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FINAL PHASE-IN REPORT

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WASTE MANAGEMENT

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I. BACKGROUND

This volume of the Transition Final Report provides the findings, recommendations and corrective actions for the Waste Management areas developed during the phase-in actions by Westinghouse Materials Company. (WMCO)

The objective is to provide a summary of the studies and investigations performed by the WMCO Company during the transition period.

The Waste Management effort at FMPC was expanded in 1984 when a separate group was formed within the NLO organization. This is considered to be an area where significant increase in priority and effort must be applied to resolve waste management problems and to bring the site in conformity to regulations and the Environmental Health/Safety Standards.

During the transition, there was a comprehensive investigation in all areas of air, liquid and solid waste management for nuclear, chemical and conventional wastes. Not all of these investigations are documented in this report, but the information gathered was used in the development of the budgets (cost accounts), programs, and organizational planning.

Issues that were considered to be high priority for the immediate future were defined as listed below along with a basis for the priority:

A. Water Pollution Control System.

Basis - This project is necessary to meet the Ohio EPA limits for nitrate in liquid effluents from the plant.

B. Establish an Interim Solution to Resolve the Problems with the K-65 Storage Silos.

Basis - The current silos are unstable and do pose a minor threat to the plant and the public should the situation worsen. The silos are also a focal point for concern by the press, local residences, and even some plant personnel.

C. Contaminated Construction Rubble Disposition

Basis - With the ongoing plant modifications and improvement, a significant amount of construction rubble will be generated. This rubble might be contaminated thus increasing the total inventory of low Level Waste LLW on site.

D. TRU Waste Resolution

Basis - The current DOE rule of 10 ppb of PU/U has shutdown certain operations, including shipments of certain wastes to NTS. Testing of waste streams to provide data for the LLWPSS cannot be accomplished since the tests involve streams containing > 10 ppb PU/U. These operations cannot begin until the issue is resolved satisfactorily.

E. Interim LLW Shipping & Disposal

Basis - The need clearly exists to continue to prepare and ship the vast inventory of LLW currently on-site to the NTS for disposal. An increase in the shipment rate within the next 9 months is a must.

F. Ferrous and NonFerrous Scrap Metal Disposition

Basis - The current piles of metal contaminated with radioactive materials are a potential source of soil and rainwater contamination. Disposition of this material in the immediate future is desirable to remove a potential source of contamination.

G. Improve Air Pollution Control

- Replace and upgrade dust collection system and filters.

- Particulate collection system replacement.

Basis - The project is necessary to further reduce the amount of uranium emitted daily via the air stacks.

H. RI/FS Program (Remedial Investigation/Feasibility Study)

Basis - Without this program, the goals and objectives for a comprehensive waste management plan cannot be obtained. The development and specification of needed waste management projects will not be possible without a complete understanding of the problems.

I. Storage Planning (Warehouses & Pads)

Basis - Numerous warehouses and pads have been requested by various plants. An integrated approach should be taken to evaluate the needs, both present and future, of the various plants and whether a single warehouse or pad could serve multiple uses. After this evaluation is completed, then the correct number, types and sizes of warehouses and pads can be specified, with a firm basis for each.

J. Thorium Material Disposition

Basis - Final disposition of the material is necessary for reducing operator exposures due to maintaining the thorium storage and for eliminating the continuing expense of maintaining the thorium in storage.

K. Waste Inventory Management & Control

Basis - Efforts need to begin within the next 9 months to assure that the needs for a waste inventory management and control are integrated with any accountability control system.

L. Disposition of Contaminated Pallets

Basis - The pile of contaminated pallets presents both an eyesore and a source of surface water and soil contamination. This source must be removed for cleanup programs to be effective. It was indicated that NTS would accept the pallets if we stacked them, tied them together, and shipped them in a strong tight box.

M. Upgrade Waste Management Plan and ES&H Plan

Basis - Necessary revisions to more clearly identify the scope, requirements and goals of the Waste Management Programs.

II. WORK TASKS

A. REVIEW WASTE MANAGEMENT PROGRAMS AND ISSUES (MEET WITH DOE)

1. Findings

- a. These reviews have provided the information necessary for WMCO to:

Prepare the 1986 nine month plan.

Assume responsibility for these programs on 1/1/86.

Identify program and organizational needs.

Make recommendations on program/project changes and improvements.

- b. These reviews of the programs and projects are an ongoing and continuing effort.

2. Recommendations

- a. Increase in-house engineering effort to provide better management and continuity of programs.
- b. Place more emphasis on meeting scheduled commitments.
- c. Instill greater initiative to resolve waste management problems by use of new methods and concepts e.g. reduce waste generation; new materials use.

3. Corrective Actions

- a. General corrective actions include:

General improvement and clarification of the ES&H Plan and The Waste Management Plans. Expand Waste Management Engineering Organization to size necessary to satisfactorily complete the necessary programs.

B. REVIEW OF THE ENVIRONMENT, SAFETY AND HEALTH MANAGEMENT PLAN

This requires a review of the Environmental, Safety, and Health (ES&H) Management Plan with special emphasis on the capital expenditure estimates. The purpose of the review is to see if the proposed expenditures and priorities are consistent with NLO, DOE, and WMCO objectives, which according to public statements, strongly emphasize reduction of generated wastes.

Occupational skin doses, both collective and individual, have been increasing over the last few years. Sixty-seven percent of these doses occur in Buildings 5 (melt shop), 9 (special products) and 6 (metals fabrication). In several areas of the plant, average skin, extremity and internal doses reach a significant fraction of DOE limits. These levels are generally higher than those found at other commercial and DOE facilities. Considering these dose trends, a significant part of the ES&H Management Plan (the Plan) should be directed toward reducing radiation exposure at FMPC.

1. Findings

a. Ventilation and Dust Collection

Ventilation and dust collection upgrades are appropriately identified as priority projects. These projects also have the highest capital expenditures. The expenditures for dust collectors reflect mostly direct replacement of existing equipment. Cost-saving measures, such as combining effluent paths, are not mentioned. The ventilation upgrade proposes a study of the current system. Combining exhausts from various processes is mentioned. However, it is not clear how well the ventilation upgrade program is coordinated with other FMPC projects. For example, the Productivity Retention Program (PRP) will result in source reduction and possibly work station changes. These improvements should reduce ventilation system requirements and costs.

b. Research and Development

Much of the R&D effort involves studying and fine-tuning existing or planned pollutions abatement and waste processes. Examples include testing and evaluating filters, optimizing the biodenitrification process, evaluating solid-liquid separation processes, and employing remote systems near radiation sources. Although these programs are useful, they focus on the waste after generation, not on the source. Sources that generate significant airborne radioactivity include uranium chip fires and melting pot blowouts.

c. High Benefit/Cost Projects

The Plan contains some relatively inexpensive projects that can have a large impact on containing radioactivity and reducing worker exposure, thus meeting DOE/WMCO objectives. These projects, however, have relatively low priority:

Installing wash basins at process area
break rooms - priority 35

Respirator washing facility - priority 73

d. ES&H Plan Priorities

There are several inconsistencies in the Plan priorities. For example, the Lockwood-Green conceptual design report refers to the ES&H improvement line item as "urgently needed" to assure compliance with regulations. However, the subprograms of this line item are found dispersed among several other programs, and not at the top of the priority list as one would expect. In some cases, the "urgency" implied by priority number, appears inconsistent with the implementation date. For example, reducing uranium in off-site wells has priority number 2, but a start date of 1990. There are other examples where the priority number seems inconsistent with DOE priorities and what plant personnel are actually working on.

In the executive summary of the Plan all projects are listed in order of priority. This has the undesirable effect of immediately focusing the reader's attention on the relative standing of the separate projects rather than the overall program.

e. ES&H Plan Editorial Improvements

Several similar projects are listed separately. For example, plant 9 "derby cleaning" and "NO destructors" could be combined as "plant 9 NO emission control." Also, the reader is immediately faced with 120 separate projects without a framework that fits them together.

Some projects appear to be more of a study than a capital project. An example is removal of uranium from storm water. While it may be appropriate to address the issue in the Plan,

it seems premature to project a \$6M line item for 1990 without knowing what the results of the study will be.

2. Recommendations

a. Ventilation and Dust Collection

Current efforts to combine certain dust collectors should be acknowledged in the EH&S Plan. Resources should be made available to investigate further effluent path consolidation. The Plan writeup and cost estimate should reflect further streamlining of the dust collection system.

The scope of the ventilation system survey should be expanded to consider the interfaces with the dust collection system, the Productivity Retention Program upgrades and possible work station improvements. This "system" approach is likely to reduce the cost.

b. Research and Development

It is suggested that some of the R&D effort should be channeled to reducing waste at the source. Specifically, analyze the causes of and formulate corrective actions for magnesium flashes, blowouts, and chip fires.

c. High Benefit/Cost Projects

Funds should be channeled into low-cost, high-visibility contamination control projects such as installing wash basins at break areas and establishing a respirator washing facility. These programs should have high priority.

More programs such as these will be identified and implemented. This is an area where plant workers could get involved most effectively. Worker involvement could be encouraged through suggestion boxes and cash awards for good ideas.

d. ES&H Plan Priorities

WMCO, must develop acceptable waste management project priorities, including the bases for the judgements. This is especially important considering potential budgetary constraints.

It may not be necessary to advertise the rankings in the final ES&H plan. The environmental plan for the Y-12 plant, for example, does not have priority numbers attached to programs. Moreover, in the Y-12 executive summary, programs are summarized separately as air, water, solid, etc. Ranking the programs in each category separately would alleviate having to choose, for example, an air pollution program over a solid waste project.

The following specific changes in priority are recommended:

K-65 Silo - Remediation projects dealing with the silo contents and the surrounding area should have increased priority, reflecting the likely impact of the recent public announcement on the structural stability of the silos. The starting dates for these activities should also be moved up.

Thorium Removal - The Plan addresses thorium stored in silos near plant 8. A more immediate concern is the thorium stored in deteriorating drums at various locations around the plant. The Plan should address this situation and increase the priority.

The metal scrap piles are visually offensive. However, there appears to be no evidence that they are a major contribution to pollution; nor do they represent a major radiation source. These piles are slowly being processed, and the extent to which they may be a hazard will be determined. The priority for these projects could be decreased.

e. ES&H Plan Editorial Improvements

Several of the projects should be combined. This would give the Plan a more integrated appearance. Areas for suggested consolidation include:

NO Destructors

Warehouses

Incinerators

Storage Pads

Flow charts should be used showing how the various projects fit together. This would be especially useful in the executive overview. A separate chart should be used for each area (air, solid, water, remedial, etc.).

For projects which are more of a study than an actual construction or hardware procurement, (e.g., removal of uranium from storm water) the dollar estimates should not be projected but investigated by the waste management engineering groups with recommendations and resolutions.

3. Corrective Actions

- a. Incorporate agreed-upon editorial recommendation into the next ES&H plan draft.
- b. Channel resources into studies to investigate streamlining the proposed dust collection and ventilation system upgrades, and consolidating the various storage pads, warehouse, etc.
- c. Develop a consensus on FMPC priorities and document these in the next draft of the Plan.

- d. Begin shifting R&D resources and priorities towards source reduction rather than pollution abatement.
 - e. Start getting the workers involved in radiation protection and contamination control projects. Solicit their ideas through suggestion boxes and cash awards for good ideas.
- C. EVALUATE THE HANDLING OF FMPC PROCESS WASTES AND OTHER HAZARDOUS MATERIAL AS RELATED TO COMPLIANCE WITH DOE, EPA, AND OHIO STATE REGULATIONS.

1. Findings

Significant improvements have been made through administrative controls to reduce the amount of uranium released to the atmosphere via the stacks and a number of dust collector replacement or upgrades have been included in budget proposals (ES&H Line Item). These improvements will enhance FMPC compliance with more stringent NESHAP regulations (25 mrem/yr whole body and 75 mrem/yr organ doses).

The liquid waste streams at FMPC are treated prior to discharge to the Great Miami River under normal situations. During periods of heavy rainfall, excess water from the storm water system is discharged eventually into Paddy's Run and has been identified by the Dames & Moore study as the major source for above background concentrations of uranium in the groundwater system south of the FMPC site. The FMPC cannot meet the revised limits for nitrates in liquid effluent until the biodenitrification system has been completed. As a result, FMPC continues to operate under the previous expired permits. Even with the expired permits, FMPC has had violations on occasion, particularly with hexavalent chromium and total suspended solids. The specific source of hexavalent chromium in the liquid effluent has not been identified nor has an explanation been developed as to why the concentration remains the same during heavy rainfall and subsequent large flowrates as it is during normal, lower flow rates.

Another finding regarding liquid effluents is that after treating the wastewater streams, they are pumped to Waste Pit 5 which then overflows to the clearwell and eventually to manhole 175. This treated water is being dumped into a pit containing waste sludge. This presents the opportunity for the treated water to become contaminated again.

The solid waste handling was reviewed primarily from the viewpoint of waste management in the waste pit and silo storage areas. The packaging of solid waste for shipment to NTS was reviewed briefly and found to be implementing excessive requirements in using DOT 7A spec drums when standard 55-gal. drums (less expensive) might be more appropriate and comply with the DOE and NTS criteria. In the waste pit area, the following observations were made:

- The monitoring program for alerting the operator within a reasonable time of a release from the pit or silo bottom does not satisfy the DOE and EPA requirements for early detection.

- The covers placed over the pits 1,2, & 3 do not comply with DOE and EPA regulations. These covers were not sloped properly nor were they constructed using low permeability material. As a result, these pits which have clay or rubber lined bottoms act as a bathtub and will result in a significant amount of leachate. The hydraulic head associated with this accumulation of leachate could be sufficient to result in the migration of leachate through the clay bottom and eventually into the groundwater supply.
- Oil containing uranium was poured onto the old fly ash pile as a test of possible methods of disposal of waste organic liquid. Also, production area rubble (bricks, concrete, etc.) containing radionuclides may have been placed in an area near the old fly ash pile.
- Uncontrolled seepage from the area of covered waste pits 1,2, & 3 was noticed a few days after a long period of rainfall. FMPC staff is not certain where the liquid is coming from.
- The toxicity testing of the material in all waste pits is to be accomplished as part of the RI/FS contract. This could result in pits other than #4 being classified as containing RCRA hazardous waste. This would contradict the FMPC RCRA Permit, part B application submitted to EPA the first of November 1983. The permit indicates that only pit 4 contains hazardous waste.
- FMPC personnel has maintained that the waste is only being stored in the waste pits but DOE correspondence refer to the pits as disposal sites. FMPC Waste Management pointed out that the RCRA Part B Application states that pit #4 is a disposal unit for hazardous waste.

- A number of discrepancies were noted while reviewing the RCRA Part B Permit Application submitted to EPA. For example, hazardous waste (barium chloride) is emptied from 55 gallon drums into a tank but no mention is made of what becomes of the drums contaminated with this hazardous material. Any drum cleaning would have to be included as part of the permit application. Another is the statement that any rainwater which collects in the pit is pumped into waste pit #5; however, waste pit #5 is not included in the permit for becoming a permitted unit. Unless the documentation, which proves that the water pumped to pit #5 does not contain hazardous material, is included in the permit, one would have to take the position that contamination is possible and that waste pit #5 should be a permitted facility. During an inspection of the waste pits a few days after a long period of rainfall, large pools of water in waste pit #4 were observed and no mechanism for pumping this water to pit #5 was in place. During periods of heavy rainfall or prolonged periods of rainfall, it would appear that water collecting in pit #4 could become contaminated with hazardous material (i.e. generate leachate) and subsequently leave the pit area and contaminate the surface and other areas the potentially contaminated material contacts.

Other findings relative to waste management and monitoring are as follows:

- Soil sampling practices at FMPC for determining the locations and degree of uranium concentration both on-site and off-site are not adequate. Only the top 2 inches (5cm) of soil was sampled at the various locations. Sampling deeper to assess the degree of uranium accumulation and transport through the soil is not a common practice.
- Waste sludge from a local firm (Albright & Wilson) was found to have elevated levels of uranium concentration (130-200 ppm). The sludge was analyzed by FMPC staff and found to contain U-236, thus leading FMPC staff to conclude that the presence of uranium is due to FMPC operations.

- EP Toxicity testing of the waste to be shipped to Nevada Test Site (NTS) has been performed to assure that FMPC is not shipping mixed waste to NTS acceptance criteria. i.e waste cannot contain any 40 CFR 261 (RCRA) hazardous waste.
- New projects, such as the Plant 8 kiln, seem to be using technology which will generate more waste streams. The off gas treatment system for the Plant 8 kiln, for example, could generate as much as four to six waste streams.
- Phase I report per DOE Order 5480.14, which addresses DOE implementation of CERCLA requirements, has not been prepared and it is due no later than April 26, 1986.
- A DOE limit of 10 ppb Pu/U ratio was imposed on FMPC as a processing limit (i.e. if the ratio is larger than 10 ppb, the material may not be processed at FMPC). This limit has resulted in no further drying and shipping to NTS of some wastes. Details on the basis this limit were not available.

Findings and recommendations applicable to this work task can also be found in Section 4 relating to the Environmental, Safety, and Health activity.

Recommendations: The following recommendations will provide the corrective actions necessary for addressing, and in a number of cases resolving, the findings identified above;

- A comprehensive Waste Management Program (WMP) should be developed prior to FY-87 in order to form the proper basis for the new waste management activities identified as being needed and to provide input to operations relative to training and revisions to operating practices. The WMP should be expanded to include the following:
- The goals and objectives for FMPC.
- The current situation (detailed assessment), applicable regulatory requirements and limits, the details regarding a waste minimization program, means for assuring that the program is implemented and adhered to properly by other organizational units, the monitoring requirements and reference to the applicable programs implementing them, and other

necessary elements for providing a comprehensive program.

- An Environmental ALARA Program should be established and documented concurrent with efforts to baseline (i.e. characterize) the FMPC site.
- Waste Management should manage RI/FS on-site, to establish the data needs (including EP Toxicity data) and plan, and to assure the timely, successful completion of the RI/FS contract. This data is essential for characterizing the FMPC site.
- Plant wide inspections should be made to identify potential fugitive emission sources which could be eliminated or minimized.
- Engineering projects directed at minimizing air emissions (e.g. dust collector improvements) and other environmental pollutants should continue. A study is recommended on means to consolidate stacks with one or more central off-gas systems. Combinations of stacks could be accomplished downstream of baghouse so as to maintain the recovery capabilities of the various baghouses.
- A plan should be established on how radioactive and hazardous mixed waste generated off-site will be handled and/or stored.
- The need to discharge treated wastewater to waste pit #5 should be assessed and a position established as to whether it must be discharged to the pit or not.
- Significant effort should be expended to either complete the biodenitrification system or provide an alternate method for denitrification.
- The source of hexavalent chromium in the liquid effluent and the mechanism of its excursion should be established immediately.
- The Environmental Monitoring Program for FMPC should be upgraded to identify specific monitoring needs, bases, and means of accomplishing them. The program should be structured to assure compliance with DOE orders and EPA regulations. The results of this program should direct the need for monitoring upgrades, such as upgrading the waste pit area monitoring system to comply with regulations.

- After the covered waste pits have been characterized in the RI/FS contract effort, immediate efforts should be directed toward an interim solution to precluding rainwater infiltration into the pits and for bringing the covers into compliance with regulations.
- Administrative controls must be implemented to minimize the potential of contaminated materials from being placed or introduced into other areas, or systems, where only non-contaminated material is to be handled. This would include ashpiles, landfills, and the incinerator.
- The RCRA Part B Permit should be revised to eliminate discrepancies and to address the issues identified above. This effort should be done immediately in order to be in a better, more technically defensible position, particularly should EPA have significant comments. Once completed, the revised permit should be submitted to DOE for submittal to EPA with a letter explaining the differences between the two permits.
- The soil sampling program should be upgraded and documented to include requirements for further, deeper sampling should contamination in the top 2 inches of soil be discovered. Details regarding how deeper samples are to be taken should be developed, verified, and documented.
- New project designs and operational changes should be reviewed by Waste Management and ES&H personnel to assure that best available technology is being utilized in an effort to both minimize the amount of waste generated and minimize the effluents to the environment. Administrative procedures should be developed and implemented for assuring that the proper staff review new designs and proposed operational changes.
- The Phase I CERCLA report entitled "Installation Assessment Report" should be completed for internal review as soon as practical. The report content and outline should comply with DOE Order 5480.14. A program plan and schedule for completing the remaining reports and efforts identified in this order should also be developed and submitted to DOE, preferably with the Phase I report.

- Waste Management Engineering personnel should establish a position paper on the issue of the 10 ppb PU/U ratio and propose the position to DOE. Close coordination with DOE on this issue is essential for assuring acceptance of the position.

Corrective Actions:

Corrective actions have been detailed in the above recommendations. During the transition phase, efforts were initiated to begin identifying the source of the problem associated with the hexavalent chromium NPDES violations. Efforts were also initiated with DOE to resolve and establish an FMPC position relative to the 10 ppb Pu/U ratio.

D. INITIATE PLAN FOR BRINGING WASTE MANAGEMENT INTO COMPLIANCE.

The report of the investigations performed in this section have been added to the appropriate sections including sections B,C,F,G and H. A combined, overall Waste Management plan will be developed during the remaining periods of FY86.

E. IDENTIFY WASTE MANAGEMENT PERSONNEL & DEVELOP ORGANIZATION

1. Findings

It was found that additional Engineers and Managers need to be assigned to the Waste Management programs to perform the tasks necessary to meet the goals and objectives for maintaining air liquid and solid wastes.

2. Recommendations

In order to resolve the present deficiencies in Waste Management programs it is recommended that added engineering effort be applied. This will permit:

Adequate management and control of all wastes.

Adequate monitoring of subcontracted line item programs.

Improved in-house engineering of more programs for greater efficiencies and improve continuity from program to program.

MANAGEMENT POSITIONS
CI - CANDIDATE IDENTIFIED
NCI - NO CANDIDATE IDENTIFIED
ENGINEERING POSITIONS
E - EXISTING
N - NEED TO HIRE

Waste Management Staffing Anticipated
For September 1986
(Based on Cost Account)
TABLE E-1

3. Corrective Actions

Actions are being taken to add to the existing staff to be as outlined below:

	<u>Mgr.</u>	<u>Secy.</u>	<u>Engrs.</u>	<u>Tech.</u>
<u>General Management</u>	2	1	0	0
<u>Line Items</u>	1	1	10	0
<u>Waste Programs Admin.</u>	1	1	7	4
<u>Waste Systems Engr.</u>	1	1	13	1
<u>Capital Projects</u>	1	1	10	0
<u>Waste Operations</u>				
TOTAL	6	5	40	5

Preliminary definition of an organizational chart is shown table E-1.

F. REVIEW OF WATER POLLUTION CONTROL PROJECTS

This summary covers three areas for this transition report. These include:

Present understanding of the site ground water system and future directions of investigation.

Liners of two impoundments currently under construction at the site.

Area 1-Site Ground Water System

Present understanding of the site groundwater system and future directions of investigation.

1. Findings

The hydrogeological environment at FMPC is very interesting, straight forward and potentially modelable. The site is located for the most part, atop the New Haven Trough. This trough is a large, ancestral river valley filled with glacial outwash sand and gravel. The Great Miami River cuts its way through this material in the area and sand and gravel operations on its banks are evident. In the immediate site vicinity, the sand and gravel is overlain by a silty glacial till. The till has pockets of higher permeability and lower permeability and frequently perches water observed in local shallow wells.

The sand and gravel deposit is the main aquifer in the region. The aquifer is physically divided into an upper and lower half by a 10-foot bed of clay which reportedly perches out to the east near the Eastern FMPC boundary. Groundwater flow is through the site to the south and to the east to ultimately discharge to the Great Miami River (References 1, 2). A portion of Reference 2 that provides a good summary of the site geology and hydrogeology is shown in appendix A.

Three off-site wells have been found to contain above background levels of uranium; however wells in the same hydrogeologic unit, upgradient of these wells contain background levels of uranium. The source of the uranium is theorized to be storm runoff from the storm sewer outfall ditch and Paddys Run downslope of the waste area. Water in the ditch and Paddy's Run percolates to the aquifer at those points where the clay bottom grades into porous sand and gravel. The similarity in uranium concentrations measured in water flowing from the storm sewer outlet with those measured in the contaminated wells supports this transportation scenario (Reference 2).

The Dames and Moore Task C Report (Reference 2) presents a good summary of the available information and adequately and methodically addresses the above background levels of uranium in the off site wells. It does not present an adequate picture of the following:

- a. Complete extent and boundaries of the groundwater flow system.
- b. Impact of the geochemistry of Uranium upon uranium transportation and concentration in the meteoric, surface, vadose and groundwaters, and
- c. Extent of the plume down gradient of the three off site wells containing above background levels of uranium.

The writers of the report did, to their credit, identify these three items as recommended additional areas for study. They also in addition identified the need for a better understanding of surface flow regimes on site.

A Remedial Investigation and Feasibility Study (RIFS) contract will soon be authorized to study the Waste Storage Area and its problems. As seen in the RFP and the offered technical scopes, the RIFS work will focus on the waste area and not areas east and south of the site.

2. Recommendations

There are two areas of information that must be developed before any remedial action is directed to any on-site waste problems. They are:

- a. Develop an understanding of the local regional groundwater flow system from the recharge boundaries through the site to the Great Miami River. The D&M groundwater study recommends this in effect by calling for definition of eastern groundwater divide and extent of the Uranium plume south of the three off-site wells containing above background levels of uranium. The RIFS Study doesn't adequately address this issue. We should understand and be able to model the complete flow system before we commit to specific remedial actions at the site.
- b. Develop sufficient understanding of the geochemistry of the contaminants and the earth media interacting with them to enable prediction of the impact of sorption/desorption on continued contamination or remediation of the aquifers, vadose zones and soil systems. D&M also called for this and the RIFS study may adequately address the issue. Mobility of Uranium, for example, is controlled by pH, oxidation reduction potential (indexed by dissolved O_2 , Fe^{+2} concentration, etc.) and pCO_2 or total carbonate species concentration. Hence uranium transportation around the site must be examined in the geochemical context.

The first item should be addressed by a firm with demonstrated expertise in groundwater modeling. Geotrans, Inc. has prepared a report requested by Ohio EPA which develops a preliminary groundwater system flow model (Reference 3). The authors identify data deficiencies including water level data northwest and east of the site, vertical gradient data, geochemical distribution data and no data for species other than uranium. The authors propose to rectify this situation, improve the monitoring system for about a million dollars. They are an experienced firm with a good reputation and they specialize in groundwater system modeling. This type of expertise should be used to develop a groundwater model of the regional system.

The second item is covered by the RIFS workscope and can be addressed by any consulting firm with groundwater geochemical experience.

The following areas of information are a slightly lower priority than the two above areas:

- a. Sampling soil to identify stream bank Uranium storage and recharge areas of for contaminated water. This is also called for in the D&M study.
- b. Develop an understanding of the groundwater flow system in the waste storage area and its interaction with the regional groundwater system.

We should move deliberately to get the best possible understanding of waste transportation geochemistry and the groundwater flow system model before we commit to any alternative to remedy the major existing on site waste problems. This will enable us to as accurately as possible predict the consequences of the on-site disposal, waste treatment or other remedial action.

3. Corrective Actions

These actions are listed with the highest priority first.

- a. Short Term
 1. Model the regional groundwater flow system within and around the FMPC site.
 2. Develop an understanding of the geochemistry of the contaminants and their interaction with the site soil, vadose water and groundwater.

b. Long Term

1. Develop an understanding of the groundwater flow system in the waste storage area.
2. Apply the above three actions to the solution of specific site waste problems.
3. Sample soil to identify stream bank uranium storage and recharge areas.

References:

1. Sedam, A.C., "Occurrence of Uranium in Groundwater in the Vicinity of the USDOE FMPC, Fernald, Ohio", USGS Administrative Report prepared for USDOE, Columbus, Ohio, 1984.
2. "Groundwater Study-Task C Report", prepared by Dames and Moore for NLO, Inc., July 1985.
3. Anon, "Preliminary Characterization of the Groundwater Flow System Near the FMPC, Great Miami River Valley - Fill Aquifer, Fernald, Ohio", prepared for OEPA by Geotrans, Inc., Herndon, VA.

Area 2-Liners of impoundments currently under construction at the site.

1. Findings

During a tour of the site given on November 22, 1985, the partially completed liners in the new clear well/treatment pond for the waste storage area and the storm water retention pond were examined. It appears that although a non-reinforced (with fabric), polymeric liner is being installed, possibly in combination with a bentonite liner, a membrane failure monitoring system is apparently not included.

2. Recommendations

The lining system should incorporate into it a:

- a. leak detection system and
- b. a vadose liquid sampling system.

This is required in both impoundments because both will contain liquid wastes from time to time.

A sense of regulatory requirements for impoundment liners currently placed upon industry is presented in an article that appeared in July/August 1985 issue of the Hazardous Waste Consultant. A copy of this article is appended. Section 202 of the Hazardous and Solid Waste Amendment (HSWA) sets the minimum requirement for impoundment liners. This standard is depicted in Figure 2 in the Appendix. The author of the article uses Figure 4 to depict the type of liner that EPA believes is preferable to the HSWA liner. Figure 2 is the present minimum acceptable liner and Figure 4 is a likely near term future minimum requirement for an impoundment liner.

3. Corrective Action

- a. Short Term - review the design-motivating considerations and the design of the present underway installation and put a hold on construction until this is done.
- b. Long Term
 1. For all potential waste-containing impoundments on site require a leak detection and sampling capability in accordance with existing local, state and federal regulations governing waste impoundments.
 2. Construct these above-mentioned impoundments to meet these requirements.

Area 3-Biodenitrification Facility

1. Findings

In principal, the decision to prepare the Biodenitrification Facility for operation as a pilot plant demonstration unit is supported by Westinghouse. This appears to be a rational approach and perhaps the only viable one considering the situation with the Ohio EPA. A critical item that must be accomplished quickly is the construction cost estimate by RUST. The project may be in a better (or worse) situation financially depending on this estimate. Another critical item is the need to proceed with the instrumentation procurement and installation since this will be the schedule limiting item for start-up. (i.e., operational testing and release of the system for start of the actual pilot plant operation.)

2. Recommendations

Proceed with the program of construction and testing of the facility with adequate documentation of project requirements. Also, the goal is to complete construction within cost and schedular limits.

3. Corrective Actions

Ensure that the following items are addressed:

- a. Are there procedures established to control the interfaces between NLO, RUST, Lockwood-Greene, and DOE? There seemed to be a lack of understanding on how comments (and drawings) were transmitted, reviewed and resolved.
- b. What are the project management controls? The project's schedular concerns now appear to be dictating the design.
- c. Has the pilot plant equipment, facility functional checks and release for pilot plant testing been defined? Nothing will work the first time. Who is following this work, and has this been factored into the schedule?
- d. Has the testing program (design of experiment) for pilot plant operations been prepared? There was no indication that the schedule or fundamental information needed for "proof" of the system concept has been identified. This could influence both the process control and sampler design needs significantly.
- e. Who will prepare the operating procedures and will they be reviewed by Production Operations?

- f. Will operating personnel be available and trained to:

Remove the calcium from the feed solution?

Tailor the chemistry of the feed solution to the testing programs needs?

Supply the personnel necessary to support testing?

Receive the waste stream from the BDN testing program?

G. EVALUATE STORAGE SITUATION FOR THORIA AT FMPC

1. Findings

The FMPC Thorium inventory is given in table 1 in Appendix B. The table also includes available known information regarding the characteristics of the materials. This information is the result of communications with Messers Gessiness, Flemming, Adams and Leist. The inventory represents the complete range of intermediate and final forms of thorium that result from thorium processing. In a discussion with Mr. Adams on November 22, 1985, the Brazilian Sludge and the Plant 8 Silo were identified as the most acute problems and that the Brazilian Sludge drums should be overpacked for shipment off site. This operation could be a potential media and employee-relations problem.

2. Recommendations

The recommendation is to detail a "plan or group of plans for the Disposition of Thorium Materials". The first two steps in this planning process is to develop a plan to characterize each lot of Thorium materials and classify the Thorium materials on site into one of the four following groups.

- a. Waste, or
- b. Materials for recycle or sale, or
- c. Materials retained for consideration of chemical processing to upgrade material for sale or recycle, or
- d. Materials to be retained indefinitely.

The third step of the planning process requires assignment of priorities to the disposition of these materials based on the following criteria listed from the most to least important:

- a. Vulnerability of the material in its existing form to release to and subsequent transportation or migration within the site and surrounding environments.
- b. Radiation hazard,
- c. Quantity of material,
- d. Condition of storage container(s), and
- e. Market conditions (demand) for the material (excepting the waste category).

The fourth step is development of a specific program plan for each Thorium material classification category. The fifth and final step in this planning process is the formulation of the overall Thorium materials disposition plan.

A detailed draft of this plan to deal with site Thorium materials is appended.

3. Corrective Actions

- a. Short Term - A preliminary excursion through the above recommended plan has produced tentative priorities for disposition of on site Thorium materials. This prioritization ignored missing data indicated by blank spaces in Table 1. Therefore short term action should constitute steps to acquire missing data on Thorium materials in four areas:

- 1. Significant mechanical properties
- 2. as-is leachability
- 3. Composition of impurities
- 4. container type, size and condition

Following data acquisition, the Thorium materials should be classified and priorities for disposition should be determined.

Complete each of the program plans called for by each Thorium material classification category and formulate the site wide Thorium materials disposition plan.

- b. Long Term - Implement the actions called for by the site-wide thorium materials disposition plan.

H. EVALUATE K-65 SILOS AND OTHER WASTE STORAGE AREA PROBLEMS

1. Findings

Residues from processing Katangan pitchblende are stored in the two earth-bermed silos located in the waste storage area. The two silos were filled during the period from 1952-1959 with the residue in the form of an aqueous slurry. The waste consists primarily of RaSO_4 with Mn, Ba, Na, Fe, Al and U and traces of many precious metals such as Au, Pt, Ag and Pd. The value of these precious metals has been estimated near \$5,000,000.

Appendix 1 of the Bechtel RI/FS proposal (Technical) has a summary of K-65 silo activity prepared and documented with copies of memoranda from the 1950's operational period. These documents indicate that some oil may also be present in the residues. For approximately three years the silos were observed "seeping" and in June 1958 one of the K-65 silos was observed to be cracked. The cracks leaked and the water in the silos was decanted and disposed of in the sewer system. Solids did not flow through the cracks.

A structural analysis has been performed on the K-65 silos. An ultrasonic probing technique was used to determine the condition of the concrete in the silo domes and walls. The results from the study indicate that the central portion of the K-65 domes are not structurally sound. Radon escaping from cracks in the dome are causing detectable radiation readings off-site. It was also found that while the side walls and base of the silos are structurally sound, there are cracks in the structures which could be a source of groundwater contamination. The walls are stable because the waste and the embankment provide forces on the walls that counteract each other.

The structural analysts recommended that:

- a. Any withdrawal of waste be paralleled by an equal removal of bermed soil outside the silo in order to preclude failure due to lateral loading.
- b. Precautions should be taken to prevent substantial snowloads on the critical portions of the domes.

- c. The walls and base slab are structurally acceptable, however, the domes are not structural adequate.
- d. A temporary, self-supporting cover over the dome to attenuate Rn release, seepage of moisture and possibly to act as a work support platform should be installed.

Radiation readings are elevated at the Western FMPC boundary to about 375 mRem/year whole body. This is understood to be gamma radiation. It is not clear whether it is direct, through-the-dome radiation or indirect, i.e., refracted by the atmosphere, or coming from escaped Rn and daughter products in the air and the soil surrounding the tank.

2. Recommendations

- a. Take immediate action to prevent failure of the silo domes.
- b. Take immediate action to characterize the radiation sources in and around the K-65 silos.
- c. Initiate silo remedial action plan as defined.
 - 1. Develop understanding of waste area aqueous geochemistry.
 - 2. Decrease the FMPC western boundary radiation problem associated with K-65 silos.

3. Corrective Actions

The following list of actions or activities should be performed with the priority indicated by the sequence that follows. Suggested solutions are listed with the activities where available and appropriate.

Immediate and short-term activities are now being implemented to address the K-65 silo problem. Immediate activities include frequent monitoring of the silo dome and provisions for preventing snow build-up.

a. Short Term

1. Protect Silo Domes Against Snow Loads and Meteoric Water Infiltration. This is currently under consideration as a high priority. A heat source is envisioned that can be activated to keep ice or snow from accumulating. A slippery cover could also be used in conjunction with heating.
2. Characterize Radiation Source Materials in Silo Area. Sources of the FMPC western boundary readings should be located and identified by thorough characterization of the tank contents, berm and under-tank soils, and the air environment surrounding the silos. Non-radioactive hazards should also be considered if present in the waste.

b. Long Term

Ultimately, the silo residue will have to be removed from the silos and either stored on site or, preferably, shipped to a disposal facility. The silo residues are mainly a result of processing high grade uranium ore that was purchased by the U.S. government for use in the Manhattan Project. Therefore, this material could be shipped, after appropriate packaging, to the Nevada Test Site (NTS) for recoverable storage.

1. Waste Area Aqueous Geochemistry. Vadose and groundwater geochemistry of the waste disposal area should be examined and understood so that the susceptibility of the waste materials in the silos to groundwater-borne transportation can be evaluated. This is also emphasized later for the site-wide groundwater environment.
2. Decrease the Radiation Problem at the FMPC Western Boundary. A cost, technical and environmentally effective decision can be made here after item 2 is completed. Possible solutions include shielding, soil removal, or extension of site western boundary further to the west to achieve acceptable radiation levels.

3. Develop Alternatives to Deal with K-65 Waste. In light of the information developed during performance of items 2 and 3, all feasible alternative means to dispose of the K-65 wastes should be developed and examined. Two broad categories, on site and off site disposal are envisioned. Within these broad categories numerous solutions or combinations of solutions may be possible. This item may receive input from subcontractors addressing structural, geotechnical and environmental issues (Camargo, RIFS awardee, etc.) related to the silos and the waste storage area. Complete solutions are required; for example, off site disposal alternatives must have a certified place to dispose of the waste.
4. Compare Alternatives and Select Best Solution. Use technical feasibility, cost effectiveness and environmental acceptability as screens or points for comparison of the various alternatives. In light of the comparison, select the best solution.

Note that parts of Items 3 and 4 may be within the scope of the RIFS activity as it presently exists.

III. SUMMARY

During the transition period WMCO examined the present condition and future plans for Waste Management Engineering at the Feed Material Production Center (FMPC). The frank discussions and the extensive support from both the DOE organization and the NLO personnel were valuable and much appreciated; without this active assistance, the transition of responsibility would have been much more difficult.

As expected, extensive deficiencies were found in Waste Management at FMPC. The causes for these deficiencies may be due to a multitude of factors, the more significant of which are believed to be:

Funding limitations

A pre-environmental-activism philosophy that did not proceed into present day environmental philosophy perhaps due to its defense related isolation from public attention.

Less than aggressive management which may not have placed sufficiently high priority on the Waste Management area of the FMPC operations.

WMCO's intention is to use the appreciable core knowledge from the NLO organization and from the DOE personnel along with a number of newly hired engineers (experienced in waste management) to create a revitalized Waste Management Engineering organization.

This revitalized infrastructure along with reasonably adequate funding is necessary to resolve the Waste Management deficiencies.

APPENDIX A

REGULATORY ISSUES

EPA TAKES STEPS TO IMPLEMENT HSWA: MASSIVE NEW PROGRAM FORESEEN

EPA regional offices are struggling to implement some of the new requirements of the Hazardous and Solid Waste Amendments of 1984 (HSWA). We recently attended a briefing in Region VIII in which the most important of these new requirements were explained to representatives of the oil and gas industry. This briefing confirmed our prior beliefs that the RCRA-regulated community is in for some surprises. In this article, we summarize the most important information presented at the briefing and add our impressions of what's coming up.

Since this information was based on an oral briefing, we have to say that we cannot cite any written regulations or guidance for our readers to refer to for more detailed information. No such guidance or documentation yet exists. In addition, information presented by regional officials dealt almost exclusively with "EPA's latest thinking." Very little assurance exists that the "latest thinking" will not continue to evolve.

SOLID WASTE MANAGEMENT UNITS: BIG TROUBLE

The coverage of RCRA is being expanded significantly by incorporating the concept of "solid waste management units" (SMU's). Many interim status facilities that have had only minimal involvement with RCRA in the past may now be looking at major new requirements.

Background

Two sections of HSWA are critical to understanding the importance being placed on SMU's: Section 206 (which adds Section 3004 (u) to RCRA); and Section 233 (which adds Section 3008(h) to RCRA).

Section 206 states:

"Continuing Releases at Permitted Facilities - Standards promulgated under this section shall require, and a permit issued after the date of enactment of the Hazardous and Solid Waste Amendments of 1984 by the Administrator or a State shall require, corrective action for all releases of hazardous waste or constituents from any solid waste management unit at a treatment, storage, or disposal facil-

ity seeking a permit under this subtitle, regardless of the time at which waste was placed in such unit. Permits issued under section 3005 shall contain schedules of compliance for such corrective action (where such corrective action cannot be completed prior to issuance of the permit) and assurances of financial responsibility for completing such corrective action." [Emphasis added]

Section 233 provides EPA with the appropriate enforcement tools to see that the corrective actions are taken:

"Interim Status Corrective Action Orders - (1) Whenever on the basis of any information the Administrator determines that there is or has been a release of hazardous waste into the environment from a facility authorized to operate under section 3005(e) of this subtitle [interim status], the Administrator may issue an order requiring corrective action or such other response measure as he deems necessary to protect human health or the environment or the Administrator may commence a civil action in the United States district court in the district in which the facility is located for appropriate relief, including a temporary or permanent injunction.

"(2) Any order issued under this subsection may include a suspension or revocation of authorization to operate under section 3005(e) of this subtitle, shall state with reasonable specificity the nature of the required corrective action or other response measure, and shall specify a time for compliance. If any person named in an order fails to comply with the order, the Administrator may assess, and such person shall be liable to the United States for, a civil penalty in an amount not to exceed \$25,000 for each day of noncompliance with the order."

SMU's Bring Entire Facilities Under Regulation

The importance of SMU's can be explained with an example. Up the Creek, Inc. (Creek) is a manufacturing facility that has been located at its present site since 1913. During that time, wastes (not necessarily hazardous wastes) have been de-

posited in various landfills on the site. Wastewater has also been processed in a series of surface impoundments, with discharges regulated under the NPDES program. None of these landfills or impoundments were lined, and over the years, some of the contents of these units have probably migrated into the ground water.

On November 19, 1980, Creek notified EPA that they were a hazardous waste storage facility because they stored some hazardous wastes for more than 90 days. The facility has been operating under interim status since that time, and its only concern with RCRA involved the generator standards and storage standards. None of the pits, landfills, or surface impoundments received RCRA hazardous wastes, and were therefore not RCRA-regulated units.

EPA now requires Creek to submit its Part B permit application. Creek is also requested to identify any SMU's on the site. This includes any "unit" where wastes are located, with or without hazardous wastes or hazardous constituents. Examples of such facilities are: sumps, landfills, recycling operations, land treatment areas, wastewater treatment ponds with NPDES permits for the outfall, areas where raw materials or products have been spilled and not cleaned up, and units that have not been properly closed under RCRA.

Creek tells EPA about the landfills and surface impoundments on the site. A preliminary assessment/site investigation is then conducted to determine if continuing releases of hazardous constituents are occurring from the SMU's.

Unfortunately for Creek, the unlined surface impoundments are found to have leaked into the ground water (hence, a release has occurred). The contaminants in the ground water are hazardous constituents (i.e., they are among the 350+ chemicals listed in Appendix VIII of 40 CFR Part 261).

If EPA determines this release to be a threat to human health or the environment, they can require Creek to take corrective action to deal with the problem. Two options would be available for Creek's surface impoundments. First, the source of the release could be eliminated by closing the impoundments. This would probably involve excavating all of the waste from the impoundments, along with underlying contaminated soil. If deemed necessary, this could also involve cleaning up the contaminated ground water.

If Creek wants to continue using the impoundments, it could line them to prevent future releases. (The liner standards that would apply to a SMU have not been determined, and may or may not be the same standards that apply to hazardous waste management units.) Ground-water cleanup may also be required under this option.

Associated with the corrective action are financial assurance requirements that assure that funds will be available to complete the corrective action. (The exact form of this financial assurance is still under development by EPA.)

General Considerations

In essence, by considering releases from SMU's, EPA is able to gain regulatory control over releases that might be occurring anywhere in a facility. They will no longer be limited to RCRA hazardous waste management units.

Additional factors that will affect corrective actions for releases from SMU's include:

- o "Releases" are being interpreted by EPA to follow the CERCLA definition: spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment. The release can be to air, soil, surface water, or ground water.
- o Application for a post closure permit (as well as a Part B permit) will trigger an assessment of solid waste management units.
- o Ground-water cleanup will probably be necessary if drinking water standards or ground-water protection standards are exceeded.

MINIMUM LINER STANDARDS

Section 202 of HSWA establishes minimum technological standards applicable to liners for landfills and surface impoundments. Figures 1 and 2 illustrate EPA's interpretation of the liner requirements as specified in the Act for landfills and surface impoundments, respectively. Basically, the landfill liner system consists of a flexible membrane liner (FML) over a compacted clay liner. Leachate collection systems are placed over the membrane liner and between the membrane and clay liners. The surface impoundment liner system is similar, except that only one leachate collection system is required.

Figure 1

SCHEMATIC DIAGRAM OF A HSWA DOUBLE LINER SYSTEM FOR A LANDFILL

Figure 2

SCHEMATIC DIAGRAM OF
A HSWA DOUBLE LINER SYSTEM FOR A SURFACE IMPOUNDMENT

EPA is skeptical about the ability of the "HSLA liner" to prevent leaks. The statute specifies that the clay liner be a minimum of 3-feet thick, with a maximum permeability of 10^{-7} cm/sec. Depending on the nature of the wastes, EPA believes that this liner may not be able to meet the performance standards specified in the Act.

The performance standards state that the top liner must "prevent the migration of any constituent into such liner during the period such facility remains in operation (including any post-closure monitoring period)." The lower liner must "prevent the migration of any constituent through such liner during [the operating and post-closure monitoring] period." EPA is therefore stating that if the HSLA liner system is used, the thickness of the clay is to be determined based on the breakthrough time of the specific waste leachate that might contact the clay liner.

The HSLA liner system can be used until EPA promulgates other standards. Figures 3 and 4 show EPA's current thinking on liner systems for landfills and surface impoundments that are preferable to the HSLA liners. These "composite" liners essentially consist of two flexible mem-

branes installed over compacted clay. Figure 5 shows a cross section of the composite liner for a landfill with appropriate dimensions and specifications.

Until such time as EPA promulgates standards for the composite liner system, owners/operators can install the HSLA liner. EPA will accept this liner if a "good faith demonstration" can be made that includes acceptable quality assurance data concerning the construction of the liner. This demonstration must be in accordance with procedures given in the soon-to-be-released publication "Construction Quality Assurance Plan for Construction of Liners."

REACTIVE SULFIDES: A VERY CONTROVERSIAL TOPIC

EPA headquarters is apparently avoiding making any difficult decisions regarding reactive sulfides. This issue is of critical importance to facilities that operate large wastewater treatment ponds. Since such ponds commonly occur in refineries, and since EPA Region VIII has a number of such refineries, the Region is out in front of the rest of the country in establishing a regulatory position on this issue.

Figure 4
SCHEMATIC DIAGRAM OF
A COMPOSITE DOUBLE LINER SYSTEM FOR A SURFACE IMPOUNDMENT

Basically, the problem is that large wastewater treatment ponds are likely to contain solids that have a significant sulfide concentration. The sulfides can be produced under anaerobic conditions such as might occur during periods of low aeration (e.g., winter operations). Sulfides are one of the materials that are specified as being a reactive waste and therefore subject to regulation under RCRA. Since it is very likely that most large wastewater treatment ponds contain some level of sulfides in the sludge, these ponds could potentially be hazardous waste surface impoundments subject to all RCRA requirements (including retrofitting with double liners by November 8, 1988).

The problem has been that EPA headquarters has not established a minimum sulfide concentration of concern. When asked for an interpretation on this issue, EPA headquarters issued a less than definitive opinion that sulfide concentrations above 200 ppm would probably be regulated, concentrations of 10 to 200 ppm might or might not be regulated, and <10 ppm would not be regulated.

When EPA Region VIII was pushed for a more definitive answer, they established a sulfide cutoff level of 20 ppm based on health considerations. At this concentration, most refinery wastewater treatment

impoundments will be considered to be regulated hazardous waste units. Obviously, the refining industry strenuously objects to this cutoff level and will undoubtedly seek to obtain a more favorable ruling from EPA headquarters.

WASTE MINIMIZATION CERTIFICATION

Beginning September 1, 1985 generators must certify on hazardous waste manifests that they have a program in place to reduce the volume and toxicity of their hazardous wastes (HSWA Section 224). EPA's current language for this certification is as follows:

"Unless I am a small quantity generator who has been exempted by statute or regulation from the duty to make a waste minimization certification under Section 3002(b) of RCRA, I also certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and I have selected the method of treatment, storage or disposal currently available to me which minimizes the present and future threat to human health and the environment."

EPA has not yet decided how much enforcement emphasis will be placed on determin-

Figure 5

SCHEMATIC PROFILE OF A COMPOSITE DOUBLE LINER SYSTEM FOR A LANDFILL

ing if the certifications are accurate. However, there appears to be a lack of enthusiasm in pursuing this issue and the presence of a signature by an appropriately authorized company official may be all that will be required.

Comment: The environmental regulatory process used to be simple. First, Congress defined the broad scope of new environmental programs in a statute. Second, EPA used the statutory language as guidance to develop regulations that actually implemented the statutory program.

The process is very different today. Congress has concluded that EPA is no longer capable of expeditiously implementing regulatory programs based on broad statutory guidance. Therefore, Congress now issues

extremely detailed environmental statutes that include a number of "hammers." These hammers make the programs self implementing if (and when) EPA fails to act.

It appears that EPA is no longer the major actor in the environmental regulatory process. Progress (or lack thereof) on the so called "codification rule" illustrates the problem. The codification rule is supposed to translate the requirements of the HSWA into regulatory language that will appear in the Code of Federal Regulations. Because HSWA is so detailed, this translation should be a straight forward process.

As we understand it, here's why almost no regulations implementing HSWA have been issued after nearly 8 months:

3.0 HYDROGEOLOGIC SETTING

This section of the Report describes the hydrogeologic setting of the FMPC. Information has been drawn from the available geologic literature (as indicated) as well as from the Dames & Moore site-specific field program.

3.1 Site Geologic Conditions

The FMPC is located in a two-mile wide valley filled with glacial deposits (Figure 3-1). This valley parallels the Great Miami River between the towns of Ross and Hooven, Ohio (Reference 9). A generalized geologic cross-section for the FMPC site area is presented in Figure 3-2.

The geologic history of the site area (as compiled from References 9, 10, and 11) can be summarized as follows:

- In Late Ordovician time (approximately 450 million years ago) sediments which would become a predominantly flat-lying shale with thin interbedded limestone were deposited in a shallow sea. This shale (a part of the Cincinnati Series) is the relatively impermeable bedrock which now underlies the FMPC site area.
- Sometime prior to, or perhaps contemporaneous with, Pleistocene glaciation, a large watercourse (larger than the present-day Great Miami River) cut its channel into this shale bedrock to a level of more than 200 feet below that of the present-day Great Miami River. This approximately two-mile wide channel (informally called the New Haven Trough) may be an abandoned course of the ancestral Ohio River.

- During subsequent Pleistocene glacial advances and retreats across the site area (Illinoisan-approximately 300,000 years to 400,000 years ago and Wisconsinan- approximately 100,000 years ago) the New Haven Trough was filled with about 200 feet of glacial sediments. These sediments were deposited by water running from the margins of the glaciers and consisted mainly of well sorted sand and gravel. Deposited on top of these sediments was a blanket of clay-rich, relatively impermeable glacial till from a more recent glacial event.

- Erosion by the Great Miami River and its tributaries then removed significant portions of the glacial till and left terrace remnants which stand topographically higher than surrounding bottom lands. The FMPC site lies on top of one of these terrace remnants.

3.2 Shale Bedrock - Geology and Hydrology

The bedrock underlying the FMPC consists of a predominantly flat-lying, grayish olive (10Y4/2)* shale with interbedded thin limestone layers. The bedrock surface slopes generally to the northwest and forms the floor and walls of the New Haven Trough as well as the hills rising above the glacial till north and south of the valley. In these upland areas, the shale bedrock is overlain by up to 60 feet of glacial till (Reference 11). At well 12 (Figure 1-1), drilled north of the Production Area, the shale is within approximately 65 feet of the land surface. To the south, along Paddy's Run Road and near the center of the New Haven Trough, shale was encountered in well 15 (Figure 1-1) at a depth of approximately 214 feet below the land surface.

* Color designations are based on The Geological Society of America's Rock Color Chart (Reference 13)

Shales of this type typically have a low (0.003 ft/day to 0.00003 ft/day) hydraulic conductivity (Reference 11). Water occurs primarily in joints and cracks in the shale which have an irregular distribution. Transmissivity of the shale is usually too low to provide a reliable supply of water for domestic or agricultural purposes (Reference 12).

3.3 Glacial Outwash - Geology and Hydrology

Unconformably overlying the shale bedrock is a sequence of highly permeable sand and gravel glacial outwash deposits laid down by the meltwaters of receding continental ice sheets.

These outwash deposits generally consist of an unconsolidated medium to coarse grained, olive brown (5Y4/4), 200 foot thick layer of sand and gravel. They are overlain by till. Occurring approximately 100 to 125 feet below grade in some areas of the site is a 10 to 20 foot thick layer of greenish black (5G2/1) silty clay. This deeper silty clay layer has been previously referred to by several authors as the "blue clay".

A series of 4 cross-sections (Figures 3-4 through 3-7) have been prepared using site drilling data. Locations of these cross sections are shown on Figure 3-3. The cross-sections indicate that:

- The bottom of the surficial silty clay till layer occurs at about elevation 540 ft MSL relatively uniformly across the site.
- The sand and gravel deposits underlying the FMPC site are approximately 150 to 200 feet thick. They consist of irregularly alternating layers of silty sand, medium to coarse sand, and medium to coarse gravel in the vicinity

of the Waste Pit Storage Area, this layer is separated into two units by a 10 to 20 foot thick layer of greenish-black silty clay. The FMPC production wells are completed below this "blue clay" layer.

- Figure 3-8 illustrates the areal extent of this "blue clay" layer as determined by the onsite boring data. This layer underlies about 360 acres of the site and occurs only in the vicinity of the Waste Pit Storage Area and the production wells. It was probably deposited in an ice marginal lake or as a backwater deposit of a glacial stream (Reference 14). The top of this "blue clay" layer lies at about 125 feet below the land surface.

- Glacial outwash deposits show only gross tendencies towards stratification.

Hydrologically, the sand and gravel above and below the "blue clay" layer acts as a single unit. The "blue clay" layer is not sufficiently extensive to act as an aquitard (Reference 14) and no significant head differences exist between wells completed above and below this layer (Table 3-1).

The hydraulic conductivity of the "blue clay" has been estimated (using temperature differences and pumping test results) to be about 0.4 ft/day (References 8 and 14). The discontinuous distribution of the "blue clay," as well as lateral variations in its thickness and consistency, apparently allow it to transmit water between the two sand layers despite its relatively low permeability.

Transmissivities and hydraulic conductivities for the sand and gravel have been measured by several authors (References 11, 12, and 14) and are reported to range from 35,000 gpd/ft to 300,000 gpd/ft and 270 ft/day to 370 ft/day respectively. Total porosities have been estimated at 25% Refer-

ence 14). Average hydraulic gradients for the area measured by the USGS (Reference 3) from water level measurements made in August, 1982 are low and were calculated to range from 0.001 ft/ft to 0.005 ft/ft. Using these data, the rate of groundwater movement (horizontal groundwater velocity) is calculated to range between 1.1 ft/day and 9.3 ft/day (Appendix 1).

Figure 3-9 is a Dames & Moore water level contour map for the western portion of the sand and gravel aquifer. This map shows that groundwater movement is generally to the south and east in this area. Figure 5-2 is the USGS water level contour map which shows that flow for the area is generally to the south.

The upper 20 to 30 feet of the sand and gravel deposits are not saturated and water in this aquifer occurs approximately 60 to 90 feet below land surface depending upon surface elevation and thickness of till. A more detailed discussion of groundwater flow patterns for the area is presented in Section 5.0-Groundwater Modeling.

3.4 Glacial Till

At the surface of the site and overlying the sand and gravel outwash deposits is a 20 to 50 foot thick layer of glacial till composed of a dense, olive-gray (5Y3/2) silty clay. The till varies in texture and composition both laterally and vertically and contains lenses of poorly sorted fine to medium grained sand and gravel. The base of the till occurs at about elevation of 540 ft MSL and overlies the sand and gravel outwash deposits.

To the west and south of the site, the silty clay till laterally grades into a sequence of silty sand and silt with some layers of silty clay. The silty clay till remains continuous to the north and east of the site and directly

overlies the bedrock in these areas. In the lower reaches of Paddy's Run and the Storm Sewer Outfall Ditch, the silty clay till has been eroded away and the underlying sand and gravel are exposed.

A saturated zone occurs within the silty clay till approximately 4 to 9 feet below land surface in some areas of the FMPC site. This saturated zone was encountered in five shallow wells (19TP, 20TP, 21TP, 22TP, and OB-1) and is probably recharged by precipitation. It was not detected in test pits near well clusters 13 and 18. This saturated zone may be present because of the vertical variations of composition and texture of the till, or near-surface weathering or desiccation induced fracturing of the till itself.

Dames & Moore's aquifer testing of this saturated zone has measured hydraulic conductivities of 0.2 ft/day to 2.5 ft/day with associated transmissivities of 3.5 gpd/ft to 150 gpd/ft (Appendix I).

TABLE 3-1
HYDROSTATIC LEVELS RECORDED IN WELLS
SCREENED ABOVE AND BELOW
THE BLUE CLAY LAYER

<u>Well No.</u>	<u>Elevation of Water Level (ft)</u>	<u>Screened above (A) or below (B) Blue Clay</u>	<u>Differences in Water Level Elevation (ft) (Shallow-Deep)</u>
1s	524.38	A	-0.57
1d	524.81	B	
8s	523.37	A	0.58
8d	522.37	B	
20d	522.70	A	0.10
P-2	522.60	B	

o Water Levels Recorded in April, 1984.

o Production Well #2 (P-2) is outside the cone of influence for Production Well P-3. Water level recorded is probably true static level.

EXPLANATION:

- APPROXIMATE BOUNDARY OF
NEW HAVEN TROUGH
- SINGLE WELL LOCATION
- CLUSTER WELL LOCATION
- PRODUCTION WELL LOCATION

REFERENCE: BASE MAP TAKEN FROM U.S.G.S. 7.5' TOPOGRAPHIC MAP,
SHANDON, OHIO (1981) QUADRANGLE

NEW HAVEN TROUGH BOUNDARIES

DANIEL B. MOORE

WEST

EAST

FMPC SITE

GREAT MIAMI RIVER
SW OHIO WATER CO.
WELL FIELD

PADDY'S RUN

ELEVATION IN FEET

THE SUBSECTIONS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.

VERTICAL EXAGGERATION: 20x

GENERALIZED GEOLOGIC CROSS SECTION OF NEW HAVEN TROUGH

DAMES & MOORE

EXPLANATION:

- SINGLE WELL LOCATION
- CLUSTER WELL LOCATION
- PRODUCTION WELL LOCATION
- CROSS SECTION LOCATION

REFERENCE: BASE MAP TAKEN FROM U.S.G.S. 7.5' TOPOGRAPHIC MAP,
SHANDON, OHIO (1981) QUADRANGLE

CROSS SECTION LOCATION MAP

THE SUBSECTIONS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.

CROSS SECTION A - A'

DAMES & MOORE

FIGURE 3-6

CROSS SECTION D-D'

THE SUBSECTIONS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.

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AREAL EXTENT OF THE "BLUE CLAY" LAYER

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FIGURE 3-8

THE ESTIMATED LIMITS SHOWN REPRESENT AN
EVALUATION OF THE MOST PROBABLE CONDITIONS
BASED UPON INTERPRETATION OF PRESUMPTIVELY
AVAILABLE DATA. VARIATIONS FROM THESE
CONDITIONS MAY OCCUR.

REFERENCE: BASE MAP TAKEN FROM U.S.G.S. 7.5' TOPOGRAPHIC MAP,
SHANDON, OHIO (1981) QUADRANGLE

EXPLANATION:

ESTIMATED LIMIT OF "BLUE CLAY"
BASED ON DATA FROM WELLS SHOWN ON
FIGURE
APPROXIMATE ELEVATION 460'

○ SINGLE WELL LOCATION
□ CLUSTER WELL LOCATION
⊕ PRODUCTION WELL LOCATION

SCALE
0 1000 2000 3000 FEET

EXPLANATION:

- 520 — WATER LEVEL CONTOUR (IN FEET)
- ⊙ SINGLE WELL LOCATION
- ⊞ CLUSTER WELL LOCATION
- ⚡ PRODUCTION WELL LOCATION

REFERENCE: BASE MAP TAKEN FROM U.S.G.S. 7.5' TOPOGRAPHIC MAP, SHANDON, OHIO (1981) QUADRANGLE

THE WATER LEVEL CONTOURS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.

DAMES & MOORE WATER LEVEL CONTOUR MAP FOR THE SAND AND GRAVEL AQUIFER

DAMES & MOORE

APPENDIX B

APPENDIX B
THORIUM MATERIAL DISPOSITION PLAN
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PLAN TO DEAL WITH THORIUM MATERIALS ON-SITE FMPC

5.0 INTRODUCTION

The plan consists of steps to characterize and evaluate the Thorium materials and then develop program plans for the permanent disposition of those groups of materials. The starting information for this activity is Table 5-12 from the FY-87 through FY-91 site development plan. The objective of this plan is to provide an overview perspective of the total Thorium materials situation and present a logical, step wise sequence of events with some prioritization to achieve the ultimate goal: removal of the appropriate Thorium wastes from the site to permanent disposal.

Each step in the plan contains elements which provide guidance or suggestions for courses of inquiry or action that will ultimately drive the plan forward. The Plan is outlined in the sections that follow.

2.0 THE PLAN

2.1 Step 1 - Thorium Materials Characterization

Characterize the on-hand Thorium materials indicated in Table 5-12, Site Development Plan for FY87-FY91, where on-hand or available data doesn't exist or existing data is questionable. The priorities should probably require that Low Grade Residues from General Atomic (Brazilian Sludge) in Bldg. 65 and Thorium oxides in the Plant 8 Silo be characterized first because they are more urgent and larger quantities than most other Thorium material categories. Five general types of characterization are envisioned including chemical, radiological, economic value, mechanical properties, and history-of-use characterization. This characterization is required because it provides information to support important decisions regarding recycle or reuse potential of materials, operational safety requirements for handling, waste form and waste shipping requirements, and disposability of the various materials. Each of the five characterization groups will be discussed in subsequent paragraphs.

2.1.1 Chemical Characterization

This characterization should minimally include leachability and solubility of the present form of the material. Chemical and physical stability of the material should be evaluated. Chemical composition should also be known.

2.1.2 Radiological Characterization

This characterization should include determination of the radiation sources present in each waste. Types of radiation

emission should be evaluated with a view toward shielding for handling and shipping purposes.

2.1.3 Economic Value Characterization

This characterization should take into account the direct market value of the metal oxide or ore. Each Thorium material should be grouped as either recycleable, recycleable with alteration or not recycleable (potential waste).

2.1.4 Mechanical Properties Characterization

This characterization should include the moisture content and physical state (liquid, powder, solid or slurry) of the material. Some index or ability to excavate should also be evaluated. Any other mechanical properties deemed relevant to shipping, handling, processing, etc. of the material.

2.1.5 History and Source of the Material

This set of information is developed to provide information including:

Process that produce the waste and the use for the product of that process.

Time period that the waste was produced.

Any other germane information.

Much of the characterization data required for Step 1 may already exist and may simply need to be sought from those existing sources at FMPC or elsewhere. Information presently available is presented in the attached Table 1. This information resulted from conversations with or information from Messers Gessiness, Flemming, Adams and Leist.

2.2 Step 2 - Classify the Thorium Materials

During this step the Thorium materials will be classified and potential for chemical processing of each group of the materials will be evaluated and a decision on the disposition of each group will be reached.

2.2.1 Thorium Material Classification

This objective is to classify the on hand Thorium materials. The suggested classification categories are:

1. Waste,
2. Materials for recycle or sale,
3. Materials retained for consideration of chemical processing to upgrade to material for sale or recycle, and
4. Materials to be retained indefinitely.

Table 2 is an initial attempt at this distinction based on existing information presented in Table 1 and as such is not final. As information gathered during Step 1 is accumulated, changes can be made in classification assignments.

2.2.2 Evaluation of Potential for Chemical Processing of the Thorium Materials

There are three alternative treatments for Thorium materials, each requiring a different scope of possible chemical processing. The Thorium materials can be chemically processed into either:

1. Immediately marketable or recycleable forms or
2. More stable, easily storable and less radioactive forms for storage awaiting future decision to market or to further process for market.

If the Thorium materials are not treated in either of the two above ways, they are given the most expedient, cost-effective treatment to prepare them for an environmentally acceptable disposal.

The current economics of chemical processing of the Thorium materials placed in Class 3 in Table 2 should be examined considering:

1. The costs of the chemical processing including capital investment to refurbish the plant(s) and
2. Production costs per ton vs. market value per ton, present or projected future.

This decision could be deferred to the future and the wastes could be chemically processed to the most stable, easily storable, and less radioactive form and then stored for future upgrading into the most marketable forms at that future time.

If the choice is made to select none of the above options, then in effect the materials have been reclassified into the first category and are waste materials. These materials will ultimately be stabilized for waste disposal. At the end of Step 2, the classification of the Thorium materials should be final.

2.3 Step 3 - Apply Priorities to the Disposition of the Thorium Materials

Materials in all four classification categories can be placed within the same system of priorities to establish the urgency of each planned remedial action. Five conditions are used to establish the urgency ranking for any particular Thorium material. They are listed by order of importance:

1. Vulnerability of the material in its existing form to release to and subsequent transportation or migration within the site and surrounding environments,
2. Radiation hazard,
3. Quantity of material,
4. Condition of storage container(s) and
5. Market conditions (demand) for the material (NA for waste category). Although these priorities are set, they can be changed if any variables change.

When Step 2 is completed the final version of Table 2 should be revised to reflect the latest classification and the materials should be ranked for urgency of disposition in view of the above five conditions.

2.4 Step 4 - Develop Program Plan to Deal with Each Thorium Materials Classification Category.

A separate type of program plan is envisioned for each of the first three classification categories depicted in Table 2. The vital and non-standard parts of each generic type of program plan will be discussed in the following sections. It is assumed that the standard review of each specific plan will include review and certification by health and safety and any other standard accepted practices.

2.4.1 Generic Program Plan for Immediate Recycle Thorium Materials

This plan should consist of the following elements:

- 2.4.1.1 Retrieval Plan - describe location and present status and the cost, plan, schedule and quality and control to retrieve the material including any appropriate concepts developed to conduct the retrieval
- 2.4.1.2 Packaging Plan - describe the containers, costs, schedule and any concepts required or envisioned to appropriately package the material including appropriate regulatory compliance.
- 2.4.1.3. Shipping Plan - describe the shipping vehicle, conditions, requirements, and schedule including any necessary concepts and the appropriate regulatory compliance.
- 2.4.1.4 Implementation Plan - overall plan to deal with material in this respective category. This includes coordinated schedule from beginning to end of the operation.

CHARACTERIZATION DATA

Location	Material Form	MT Th	% With Commercial Use Potential ^①	Possibility of Processing to Commercial Use Purity In-House, If Processing Equipment is Restored
Bldg. 67, Bldg. 72	ThO ₂ Dense	4.3	100%	NA
Bldg. 67	ThO ₂ Sol Gel	25.9	88%	NA
Pilot Plant Tank #2 and Lab	Pilot Plant - WIP	9.2	0	Yes
Pilot Plant Warehouse	Impure Thoria Gel	338.3	0	Yes
Plant 8 Silo	Thorium Oxides	174.6	0	Yes
Bldg. 67, Bldg. 72	Thorium Oxalate Cake	1.2	0	Yes
Bldg. 67	Thorium Nitrate Crystals	1.2	0	Yes
Bldg. 65	Low-Grade Residues from General Atomic	321.7	0	None
Bldg. 67	Offsite Thorium Hydroxide	10.8	0	Yes
Bldg. 67, Bldg. 72	Offsite Thorium Oxides	74.4	94%	NA
Bldg. 67	Thorium Nitrate Solution	0.9	0	Yes
Bldg. 67	ThF ₄	0.8	0	Yes
West Bldg. 65, Bldg. 72, Bldg. 67	Metal	79.9	94%	NA
West Bldg. 65	Clad Metal	4.4	0	None
West Bldg. 65, Bldg. 67, Bldg. 72	Alloyed Metal	3.5	0	None
Bldg. 67, West Bldg. 65	Material Held for Historical Purposes	0.5	0	NA
Bldg. 67, West Bldg. 65	High Grade Residues (>30% Th.)	35.7	0	Yes
Bldg. 67	Low Grade Residues (<30% Th.)	0.2	0	?
Waste Area	Th Mixed with U in Waste Pits	80.0	0	None

① Calculated from Attachment 2, Spencely to Reafsnider memo authored by Liest

② Pure if from GSA, impure if from Hanford (Curtis Bay, MD or Hammond, Indiana)

③ See inventory records

④ May contain all or part of 4411 gms of accountability listed U-233 dispersed in it

⑤ Based on surface readings at warehouse where these materials are stored

TABLE 1

Probable Storage Container	Purity	Composition/ Impurities as Known	Gamma Radiation Field mR/hr	Significant Mechanical Properties	Leachability (as is)	Other Comments Including Solubility, Leachability, Etc.
---	Pure	ThO ₂ sintered Pwdr/ CA deliberately added in some cases	---	---	---	
---	Pure	ThO ₂ or Th(OH) ₄ • NH ₂ O	---	---	---	All non-sintered ThO ₂ & Th(OH) ₄ are hygroscopic
Tank	Impure	Th(NO ₃) ₄ • NH ₂ O	~22	---	---	Must be extracted, soluble must be converted to oxide or hydroxide
Lined 55 gal drums	Impure	Th(OH) ₄ • NH ₂ O	~30	---	---	Must be extracted
Dry bulk silo	Impure	ThO ₂ to Th(OH) ₄ • NH ₂ O	4 at silo surface	---	---	Was free flowing 4 or 5 years ago ⁽⁴⁾
Plastic or Plastic Lined 5-gal, can	Pure	Th		---	---	Created as part of purification process, insoluble. Intended to be calcined
---	Pure/Impure ⁽²⁾	Th(NO ₃) ₄ • 4H ₂ O	20 to 65 ⁽⁵⁾	---	---	Oxidizer, water soluble
Unlined 55-gal drums	Impure Residues from thorium processing	/Th daughters	17 to 80 ⁽⁵⁾			Corroded drums, gamma ra- diation problem highest priority waste problem
	Impure/Pure ⁽³⁾	Th(OH) ₄ • 4H ₂ O	20 to 65 ⁽⁵⁾			Government owned materials shipped here ⁽⁴⁾
	Impure/Pure ⁽³⁾	ThO ₂	20 to 65 ⁽⁵⁾	---	---	Government owned materials shipped here ⁽⁴⁾
	Impure	Th(NO ₃) ₄ Solution	20 to 65 ⁽⁵⁾	---	---	Shipped from Hanford, initially too hot to ship because of daughters
5-gal cans	Pure	ThF ₄ or white salt		---	---	Insoluble - feed for Th production
---	Pure/Impure ⁽³⁾	Th		---	---	
---	Impure (by design)	Th plus/Al, Stainless Steel, Zr, Sn		---	---	
---	Impure (by design)	Th plus/Ni, Mo, others		---	---	Small samples, oddities, metals, display samples
---	Impure		Possible 17 to 80 range	---	---	
---	Impure		Possible 17 to 80 range	---	---	
Lagoon						Mixed with U wastes

2.4.2 Generic Program Plan for Process-to-Recycle or Sell Materials

This plan should consist of the following elements:

- 2.4.2.1 Process Preparation Plan - describe the combination of unit operations necessary to achieve the necessary product qualifications. Include refined version of the previous cost estimates and any relevant details of plan location, etc. This includes any retrieval activities.
- 2.4.2.2 Processing Plan - describe the processing schedule, required material and reagent quantities and other relevant necessary engineering, technical and other data and information.
- 2.4.2.3 Packaging Plan - describe the containers, costs, schedule and any concepts required or envisioned or appropriately package the material including appropriate regulatory compliance.
- 2.4.2.4 Shipping Plan - describe the shipping vehicle, conditions, requirements and schedule including any necessary concepts and the appropriate regulatory compliance.
- 2.4.2.5 Implementation Plan - overall plan to deal with material in this respective category. This includes coordinated schedule from beginning to end of the operation.

2.4.3 Generic Program Plan for Waste Preparation for Disposal

This generic plan should consist of the following elements:

- 2.4.3.1 Identification of the Waste Disposal Facility and Disposal Requirements - determine whether the present waste form meets the identified site's disposal requirements. If it doesn't, identify the shortcomings and envision one or more overview concepts to bring the waste up to standard.
- 2.4.3.2 Shipping Plan - compare the appropriate data from 2.1 to DOT, NRC or other known shipping requirements. If "as is waste" meets or exceeds those requirements, waste goes as is. If not specify why (rad levels too high, containers not acceptable or other) and envision detailed shipping or processing concepts to bring waste up to shipping standards.
- 2.4.3.3 Waste Form Evaluation Plan - (if required) describe the waste form requirement to meet disposal requirements presented in 2.4.3.1 and 2.4.3.2, and develop a detailed concept or methodology to achieve that form.

Table 2

Classification Category

Material Form	1	2	3	4
	Waste	Material for Recycle or Sale	Material Retained for Consideration of Chemical Pro- cessing to Upgrade To Material for Sale or Recycle	Material to be Retained Indefinitely
ThO ₂ (Dense Bettis)		X		
ThO ₂ (Sol Gel)		X-88%	X-remainder	
Pilot Plant - WIP			X	
Impure Thoria Gel			X	
Thorium Oxides			X	
Thorium Oxalate Cake			X	
Thorium Nitrate Crystals			X	
Low-Grade Residues from General	X			
Offsite Thorium Hydroxide			X	
Offsite Thorium Oxides		X-94%	X-remainder	
Thorium Nitrate Solution			X	
ThF ₄			X	
Metal		X-94%	X-remainder	
Clad Metal	X			
Alloyed Metal	X			
Material Held for Historical Purposes				X
High Grade Residues (30% Th.)			X	
Low Grade Residues (30% Th.)			X	

Present a testing plan to verify the waste form qualifications.

2.4.3.4 Plan to Prepare Waste for Disposal - select the concept to prepare the waste for disposal, meeting above requirements and develop design for the actual process.

2.4.3.5 Implementaton Plan - overall plan to deal with material in this respective category. This includes coordinated schedule from beginning to end of the operation.

2.5 Step 5 - Formulate The Overall Thorium Materials Disposition Plan

Each program plan developed for each separate Thorium material listed in Table 1 and Table 2 must be combined into a master or overall Thorium Materials Disposition Plan based on the priorities developed in Step 3. The overall plan may simply be a single step wise application of resources to each separate material starting with the most urgent going to the least urgent; however, Westinghouse would like to simultaneously conduct as many operations as practicable to solve the Thorium problem as soon as possible. It is more likely that availability of process facilities, manpower and budgetary design will provide the limits to the number of simultaneous Thorium remediation activities conducted.

3.0 PRESENT STATUS AND NEEDS TO ADVANCE THE PLAN

Examination of Table 1 indicates that many bits of information are missing and incomplete. The following areas would benefit from additional information:

1. Significant mechanical properties
2. Leachability (as is)
3. Composition of impurities
4. Container type and size

In spite of the deficiencies, it is possible to tentatively prioritize groups of the Thorium materials for urgency of remedial action. The priorities and these bases for that determination are listed in Table 3. Further prioritization may become apparent as additional information is found for each Thorium material.

TABLE 3

PRIORITIES FOR THE DISPOSITION OF FMPC THORIUM MATERIALS

<u>Highest</u>	Justification for Priority
PRIORITY 1 Low grade General Atomics residues, Bldg. 65 Bldg. 65	1. Significant rad hazard due to gamma emissions from daughter products 2. Containers in bad condition 3. Large quantity 4. Clearly waste with no value
PRIORITY 2 Impure Thoria Gel	1. Significant rad hazard due to impurities 2. Containers in unknown condition 3. Largest quantity of Thorium on site
and	
Thorium Nitrate crystals and solution in Bldg. 67 and Pilot Plant Tank	1. Rad hazard due to impurities and <u>water soluble</u> 2. Container condition unknown
PRIORITY 3 Impure materials remaining in Bldg. 67 and 65	1. Limited rad hazard in some materials
PRIORITY 4 Thoria in Plant 8 Silo	1. Large quantity
PRIORITY 5 Pure Thorium materials in any building	
PRIORITY 6 Thorium mixied in waste pit 4	