availability and, hence, competition may be restricted. Rather than supplying the technology to cleanup companies, which has not proven a successful strategy, Battelle has helped form a new company with startup capital. The new company, the GeoSafe Corp., will seek additional venture capital and will enter the hazardous waste cleanup business directly with ISV; it has the exclusive worldwide rights for this market. No competitive bid process now appears possible.

The ROD omitted any commitment to SARA's requirement for 5-year reviews when hazardous material remains onsite, a requirement which applies in this case because of the stabilization aspect of the technology. For example, the 5-year review was called for in the Chemical Control ROD, which selected in situ stabilization, and at the Tacoma Tar Pits, which selected stabilization.

The Pristine case illustrates how different offices of the same EPA contractor and how different Superfund contractors can use substantially different data. One contractor's office used a cost for incineration for Pristine of about twice what another of the contractor's offices used for the Davis Liquid Waste and ReSolve sites. A close examination of the calculations for estimated costs at Pristine reveals that a very high indirect or cost burden was used, compared to indirect costs in FSs for several sites. Such cost variations have no technical basis.

Case Study 7
Renora, Inc., Edison Township, New Jersey, EPA Region 2

Capsule OTA findings:-The selected remedy makes use of offsite landfilling for soils contaminated with PCBs. Biological treatment was selected for soils contaminated with diverse organic compounds and toxic metals and for contaminated groundwater, but no treatability study supported its selection.

Key dates:

- Entered Superfund system: 5/1/81
- Preliminary Assessment: 8/1/82
- Site Inspection: 9/1/81 to 8/1/82
- National Priorities List
  –proposed date: 12/1/82
  –final date: 9/1/83
  —site rank: #378 out of 770
- RIFS start and completion: 5/85 to 8/87
- Public comment period before Record of Decision: 8/18/87 to 9/10/87
- Signing of ROD: 9/29/87
- Estimated complete remediation: 1 to 2 years after signing

Total time.—8 years

Brief description of site.–The site "is an approximately one acre parcel of land in an area zoned for light industrial use. The surrounding area is residential with three sensitive uses (a nursery school, senior citizens center, and an apartment complex) within two thousand feet of the site. . . . two residential developments [were] built in close proximity to the site during the period of time the RI/FS was conducted. From 1978 to 1982 Renora Inc., transported and accepted materials containing hazardous substances for transfer, storage, blending and ultimately, disposal through abandonment at the site [in 1982]."

Major contamination/environmental threat.—Evidence of contamination problems started in 1978. In 1985, the Remedial Investigation (RI) said: "Surficial soils (0 to 2 feet) are primarily contaminated with polychlorinated biphenyls (PCBs) and polynuclear aromatic hydrocarbons (PAHs) and to a lesser extent with volatile organic compounds (VOCs), acid extractable compounds (AECs), other base/neutral organic compounds (BNCs) and heavy metals. Shallow groundwater beneath the site is contaminated with low levels of chloroethane, (a volatile organic compound) and heavy metals. Surface water and sediment samples show levels of heavy metals, tetrachloroethene, phenols and pesticides. No evidence of air contamination was found at the site, No buried drums were found at the site. "

The RI concluded that the significant pathways of exposure are direct contact and subsequent incidental ingestion by children tres-

passing the site, future onsite workers, and future site residents.

According to the ROD:" . . . there are no off-site impacts directly attributable to site operations. Therefore, no management of migration measures were selected as part of the overall remedy for any environmental media. Although groundwater does not pose a public health risk, achievement of target treatment/residual levels will result in restoration of groundwater quality to potable water standards. "

HRS scores.-groundwater 69.32; surface water 9.4; air 0.00; total 40.44

Removal actions.-The ROD said: "A removal action was initiated in October 1984 and continued through April 1985. During the cleanup, approximately 33,000 gallons of liquid waste and 28,000 gallons of PCB contaminated waste oil along with approximately 500 cubic yards of non-PCB contaminated soils and 560 cubic yards of PCB-contaminated soils were shipped off-site for proper disposal [presumably in a landfill]." The SCAP shows a Federal removal action 10/23/84 to 10/31/84 at a cost of $27,000 and that the responsible parties performed one, 9/28/84 to 4/16/85. Data from the New Jersey Department of Environmental Protection indicates that the responsible parties spent $4 million for their removal action.

Cleanup remedy selected.—The remedy has four key components:

1. " . . . excavation of all PCB-contaminated soils containing concentrations above 5 ppm [parts per million] (approximately 1,100 [cubic yards]) and off-site land fill disposal . . . "
2. ". . . biodegradation of all PAH-contaminated soils containing concentrations above 10 ppm (approximately 4400 [cubic yards]) . . ."
3. " . . . use of groundwater ***as*** an irrigation medium for the bioremediation system . . . " [and]
4. " . . . backfilling, grading and revegetation."

The cost of the selected remedy was estimated at $1.4 million.

A number of cleanup alternatives were examined, including containment approaches, treatment of less material, use of incineration instead of landfilling, and conventional groundwater treatment.

Satisfaction of SARA statutory requirements:

1) ***Selection of permanent cleanup.—The*** ROD said: "Overall, [the selected remedy] is protective of public health and the environment. An innovative treatment technology would be utilized as a major portion of the remedy. There is ***complete*** reduction of the toxicity, mobility, and volume of the contamination. The remedy is permanent and would not require long-term management" (emphasis added). More cautiously, the ROD said the remedy ***"significantly*** reduces the toxicity, mobility and volume of contaminants" (emphasis added). Also: "Upon completion of the remedy future site uses will be unrestricted."

There is no specific technical information in the ROD or Feasibility Study to support the selection of biological treatment for the Renora site. There are no test data, no citations to the technical literature, nor reference to previous use at specific sites. The ROD stated: "A prerequisite to implementation of the bioremediation portion of the alternative is a pre-design treatability study to refine parameters of the operation." There are a large number of contaminants, and many of the organic contaminants and heavy metals are considered difficult to biodegrade. The biological approach is not off-the-shelf cleanup technology, except for a few simpler types of cleanups.

A key issue is the extent of destruction by biotreatment. While it can be easy to get ***some*** destruction, it can be very difficult to get complete destruction or as much, for example, as required for incineration (99.99 percent destruction). Finding ways to enhance biodegradation for a complex set of chemicals and for recalcitrant contaminants can be difficult. For example, a recent research paper discussed the "degradation of Benzo[a]pyrene and other recalcitrant PAHs" and explained its failed attempt to foster biodegradation by noting that

"organic amendments which are readily utilized for carbon and energy are often ineffective in stimulating degradation of recalcitrant organic compounds." (M.P. Coover and R.C. Sims, ***Hazardous Waste & Hazardous Materials, vol. 4, No. 2, 1987,*** pp. 151-158.)

The current state of technical knowledge and experience does not support the cleanup selection in the absence of site-specific data to prove effectiveness in meeting the cleanup goals. There are substantially different forms of biological treatments, ranging from simple land treatment to the sophisticated use of bioreactors using a variety of additions to promote and sustain biological destruction to desired residual levels of contaminants, but the ROD dealt with the technology only in its simpler, generic terms.

Biodegradation was selected for the French Limited site in Texas, but the ROD emphasized that "biodegradation of PCBs to the criterion (23 ppm) has not been demonstrated." EPA required, therefore, that a secondary stabilization treatment be used on the residue from the biotreatment.

The FS for the Liquid Disposal site in Michigan examined biological treatment in more detail than most studies and did not select it. A chief reason was: "The level of effectiveness of the biodegradation technologies on a nonhomogeneous waste stream is unknown." The study noted that extensive testing would be necessary to prove the technology effective for the site.

Biological treatment was rejected in the Feasibility Study for Crystal City because "[it] is generally ineffective for destroying these wastes as the treatment is not performed in a controlled environment. Several processes are being developed which show potential. However, none of these processes have been developed past the laboratory stage. Therefore, biological treatment has been ruled out. " Biodegradation was also rejected in the ROD for the Tower Chemical Superfund site in Florida: "Biodegradation does not address the metals contamination found at the site and would require long term operations before full clean-up is effective. Other technologies, e.g., incineration, would provide equal destruction efficiencies in a shorter time frame. "

The Renora ROD said:

- " . . . bioremediation of soils is considered an innovative treatment technology in the field of hazardous waste management."
- "Although available scientific literature indicates implementation of the bioremediation portion of the alternative is feasible; a pre-design treatability study would be required to confirm the operational reliability of the alternative. "
- " . the bulk of the contaminated soils (approximately 60 percent of the total) which remain are amenable to onsite bioremediation. Available scientific literature and its use in the oil refining industry indicate that the bioremediation aspect of the selected alternative will achieve the target treatment/residual levels."
- "The prospect for long-term reliability of the alternative would be established by the pre-design treatability work and subsequent verification sampling. However, as this remedy is permanent and ***substantially*** reduces the toxicity, mobility and volume of contamination the likelihood of remedy replacement is low" (emphasis added; compare to different statement above).

The choice of offsite landfilling over incineration was not discussed in detail in a direct way for the alternative selected. Other alternatives which would include more use of incineration, because no bioremediation would be used, were said to "not result in providing any greater protection of public health or the environment that would justify the incremental cost increase. "

Z) Accurate assessment of land disposal and containment alternatives.—The use of offsite landfilling for the PCB contaminated soil instead of treatment is contrary to the intent of SARA, even though the amount is relatively small. A recent EPA study on PCB cleanup concluded: "Landfilling of such materials, where legal, is a potential source of groundwater con-

lamination, and only a temporary measure at best." (U.S. Environmental Protection Agency, Office of Research & Development, "Bengart & Memel PCB Site Soil Decontamination Project," undated but apparently 1987.) The FS for the Liquid Disposal site in Michigan said: ***"However, moving wastes from one site to another does not constitute a permanent remedial action"*** (emphasis added). For Renora, there was no discussion of the negative aspects of using offsite landfilling. The Renora ROD looked strictly from the perspective of this site: "Excavation of PCB contaminated soils and offsite landfilling will physically remove hazardous substances, pollutants and contaminants from the site."

RIFS contractor.—The RIFS was paid for by a group of potentially responsible parties and conducted under contract by BCM Eastern Inc.; $250,000; an endangerment assessment was done by Camp Dresser and McKee under contract to EPA.

State concurrence.—The State of New Jersey concurred with the selected remedy.

Community acceptance.—The responsiveness summary gives little information on what the community felt about the selected remedy.

Special comments.–The analysis of cleanup alternatives was somewhat confusing because some options, including the selected one, referred to offsite disposal consisting of either landfilling or incineration. Except for cost, there were no distinctions made within an alternative for the use of landfilling versus incineration. Therefore, the selected alternative might have received overly high evaluations because incineration was included as an option but ultimately not selected.

The ROD contained a good statement on capping: "[it] would not be considered permanent since the toxicity and volume of contaminants in the soil would remain essentially unchanged."

The ROD did not commit to groundwater monitoring after the selected remedy is implemented, which seems relevant, since it says that the groundwater will be restored to a potable condition and since the HRS groundwater score was quite high. However, the responsiveness summary did include a monitoring step in its description of the selected remedy.

General conclusions.—A key issue is the choice of offsite landfilling over offsite incineration for the PCB contaminated soil. A major driving force behind SARA's requirements for permanently effective treatment technologies was the long-term ineffectiveness of moving buried hazardous waste from Superfund cleanup sites to other land disposal sites. This ROD, considering only this site, implied that offsite disposal results in maximum protection. It did not consider the long-term consequences at ***another site*** of landfilling materials transported from this site. In addition to the two EPA sources already noted, the FS for the Pristine site in Ohio rejected the option of sending contaminated soil to an offsite landfill because " . . . there is potential for the contaminated soil to cause a problem at the off-site facility. . . . the alternative is not permanent and is the least preferred under SARA." The reasons for ruling out offsite incineration of the PCB contaminated soil at Renora were not given.

The Renora remedy also perpetuates a trend started by the major removal action completed at the site in 1985. A viable alternative, as examined in the ROD, was to incinerate the waste instead of landfilling it. Indeed, the ROD contained an important statement on this point in the discussion of the alternative that was selected: "If the excavated PCB contaminated soils are incinerated instead of landfilled, there would be a permanent reduction in the toxicity, mobility and volume of contaminants in soils." The clear implication is that landfilling is not comparable in meeting SARA's requirements. The chief reason for not selecting incineration of the PCB contaminated soils appears to be its greater cost, an additional $4.6 million. The ROD noted: "it is likely that the [potentially responsible parties] will implement the selected remedy." In other words, approval of offsite landfilling by EPA may have facilitated getting an agreement from the responsible parties to clean up the site.