COGEMA's LaHague plant extracts 99.98 percent of plutonium contained in spent fuel. The volume of the waste is also reduced from 2 cubic meter per ton of U to 0.5 cubic meter. He argued that the RCR policy is fair to the future generations who will benefit by having larger energy resources and smaller waste volumes; it also meets the definition of sustainable development, "development which meets the needs of present generations without compromising the ability of future generations to meet their own needs."

Veronica Andrei (Romanian Electricity Authority, Bucharest) described the waste management policy in Romania. There is one CANDU-6 reactor at Cernavoda (generating 8 percent of Romania's energy), a fuel manufacturing plant and a research center at Pitesti, and a heavy water plant at Drobeta Turnu Severin in Romania. All of these facilities generate nuclear waste. Romania uses Canadian technology to treat, package and dispose of waste. Spent fuel is temporarily stored for ten years in the reactor bay. An interim dry storage facility is planned to be operational in 2007 while work will proceed in developing a final solution. The low and intermediate level waste is collected, packaged, and temporarily stored on site. A near-surface facility for this waste is expected to open in 2005. The spent fuel from a TRIGA research reactor will be returned to the U.S. for disposal.

Bernard Lenail (COGEMA - France) described issues related to nuclear material transportation. Transport is a key component of the nuclear fuel cycle. Some million radioactive casks are transported around the world every year but only 5 percent of these contain nuclear fuel cycle material. The remainder is related to radio-isotope transport generally used for medical purposes. To gain perspective, he cited the example of France where 15 million dangerous goods containers are transported every year; 0.1 percent of these carry fuel cycle material; out of these only 5 percent are type B packages that carry high activity material. Because of popular media's attention to transportation of nuclear material, the public considers this transport to be especially dangerous. In support of this view he cited the recent protest in Germany. The protestors tried to stop the shipment of vitrified waste from the COGEMA plant in France to Germany. COGEMA processed the spent fuel from Germany and was returning the waste to Germany, where it would go to the Gorleben storage facility. Mr. Lenail characterized the protest not so much against the shipment of nuclear waste but rather against the overall policies (unrelated to nuclear waste) of the German government. He emphasized the international nature of the transportation system and cautioned that all (and not just those involved directly in transport) have responsibilities towards informing the public.

Kenneth A. Chacey (DOE) summarized the status of the U.S. foreign research reactor spent fuel program. In 1996, a new nuclear weapons nonproliferation policy was put in place that applied to foreign research reactors. The policy established that over a 13 year period, the U.S. will accept up to 20 metric tons of spent fuel from research reactors in 41 countries. Only spent fuel containing uranium enriched in the U.S. is covered in this policy. The first shipment under the policy was obtained in September, 1996. The primary challenge for the DOE is to continue to transport this material in a consistent, cost effective manner over the 13 year duration of the program.

John T. Greeves (NRC) spoke about the status of the international convention on the safety of radioactive waste management. The convention will result in an international legal instrument that the member countries will have to ratify. Mr. Greeves noted that the U.S. Senate has not yet ratified the previous convention on the safety of nuclear reactors and for that reason the U.S. will not be able to participate in the forthcoming meeting in April. The objective of the convention is to promote international cooperation. The IAEA has put forward the basic principles of the convention. Subjects addressed by the convention include transboundary movement, promotion of safety culture (includes articles on safety assessment, EIS, QA, and financial assurance), and incentives to improve national waste management practices. The general principles emphasized protection of individual, society, and the environment; prevention of accidents and mitigation of consequences; and fairness for future generations. The scope of the convention is broad and it includes all types of wastes including spent fuel. The NRC plans to seek public comments on the convention.

Mikael Jensen (SSI - Sweden) talked about the role that Sweden and other Nordic countries have played in waste management in the Russian federation. The effort began with a seminar in Vienna in May, 1995. The Russian participants presented a list of high priority projects in that seminar. The list contains legal and regulatory projects, but production and hardware projects dominated the list. The European Union has committed 6 million U.S. dollars for technical assistance in waste management to Russia; Norway has contributed the most to this fund. The SSI has a program with the Russian regulatory authority—Gosatomnadzor. Mr. Jensen emphasized that it is critical to safety to enhance the technical competence of the regulator and that international cooperation (rather than bilateral projects) will be more cost efficient.

Wednesday, March 6 - Hanford Tank Waste. I was able to attend only one of the three papers in this session, which related to gas generation in the tanks, presented by G.D. Johnson (Westinghouse Hanford Company). Hydrogen gas is generated in the tanks due to radiolytic decomposition of water and due also to organic reactions. Theoretical models for gas generations are being developed; at the same time gas generation is being measured in Tank SY-103. The modeling results obtained so far indicate that radiolytic generation dominates if the temperatures in the tank are less that 30 °C. At temperatures greater than 60 °C, thermal gas generation due to organic reactions is the dominant mechanism. Good correlation has been found between the modeling results and measured data. The primary safety hazard is in the flammability of gas. Gas can be retained in the waste and released periodically, which can exceed the flammability limit (the most worrisome is tank SY-101). Bubbles provide the primary mechanism for gas storage. The supernatant liquid provides the hydrostatic pressure for gas retention. Six double shell tanks and one single shell tank have been instrumented to measure void fraction and retained gas. The gas release mechanism is spontaneous buoyancy or it is man-induced (e.g., waste removal). In Tank SY-101, 14 gas release events have been observed; the maximum release in any event has been 200 cubic meters. Single shell tanks release much less gas. The gas hazard will persist until all the waste has been removed from the tanks.

IMPRESSIONS/CONCLUSIONS:

The meeting was very useful in obtaining information about ongoing waste management activities. There was a large number of exhibits from companies and organizations dealing with nuclear waste problems and issues. Only a small part of the meeting dealt with the YM Project; more time was devoted to low level waste, mixed waste, site decommissioning, uranium recovery management, HLW at DOE sites, and international practices and policies. With the CNWRA widening involvement in regulatory aspects of various types of waste, attendance at this meeting can be a good opportunity to learn as well as disseminate information. Several NRC staff presented papers at the meeting.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

None.

SIGNATURES:

Budhi Sagar
Technical Director

4/1/97
Date

CONCURRENCE SIGNATURES AND DATE:

W.C. Patrick
President

4/1/97
Date

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