THE APPLICATION OF NUCLEAR WASTE MANAGEMENT TECHNIQUES AND SYSTEMS TO NON-RADIOACTIVE HAZARDOUS WASTE MANAGEMENT

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CHEMICAL WASTE/NUCLEAR WASTE DISPOSAL —
IS THERE A DIFFERENCE?

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Is there a difference? Of course there is, and we all lament the fact that the public just can't seem to grasp the differences between high and low-level waste, between radioactive waste and chemical waste, or between Love Canal and West Valley. Perhaps there is a message to be taken from the repeated confusion: that the issues in the management of industrial chemical wastes and low-level radioactive wastes simply aren't that far apart.

As a case in point, Chem-Nuclear Systems is in the business of managing both chemical and radioactive wastes. We have operated our low-level radioactive waste site in Barnwell, South Carolina since 1971 and have also provided a range of services for treatment, transportation and cleanup of radioactive waste. Six years ago we applied our waste management expertise to open our Arlington, Oregon site, which has been treating and disposing of industrial/chemical wastes since that time. We provide transportation and field services in the chemical waste area as well. As a corporation, we take practical advantage of the commonality between industrial and low-level waste in shared approaches to siting, operations, research and design, technology, and regulation.

There are a number of directly comparable issues, and they fall into two primary categories: public perception or institutional factors, and technology. The general public in this country seems to view waste management, whether chemical or radioactive, as a problem -- they fail to see that it is the solution to the potentially disastrous problems presented by irresponsible management. Overcoming this common misconception needs to be an objective in both industries. In addition to shared problems of public perception, there are many lessons that have been learned on the technology side which can be applied, including siting, treatment methods, and facility operations.

NATURE AND SOURCES OF THE WASTE

The nature of both problems start with the waste streams themselves, where they are produced and in what volumes, their characteristics, and the systems needed to manage them safely and economically. About 60 million tons of industrial/chemical waste are generated annually[1]. The following table summarizes the primary industry categories producing these hazardous wastes in a typical year, the types of waste they produce, and the percentage of the total estimated national volumes that they represent.

TABLE I

Chemical Wastes

Industry	Examples Of Hazardous Wastes	% Of Generation[1]
Primary Metals	tin, copper, phenol, chromium	29%
Organic Chemicals	solvents, PCB's	23%
Metal Finishing	cyanide, oil, heavy metals	18%
Inorganic Chemicals	asbestos, calcium fluoride, chlorinated hydrocarbons	12%
Textiles	zinc, copper	6.4%
Petroleum Refining	phenols, heavy metals, oils	6.4%
Other	---	5.2%

Commercial low-level radioactive wastes are generated in about the following proportions[2].

TABLE II

Low-Level Radioactive Wastes

Industry	Examples of Wastes	% Of Generation*
Nuclear Power Plants	trash, solidified liquids, resin beads, contaminated components	50%
Hospitals/ Universities	trash, biological wastes	24%

Industry	Examples of Wastes	% Of Generation*
Industry (pharmaceuticals, smoke detectors, exit signs, etc.)	trash, solidified liquids	26%

*Disregarding government-generated waste disposed of formerly at commercial sites.

Reduction of low-level radioactive waste volumes at the source and after generation is an increasing practice, and will reduce waste volumes even more as new techniques are developed and become economically more feasible. Even with these reductions, annual low-level waste volumes are projected to increase to around 6.5 million cubic feet by 1990[2]. That seems a very small amount as compared with the much larger industrial/chemical waste volumes, but it is more than existing disposal facilities can handle. That points to another area of similarity: the national need for development of new facilities. Many existing chemical waste sites will be closed because of their inability to comply with the RCRA regulations, so the need for new, RCRA-compliant sites is urgent. Comparatively, since only three low-level radioactive waste sites are open today, new facilities must be developed for handling those wastes as well, but fewer will be needed.

The similarities between chemical and low-level radioactive waste include their diversity in physical and chemical forms. One of the primary differences is that radioactive waste offers a fairly easy parameter for detection and measurement. A survey of the material will provide a reading of its penetrating radiation or activity, and the types of radiation are limited. Not having that fairly simple parameter, chemical wastes cannot be as uniformly and economically measured and they offer a far larger challenge in characterization. Organic wastes of either kind present particular problems in treatment and disposal. In some cases a waste material may contain both chemical and radioactive constituents, and the predominant category may not be obvious. For the most part, industrial wastes are more complex and widely varying, making them harder to catalogue and track.

TREATMENT

There is considerable attention being paid nationwide to recycling, recovery, and treatment of both kinds of waste. Many factors are affecting these moves: concern for the protection of the environment, liability, disposal availability, recovery of scarce resources, and economics.

Waste generators are finding that they can, in some cases, reduce the amount of waste they generate at the source. This can be accomplished through redesigning their processes, substituting materials, and simply through more careful housekeeping. Once waste has been generated, there are diverse methods for treating it, reducing its volume and/or toxicity, and stabilizing it for shipment and disposal. The table below compares treatment technologies for industrial/chemical waste and low-level radioactive waste, most of which are in use today.

TABLE III

Treatment Technologies

Chemical Waste	Radioactive Waste
Solar or Mechanical Dewatering/ Filtration	Filtration Evaporation
Incineration	Incineration
Solidification (e.g., cement, fly ash)	Solidification (e.g., cement, polymer)
Chemical Destruction	Ion Exchange
Biological Destruction	Compaction
Adsorption	Storage for Decay
Distillation	
Oil/Water Separation	
Solvent Injection	
Radiological Destruction (experimental)	
Desalination (experimental)	

The trend will probably be, in both areas, to increased use of volume reduction and stabilization techniques. Low-level waste regulations, as proposed, place new emphasis on segregating waste forms and types (for stability and protection of intruders) and on providing external barriers to keep those intruders from encountering the waste in the future (engineered barriers, deeper disposal).

HAZARDS

The effects on humans and the environment also vary between chemical and low-level wastes. The exposure limits derived for radioactive wastes are based on the relatively long-term chronic effects one would receive from exposure to the radiation emitted by typical waste types. People often think of the hazards of chemical waste as being more acute: e.g., dropping acid on your arm and causing skin damage, or an explosion of an ignited low-flash-point hydrocarbon. While these again are potential threats, it is not well understood that the hazards of exposure are very diverse and primarily chronic. Long-term exposure to pesticides, for example, can cause chronic cancer or birth defects. While short-term exposure to PCB's has not been proven to be toxic, the longer-term results can also include cancer, liver damage, or eye or skin problems.

A discussion of comparable hazards leads to the question of longevity. While radioactive waste has another "convenient" measurement, that of the radioactive decay half-life, many chemical wastes do not. This presents the specter of perpetual hazard and the need to destroy the materials or control them forever. It is generally assumed that, depending on quantities and concentrations, low-level waste reaches nonhazardous levels of activity within 10 half-lives. This allows calculation, as the Nuclear Regulatory Commission has recently done, of which isotopes are acceptable for a shallow-land-burial facility expected to be controlled for a certain number of years. In an industrial waste disposal facility there will be some degradation of organics, and some will be destroyed before disposal, but there is no corresponding concept of decay. This alters the requirements for long-term care and control of the site and changes the perception of its hazard.

REGULATION & REGIONALIZATION

The driving force to develop comprehensive regulations for waste management has come from past problems. In both fields, regulations that are currently under development are molding waste management practices, facilities, and technologies. The establishment of the Resource Conservation and Recovery Act *(RCRA)*[3] as a national program for systematically managing hazardous wastes was a giant step. Before that time there were no federal standards for what constituted acceptable practices in handling, treating, and disposing of potentially hazardous industry residuals. Defining and putting into practice all of the pieces of such a sweeping regulation have not been easy, and indeed are still evolving. The Act gives states, however, a baseline from which to build their own programs or to adopt a set of requirements as they stand; in either case a regulatory framework to begin controlling a complex problem.

Other activities have been triggered by RCRA as well. There is an increasing move in the states to inventory waste streams so that adequate and economical management systems can be developed. In areas where it is feasible because of particular markets, regional facilities are being encouraged so that availability to the users is ensured while economic viability is also maintained. There is a growing emphasis in the states on maximum recovery, recycling, and treatment; with land disposal as the last option. The requirements of RCRA also mandate a manifest system, which is a much more accurate way to track and control wastes, avoiding mismanagement and supplying the data needed for accurate planning.

The national scene for low-level waste management is similar in many ways. National legislation provided impetus for states to consider the need for new facilities, and the Low-Level Radioactive Waste Policy Act (PL 96-573)[4] was passed in late 1980. Based on the state responsibility mandated in the Act, a regional emphasis has been placed on planning for waste management facilities. Since annual low-level radioactive waste volumes are so much smaller than industrial waste volumes, fewer facilities are required or are economically feasible, so a regional approach makes even more sense. Economic factors dictate that a sufficient annual facility volume is necessary to price waste management services realistically, but political realities preclude the treatment or disposal of "everybody's waste" in "one person's backyard" strictly for the purpose of reducing the cost per cubic foot. Transportation distances have also influenced the regional decisions, and groups of states are working now to develop and ratify interstate compacts and start developing new sites.

The Nuclear Regulatory Commission's proposed regulations for licensing land disposal facilities, 10 CFR Part 61, offer a framework for developing and operating new sites which is similar to RCRA. States that have received NRC authorization to regulate low-level waste activities under the Agreement State program will adopt regulations that are at least compatible with Part 61, if not identical. The states are also, as in the chemical waste area, working with their regulators and generators to inventory the amounts and types of waste produced, assess the current treatment practices, and project future trends. Another requirement in common is the manifest system proposed in Part 61, which will meet needs for shipment control and data gathering much as will the chemical waste manifest program.

With this national regulatory structure and a regional approach to siting, the elements are there for a coherent, effective system of low-level waste management in this country. Since compacts are being developed to exclude out-of-region waste from regional facilities in 1986, however, developing new sites in those regions without existing ones is an urgent need. In this regard, the low-level waste issue differs from chemical waste siting, since there are no formal restrictions on which states may dispose of their industrial wastes at certain facilities. Transportation and market factors affect the costs, but at this time state boundaries are not used to bar shippers from particular sites. In low-level waste, on the other hand, possible exclusion as early as 1986, combined with a 4-5 year site development timeframe, suggest real interim problems for generators disposing of their wastes.

SITING NEW FACILITIES

The processes for locating, developing, and licensing new facilities for either industrial or low-level wastes are very similar, and offer particularly good opportunities to share approaches. Working within the requirements or at least the spirit of the National Environmental Policy Act (NEPA), site location involves exhaustive environmental and geologic characterization of the proposed site as well as justification for its selection in the first place. Criteria for screening and selecting sites also cover most of the same factors. A license or permit application for either type of site must include a detailed environmental analysis based on the site characterization (including at least one full year's environmental monitoring data to provide a baseline measurement for future comparison); plans and procedures for site operations, staffing, security, environmental monitoring and closure; and engineering designs for the facility. Knowledge and experience with that process can be applied effectively to either type of site, and the skills required for each are complementary in terms of staffing.

Another major area of similarity is in the public/political/institutional arena. Recognizing that a key overriding problem with developing new sites is dealing with people's fears and misconceptions about the hazards, and in addressing their legitimate concerns, a comprehensive public and state involvement program will be essential in all cases. Such a program should consider early concerns of state political leaders and regulators, and should involve local leaders and members of communities as the site selection process narrows down to a particular location.

In neither case does the involvement of the community mean that decision-making authority is delegated to the general public. It means, however, that an honest and open program of information should be presented throughout the site development process, and state and local ideas should be actively sought and considered in the development of the site. It is not practically possible in today's environment to establish a facility such as this without working closely with the state and locality in which it will be located, and there are many examples of the futility of trying to do so. A working partnership will, if all goes well, get the facility established and allow it to operate as a productive part of the community.

SUMMARY

Technology transfer is a buzzword these days, but it represents a concept that is difficult to dispute: that reinventing any wheel, anytime, is not an efficient use of time or resources. What have been described here are a large number of comparable issues in chemical and low-level waste management. The two fields face similar problems with political and public acceptance, regulatory compliance, technology development, and economics. There is a great deal of similarity in the siting processes, the regulatory framework, the manifest requirements, and other areas.

Sharing this knowledge is a healthy trend, and needs to continue. However, carrying that sharing so far as actually co-locating chemical and radioactive waste facilities, for example, raises issues of community and political acceptance. The two types of sites can perhaps be used as trade-offs between states or regions to improve their economic viability and avoid unnecessary site proliferation. State governments must talk to one another, at any rate, to create mutually beneficial alliances where they can; and we in the industry have a primary motivation to shorten our own learning curve by applying the lessons learned in both industries. A great deal of the necessary technology is in place; the regulatory structure is taking shape; and we've learned many things already about the institutional and public issues. It would seem that we can continue to learn from experience in both chemical and low-level waste management in an ongoing dialogue, with the objective of creating workable national systems in both areas with a minimum of pain for everyone involved.

REFERENCES

1. Hazardous Waste Market - Handling, Storage and Disposal, Frost & Sullivan, Inc., February 1981.

2. DOE/NE-0015, Low-Level Radioactive Waste Policy Act Report, U.S. Department of Energy.

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4. Public Law 96-573, Low-Level Radioactive Waste Policy Act, 96th Congress, December 1980.