PNC TN9600-88-004

アメリカ原子学会(ANS) 主催廃棄物管理国際会議 "SPECTRUM '88" 及び米国内関連施設訪問

— 海外出張報告 —

技術管理室
No. 896 14
動力炉・核燃料開発事業団大洗工学センター

1989年2月

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動力炉・核燃料開発事業団（Power Reactor and Nuclear Fuel Development Corporation）

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アメリカ原子力学会(ANS) 主催廃棄物管理国際会議 "SPECTRUM '88" 及び米国内関連施設訪問

海外出張報告

虎田真一郎*
塩月　正雄**

要　旨

1. ANSトピカルミーティング "SPECTRUM' 88"

本ミーティングはANS主催の廃棄物トピカルミーティングとしては84年、86年に続く国際会議であり、高レベル、中低レベル、除染・デコミ等に関し、約500名の登録参加者を集めて行われた。動燃からは高レベル廃液ガラス固化における溶融炉開発及び施設の除染・デコミ技術の2件を報告した。溶融炉技術については、同様の技術開発を実施中の米国、西独から多くの質問があり、これについては引き続きハンフォードの研究施設訪問に際しても議論を行うこととなった。

除染・デコミ技術に関しては、国際舞台にてPNCにおけるこれらのアクティビティを公式に発表することは初めての機会であり、米国、欧州等から数々の質問等があった。

2. 関連施設訪問

2-1　ハンフォードサイト〔ウエスチングハウス・ハンフォード(16日)、バッテルノースウエスト研究所(19日)〕

ハンフォード実施中のガラス固化プロジェクト(HWVP)関係者と溶融炉技術について意見交換を行った。主要な論点はガラス固化におけるFP元素のうち、白

*　東海　環境工学開発部　高レベル廃棄物処理技術開発室
**　大洗　管理部　廃棄物処理課

金族元素の溶融ガラス中の挙動に関するもので、この問題については日本が一歩先にＲ＆Ｄを実施していることから、その結果を参考にハンフォードでもＲ＆Ｄを進めたい意向であった。また、バッテル研究所ではホットのガラス固化に使用したセルの除染及び機器撤去を来年より実施予定であり、その紹介を聞いたあと、ＰＮＣの溶融炉解体技術を紹介し、意見交換を行った。

2-2　アイダホ国立研究所〔ウエスチングハウス・アイダホ（20日）ＥＧ＆Ｇ（21日）〕

高レベル廃液の流動床仮焼プラント（ＮＷＣＦ）を見学後、仮焼体を将来固化するためのＨＩＰによるセラミック固化処理技術開発について説明を受けた。ジルコニアを主成分とする仮焼体の組成を生かし、ＨＩＰでさらに減容するための小型コールド試験を実施していた。ＥＧ＆Ｇでは、低レベル廃棄物の減容処理施設（ＷＥＲＦ）及びＴＲＵ廃棄物貯蔵（ＲＭＷＣ）、廃棄物ドラムの非破壊検査装置の説明を受けた。

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　４－２　ウエスチングハウスハンフォード（ＷＨ） …… ２５
　４－３　バッテル　パシフィックノースウエスト研究所 …… ２７
　４－４　アイダホ国立研究所：ウェスチングハウスアイダホ
　　（ＷＩＮＣＯ)及びＥＧ＆Ｇ …… ３３
　　・　高レベル廃液仮焼施設（ＮＷＣＦ）及び研究施設
　　・　廃棄物減容技術試験施設（ＷＥＲＦ）及び放射性廃棄物管理貯蔵施設
　　（ＲＷＭＣ）
5. あとがき …… ４０
6. 入手資料一覧 …… ４２
7. 付　録 …… ４３
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　　Ｂ　ＳＰＥＣＴＲＵＭ ’８８　発表資料
　　Ｃ　訪問した各サイトの施設概要
　　Ｄ　Hanford Waste Vitrification Plantの概要
　　Ｅ　ＨＷＶＰにおける白金属スラッジ対策研究開発計画及びスケジュール

アメリカ原子力学会（ＡＮＳ）主催廃棄物管理国際会議“ＳＰＥＣＴＲＵＭ’８８”
及び米国内関連施設訪問

1. まえがき

本出張では、ＡＮＳが主催する放射性廃棄物に関するトピカルミーティングに参加し、動燃における高レベル廃液ガラス固化技術開発、並びに核燃料関連施設のデコミッショニング技術開発の成果を報告した。また、同分野における各国の最新情報を取得し、特にＤＯＥ関連施設では、施設見学及び担当者との議論を行い、技術開発の現状を調査した。　主たる出張・訪問先は以下の通りである。

(1) ＡＮＳ主催　廃棄物管理国際会議　ＳＰＥＣＴＲＵＭ’88
　　於　米国　ワシントン州パスコ

(2) ウェスチングハウス・ハンフォード社（ＷＨ）
- ハンフォードガラス固化プロジェクト（ＨＷＶＰ）オフィス

(3) バッテルパシフィックノースウェスト研究所（ＰＮＬ）
- 300エリア 324ビル内ホットセル施設

(4) アイダホ国立研究所
- ウェスチングハウスアイダホ社（ＷＩＮＣＯ）－ＮＷＣＦ
- ＥＧ＆Ｇ社 —— 廃棄物減容技術試験施設（ＷＥＲＦ）
　　—— 放射性廃棄物管理貯蔵施設（ＲＷＭＣ）

2. 出張日程

2-1　期　間　　昭和６３年９月１０日から２３日（１４日間）

2-2　出張者　　虎　田　真一郎　　東海ＨＩＳ　　主査副主研

　　塩　月　正　雄　　大洗ＷＭＳ　　研究員

2-3　日　程

	MORNING & AFTERNOON	EVENING
9.10(土)	移動。成田　→　パスコ	
11(日)	登録及び Plenary Session	
12(月)	Session （虎田　発表）	ポスターセッション 会食(Battelle 大西氏等
13(火)	Session （塩月　発表）	Banquet
14(水)	Session	会食(ｻﾊﾞﾝﾅﾘﾊﾞｰ研 Mr.Kitchen)
15(木)		
16(金)	訪問－ｳｪｽﾁﾝｸﾞﾊｳｽﾊﾝﾌｫｰﾄﾞｵﾌｨｽ (DOE－ﾘｯﾁﾗﾝﾄﾞ, ｳｪｽﾁﾝｸﾞﾊｳｽ, Battelle-PNL)	
17(土)	休　日	会食(Battelle-PNL)
18(日)	休　日	
19(月)	訪問－Battelle-PNL.324ビル	会食(Battelle Mr.Holton Mr.Chapman)
20(火)	訪問－アイダホ　ＩＣＰＰ (DOE-ｱｲﾀﾞﾎ, ｳｪｽﾁﾝｸﾞﾊｳｽ)	
21(水)	訪問－アイダホ　ＲＷＭＣ (EG&G)	
22(木)	移動。サンフランシスコ	
23(金)	移動。　→　成田	

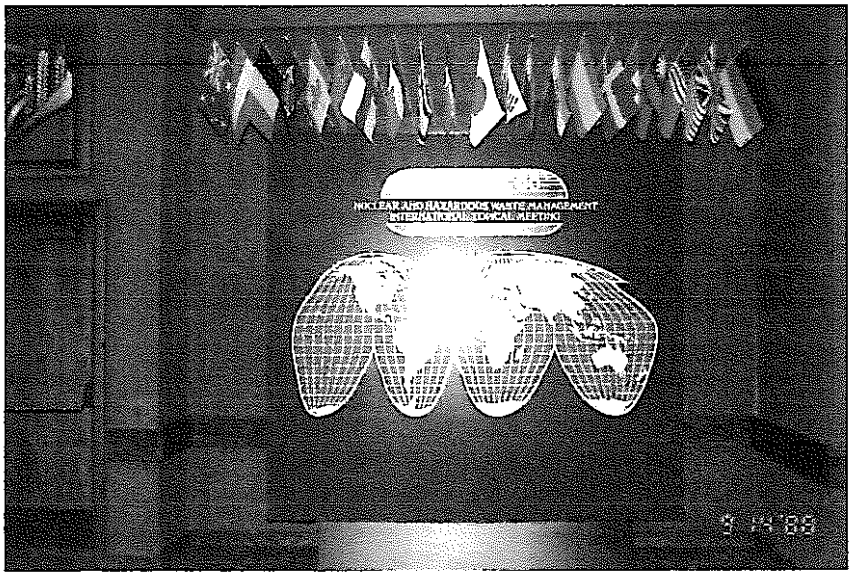
3. ＡＮＳ主催廃棄物管理国際会議“ＳＰＥＣＴＲＵＭ ’88”

３－１　概　要

本ミーティングは、ＡＮＳ主催の廃棄物トピカルミーティングとしては84年（於ジャクソン）、86年（SPECTRUM ’86於ナイアガラフォールズ）に続く国際会議であり、高レベル、中低レベル廃棄物に関し23のセッションに分け９月11日～15日にわたって行われた。

登録参加者数は約500名で、欧米はじめアジア各国からも多数の参加者が身受けられた。参加者リストをAppendix-Aに示す。写真－１に講演会場内に揚げられたシンボルマークを示す。

動燃からは、ガラス固化におけるガラス溶融炉技術の開発、及び施設除染とデコミショニング技術に関して報告した。



写真－１　スペクトラムシンボルマーク

3-2　全体日程

日　付	午　　前	午　　後	
9／11 （日）		Plenary Session NATIONAL AND INTERNATIONAL OVERVIEWS	
9／12 （月）	Session 1 US HLW VITRIFICATION Session 2 Treatment of Reactor Solid LLW Session 3 Mixed Waste Regulations	Session 4 INTERNATIONAL HLW VITRIFICATION Session 5 Cement-Based Waste Form Technology Session 6 Regulatory Issues Session 7 Spent Fuel Characteristics and Storage	POSTER SESSION
9／13 （火）	Session 8 HLW PRACTICES AND PROPOSALS Session 9 Liquid LLW Treatment Session 10 Radioactive Mexed Waste Treatment Session 11 Experience In Decomissioning Nuclear Reactors	Session 12 Construction and Maintenance of Nuclear Facilities Session 13 Disposal Facility Siting and Construction Session 14 Waste Minimijation Session 15 DECOMMISSIONING NUCLEAR FACILITIES	
9／14 （水）	Session 16 Waste Management Practice Around the World Session 17 Disposal of Defence LLW Session 18 TRO Waste(Processing & Treatment) Session 19 DECONTAMINATION TECHNIQUES	Session 20 Performance Assessment Session 21 LLW Treatment and Disposal Plans Session 22 Public, State and Agency Interaction Session 23 Transportation (Packaging and Shipping)	
9／15 （木）	Option Tour to the DOE Hanford Site		

3-3　会議のプログラム

本プログラムは既に刊行されている、SPECTRUM'88 のプロシーディングと同内容である。

SPECTRUM 88
NUCLEAR AND HAZARDOUS WASTE MANAGEMENT
INTERNATIONAL TOPICAL MEETING

P.O. Box 159
Richland, Washington 99352-0159

Final Program

SPECTRUM 88
NUCLEAR AND HAZARDOUS WASTE MANAGEMENT
INTERNATIONAL TOPICAL MEETING

September 11-15, 1988
Pasco, Washington, USA

This isn't any ordinary technical meeting

Welcome to SPECTRUM '88. You are about to be treated to speakers from around the globe who will share their experiences and plans for high- and low-level radioactive waste and hazardous waste management. By discussing "Tomorrow's Solutions Today," they will provide new insights that you can take home to your own work place — wherever in the world that may be. So Enjoy. Learn. Challenge and be challenged.

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General Chair	William F. Bonner
Assistant General Chair	Joan M. Tenorio-Zimmer
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- ANS Environmental Sciences Division
- ANS Remote Systems Technology Division
- ANS Reactor Operations Division
- ANS Isotopes & Radiation Division

Sunday, September 11, 1988

* 10:00 a.m. **Registration**
* 2:00 p.m. **Plenary Session: "A National and International Overview"**

M. J. Lawrence, Manager, U.S. Department of Energy Richland Operations Office
Congressman S. Morrison, Honorary Chair
A. L. Snow, ANS FCWM Division Chair
G. R. Armstrong, ANS EW Section Chair
D. Alexandre, France
B. Ponsford, United Kingdom
R.-P. Randl, West Germany
H. Kamegawa, Japan
T. B. Hindman Jr., U.S. Department of Energy-HQ
C. E. Findley, Environmental Protection Agency

* 6:00 p.m **Reception**

Monday, September 12, 1988

* 7:00 a.m. **Speakers Breakfast**
* 7:00 a.m. **Registration**
* 8:00 a.m. **Technical Sessions:**

Session 1 — U.S. HLW Vitrification
Co-chairs: J. L. McElroy, R. W. Brown

1. Hanford Waste Vitrification Plant - An Overview (B. A. Wolfe, P. Felise, J. L. Scott, K. R. Shah - WHC and C. R. Allen - PNL)
2. Technical and Project Highlights for the Defense Waste Processing Facility (D. I. McIntosh - SRL and L. M. Papouchado - SRP)
3. Progress of the West Valley Demonstration Project Vitrification System (J. M. Pope, S. M. Barnes and P. S. Klanian - West Valley Nuclear Services)
4. In-Tank Precipitation — the First Step in the Long-Term Management of High-Level Waste at the Savannah River Plant (S. M. King - DOE-SR)
5. Feed Preparation for the Defense Waste Processing Facility (B. H. Glasscock - SRL)
6. Qualification of West Valley Production Glass (L. R. Eisenstatt - West Valley Nuclear Services Co., Inc. and C. C. Chapman - PNL)
7. Evaluation of Strategies for Controlling Hanford Waste Vitrification Plant Glass by Process Simulation (W. L. Kuhn, J. H. Westsik Jr., B. A. Pulsipher - PNL and J. L. Nelson - WHC)

Session 2 — Treatment of Reactor Solid LLW
Co-chairs: L. Snow, J. S. Baptista

1. Properties of a Composite Polyethylene-Fiberglass Reinforced Plastic High Integrity Container for Low-Level Radioactive Waste Disposal (H. Lowenberg - Lowenberg Assoc. and A. J. Stock - Bondico Nuclear)
2. Radwaste Experience at WNP-2 - The First Four Years (P. J. Macbeth and K. A. Smith - WPPSS)

Monday, Sept. 12, 1988

3. Low-Level Waste Management Developments in U.K. Nuclear Power Stations (F. H. Passant - Central Electricity Generating Board)
4. Computerized Management of LLW Temporary Storage for Chin-Shan NPP in Taiwan (C.-L. Shih, Y.-B. Chen - Institute of Nuclear Energy Research, H.-L. Chiu - Taiwan Power Company and C.-K. Chen - China Management System Corporation)
5. The Establishment of Computer Codes for Radiological Assessment on LLW Final Disposal in Taiwan (H.-T. Chen, C.-L. Shih - Institute of Nuclear Energy Research, C.-S. Yeh, C.-M. Tsai - Radwaste Administration and C.-C. Yang - CTCI Corporation)
6. Development of Commercial Robots for Radwaste Handling (K. A. Colbom - Pentek, Inc.)
7. Transfer Station and Storage Facility for Medium Active Solid Waste (S. L. Josef - Voest-Alpine Maschinenbau GES. M.B.H., Austria)

Session 3 — Mixed Waste Regulations
Co-chairs: D. E. Wood, R. F. Weiner

1. The SARA Mandate, the CERCLA Remedial Action Process, and a Review of Superfund Cleanups (C. F. Baes III and G. Marland - ORNL)
2. Environmental Compliance at U.S. Department of Energy FUSRAP Sites (S. D. Liedle and B. W. Clemens - Bechtel National)
3. Management Initiatives to Waste Management Decisions and Environmental Compliance in Oak Ridge, Tennessee (C. G. Jones - Martin Marietta, ORNL)
4. Regulatory Issues Relevant to the Lead Component of Transuranic Mixed Waste at WIPP under the Resource Conservation and Recovery Act (P. L. Bradshaw - IT Corp.)
5. Radioactive Mixed Waste and the Land Disposal Prohibitions: Implications to DOE Facilities (R. G. Carnes - IT Corp.)
6. Disposing of the Hazardous Chemical Component of Radioactive Mixed Waste at the Waste Isolation Pilot Plant (E. T. Louderbough - IT Corp.)
7. Regulatory/Permit Activities for Mixed Waste Disposal at the Hanford Grout Treatment Facility (O. L. Bostic, W. G. Richmond and R. H. Guymon - WHC)

* 12:00 p.m. **Luncheon — Guest Speaker E. Baynerd, Assistant Secretary of Environment, Safety and Health, DOE-HQ (Poster Speakers Meeting)**
* 1:40 p.m. **Technical Sessions:**

Session 4 — International HLW Vitrification
Co-chairs: C. G. Sombret, R. Kroebel

1. Industrial Vitrification of High-Level Liquid Wastes with the PAMELA Plant in Belgium (E. Ewest and H. Wiese - DWK)
2. La Hague Vitrification Plants: A Status Report (M. Lung, H. Regnaut - SGN, France, D. Alexandre - COGEMA, France and P. Saverot - Numatec)

3. Development of Glass Melter for the PNC Tokai Vitrification Facility (S.-I. Torata, N. Sasaki, M. Horie and N. Tsunoda - Power Reactor and Nuclear Fuel Development Corp.)
4. The Serse Pilot Plant: Design and Results for the High-Level Waste Treatment (A. Marrocchelli, L. Pietrelli, C. Calle and A. Luce - ENEA, Italy)
5. The Vitrification in the German Reprocessing Plant Wackersdorf - Status of Design, Arrangement and Maintenance Concept (D. Schmidt and B. Racky - NUKEM GmbH, FRG)

Session 5 — Cement-Based Waste Form Technology
Co-chairs: E. W. McDaniel, H. Kuribayashi

1. The Grout Treatment Facility - Processing Facilities for LLW Immobilization and Disposal (R. H. Guymon, L. D. Vanselow and G. D. Campbell - WHC)
2. Saltstone Processing Startup at Savannah River Plant (E. L. Wilhite, C. A. Langton and H. F. Sturm - E. I. du Pont de Nemours and Company - SRL, R. L. Hooker and E. S. Occhipinti - SRP)
3. Savannah River Plant Saltstone - Formulation Variability and Operating Limits (C. A. Langton - E. I. du Pont de Nemours and Company)
4. Immobilization of IFR Salt Wastes in Mortar (D. F. Fischer and T. R. Johnson - ANL)
5. Cement Solidification of Spent Ion-Exchange Resins Produced by the Nuclear Industry (C. Jaouen and B. Vigruex - SGN, France)
6. Performance Testing of Blast Furnace Slag for Immobilization of Technetium in Grout (R. D. Spence, T. M. Gilliam, B. S. Evans-Brown, I. L. Morgan, J. L. Shoemaker and W. D. Bostick - Martin Marietta, ORNL)
7. Near Surface Containment with Abundant Regional By-Products (D. H. Hebb - Hebb Resources Int'l.)
8. Setting Temperature Evolution of Nitrate Radwaste Immobilized in Ordinary Portland Cement (B. M. Rzyski and A. A. Suarez - IPEN-CNEN/SP, Brazil)

Session 6 — Regulatory Issues
Co-chairs: M. G. White, S. L. Clark

1. Secrets of Successful Siting Legislation for Low-Level Radioactive Waste Disposal Facilities (A. D. Pasternak - Cal Rad/Pasternak Consulting, Inc.)
2. De minimis Low-Level Regulatory Concerns (S. M. Neuder - U.S. NRC)
3. EPA's Regulatory Activities in Radioactive Waste Disposal (F. L. Galpin, W. F. Holcomb, R. L. Clark, J. L. Russell and R. S. Dyer - EPA-HQ)
4. Impacts of Recent Regulations or Changes in Regulations on DOE Remedial Action Programs (A. Wallo III and J. J. Fiore - DOE-HQ)
5. Hazardous Waste Regulatory Update (C. F. Sigmon and F. E. Sharples - ORNL)
6. The Hanford Grout Treatment Facility - Environmental Assurance in Low-Level Waste Disposal (J. M. Allison and T. B. Bergman - WHC)
7. Regulatory Compliance and the UMTRA Project - A Look at Three Sites (D. Bierley - R. F. Weston, Inc.)

Monday, Sept. 12, 1988

Session 7 — Spent Fuel Characteristics & Storage
Co-chairs: W. Ballard, R. Lambert

1. Development of a Dual Purpose Spent Fuel Storage Cask (L. E. Efferding - Westinghouse Electric Corp.)
2. The Dutch Monitored Retrievable Storage Plans (F. Geevers - N.V. KEMA, Netherlands)
3. Characteristics of Spent Fuel, High-Level Waste and Other Radioactive Wastes Which May Require Long-Term Isolation (K. J. Notz - ORNL)
4. Characteristics of Defective LWR Spent Fuel (D. L. Phung, C. G. Lawson - PAI Corp. and K. J. Notz - ORNL)
5. Preliminary Preclosure Radiological Safety Analysis for Normal Operations of a Prospective Yucca Mountain Repository (L. J. Jardine, C. W. Ma, R. C. Sit, S. J. Zavoshy, D. J. Hartman - Bechtel National and T. W. Laub - SNL)
6. C-E Spent Fuel Consolidation System: The Second Generation (M. J. Falzarano, R. C. Jacques and J. F. Theroux - Combustion Engineering)

* 5:45 p.m. Poster Session with Reception
Co-chairs: K. J. Schneider, H.-S. Park

1. Practical Experience with the Fabrication of the Savannah River Plant Defense Waste Processing Facility Process Cell Tanks and Glass Melter Vessel Assemblies (R. E. Athey - CBI Services, Inc.)
2. Shop Completion of Melter Vessel Assembly No. 1 for the Defense Waste Processing Facility at Savannah River Plant (B. K. Parsons - Bechtel National)
3. Seismic Design of the Waste-Handling Building at the Prospective Yucca Mountain Nuclear Waste Repository (C. V. Subramanian - Sandia, C. L. Wu and C. D. DeGabriele - Bechtel National)
4. Decontamination in a Full Scale Prototype Electrochemical Treatment Plant (R. D. Bond and M. J. Sanders - Winfrith Atomic Energy Establishment, U.K.)
5. Recent Development of the Winfrith Modular Containment System (M. J. Sanders - Winfrith Atomic Energy Establishment, U.K.)
6. Abrasive Water-Jet Cutting; Remote Hot Cell Application (K. J. Leist and G. J. Funnell - WHC)
7. Closure, Decontamination and Characterization of Canisters of High-Activity Borosilicate Glass (J. E. Surma, M. L. Elliot, L. K. Holton Jr., R. F. Klein and Y. B. Katayama - PNL)
8. Field Experience with a Commercial Concrete Decontamination System (S. Lefkowitz - Pentek, Inc.)
9. Evaluation of Wastewater Treatment Methods for Hanford Laundry (J. Wilder, A. Rossi - Envirosphere Company, R. Yakochko and C. Hatch - WHC)
10. Study of the Industrial Operation of Plants for the Treatment of Radioactive Waste with Regard to Quality Control (B. Ganser - NUKEM GmbH, FRG)
11. Options of LLW Volume Reduction in Loviisa NPP (E. H. Tusa - Imatra Power Company, Finland)
12. Potential Benefits of Semiautomated, Synoptic Geologic Studies for Characterization of Hazardous Waste Sites (M. G. Foley, D. E. Beaver, M. A. Glennon - PNL, and J. R. Eliason - Geologic Analysis and Consulting Services)

3. Protective Barrier Development: The Field Lysimeter Test Facility (N. R. Wing, S. J. Phillips - WHC, G. W. Gee, R. R. Kirkham, J. L. Downs and M. D. Campbell - PNL)
4. Monitoring Methods Used at the Radioactive Waste Management Site at the Nevada Test Site (D. F. Emer and K. M. King - Reynolds Electrical & Engineering Co., Inc.)
5. A Bar Coding System for Environmental Projects (B. J. Hunt, R. B. Barber and G. M. Burgess - Bechtel National)
6. CHEMHAZ: A Hazardous Chemical Wastes Inventory Database Management System (J. C. Lavender and D. L. Lundstrom - PNL)
17. Control of the Reduction/Oxidation Potential of Hanford Waste Vitrification Plant Feeds (O. L. Kruger - WHC and M. E. Peterson - PNL)
18. Kinetic and Thermodynamic Implications of Some Commonly Used Rate Laws for Glass Dissolution (M. W. Grant - Dames & Moore and M. J. Plodinec - E. I. du Pont de Nemours and Co., Inc. - SRL)
19. High-Level Waste Disposal Engineered Barriers - Objectives and Results of the French R & D Program (G. Baudin, R. Atabek and M. Jorda - CEA, France)
20. In Situ Testing of Candidate Overpack Materials in Deep Argillaceous HLW Disposal Environments (W. Debruyn and H. Tas - SCK/CEN, Belgium)
21. COMPAS: A European Project for the Assessment of Structural Performance of Metallic Containers (B. Haijtink - CEC, Belgium, J. Miles and S. Hendry - Ove Arup & Partners, U.K.)
22. The Effect of a Stationary Precipitation Front on Nuclide Dissolution and Transport: Analytic Solutions (W. B. Light, P. L. Chambre, W. W.-L. Lee and T. H. Pigford - Lawrence Berkeley Laboratory, University of CA)
23. Dissolution/Precipitation of a Two-Member Chain at a Dissolving Waste Matrix (W. Zhou, J. Ahn, W. W.-L. Lee, P. L. Chambre and T. H. Pigford - Lawrence Berkeley Laboratory, University of CA)
24. Development of a Transuranic Isotope Assay System Using an Active Neutron Technique (H. Yokobori, Y. Endou, H. Suwa, S. Ohta - Mitsubishi Atomic Power Industries, Inc., Japan and Y. Nishihara - Mitsubishi Heavy Industries, Ltd., Japan)
25. Pilot-Scale Grout Production Using a Simulated Low-Level Waste - Process Description and Product Characterization (R. O. Lokken and D. H. Mitchell - PNL)
26. System Design, Construction and Start-up of the Hanford Transportable Grout Equipment Facility (H. Gaines Jr. - ATI and M. Carrigan - WHC)
27. New Tools for Remote Maintenance by Crane (H.-R. Oeser - KEWA, FRG)
28. Transportation ALARA Analysis for a Nuclear Waste Management System (G. McNair, K. Schneider, R. Smith, W. Ross and D. Faletti - PNL)
29. A Seal Analyzer for Testing Container Integrity (P. K. McDaniel and C. E. Jenkins - Seal Integrity Systems, Inc.)
30. An Alternative Approach to High-Integrity Containment of Low-Level Radioactive Waste (W. D. Black, P. M. Myers - Babcock & Wilcox and R. S. Watterson - Avancer Technologies, Inc.)
31. Characteristics of Intact LWR Spent Fuel (R. S. Moore, I. R. Moisson - MAXIMA Corp., K. E. Jones - University of Tennessee, B. T. Rhyne and K. J. Notz - ORNL)

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32. Action Taken to Remediate the 183-H Solar Evaporation Basins at the Hanford, Washington Site (W. F. Heine - WHC and J. H. Slaughter - DOE-RL)
33. An Integrated Approach to Volume Reduction at the West Valley Demonstration Project (D. E. Frank, S. R. Reeves and P. J. Valenti - West Valley Nuclear Services)
34. Studies on the Migration of Neptunium Isotopes at the Savannah River Plant (C. M. King, P. F. McIntyre, M. V. Kantelo, W. G. Winn and J. R. Cook - SRL)
35. Transportation of Contact Handled TRU Wastes (K. L. Ferguson - Westinghouse and G. J. Quinn - Nuclear Packaging, Inc.)
36. Shielded Canister Transporter Equipment Acceptance Test Operations (A. T. Kee and D. L. Swannack - Nuclear Packaging, Inc.)
37. Materials Selection for Process Equipment for the Hanford Waste Vitrification Plant (M. R. Elmore - PNL and D. E. Mitchell - WHC)
38. Immobilization Into Concrete of Liquid Radwaste (D. Mangin, M. Guerin, C. Lattaud and A. Malfondet - CEA Centre De Valduc, France)
39. Size Reduction of Large Waste Objects Contaminated With TRU (D. Mangin, A. Malfondet and C. Decobecq - CEA Centre De Valduc, France)
40. Radioactive Waste Systems of Spanish Boiling Water Reactors (F. Alverez - VALDECABALLEROS NPP, J. de D. Sanchez - COFRENTES NPP and F. de Lucas - STA. MARIA DE GARONA NPP, Spain)
41. PWR Nuclear Plants and His Solidification Systems in Spain (J. Sanchez Baptista - ASCO NPP and M. Ibanez Giner - UNIDAD ELECTRICA, S.A., Spain)
42. Field Testing Program for Radon Barriers at ANDUJAR Uranium Tailings Site (J. L. Santiago and J. M. Gravalos - ENRESA, Spain)

Tuesday, September 13, 1988

* 7:00 a.m. **Speakers Breakfast**
* 7:30 a.m. **Registration**
* 8:30 a.m. **Technical Sessions:**

Session 8 — HLW Practices & Proposals
Co-chairs: J. L. Knabenschuh, G. Baudin

1. HWVP Reference Glass Development and Evaluation (S. O. Bates - PNL)
2. The Effect of Waste Chemistry on the Fluidized Bed Calcination Process for High-Level Liquid Waste Disposal (H. B. Eldredge, J. P. Law and B. J. Newby - WINCO, INEL)
3. Optimum DWPF Processing Rate (C. B. Goodlett, W. R. McDonell, S. D. Thomas - E. I. du Pont de Nemours and Co. and J. W. Geiger - DOE/SROO)
4. TRU Removal from NCAW with Pneumatic Hydropulse Filtration (F. M. Simmons - WHC)
5. Development and Design Application of Cerium (IV) Decontamination Process (L. A. Bray and J. M. Seay - PNL)

6. CURE: A Commercial High-Level Waste Management Alternative (H. R. Brager, J. A. Rawlins, W. W. Schulz, J. P. Sloughter - WHC and C. H. Bloomster - PNL)

Session 9 — Liquid LLW Treatment
Co-chairs: G. T. Wright, F. Passant

1. Conditioning of Liquid Waste at Karlsruhe Nuclear Research Center (R. Pfeiffer - KIK, FRG)
2. Multi-Function Tooling for Effluent Treatment at Power Plant (C. Glorennec - EDF, France)
3. Processing Radioactive Wastes Using Membrane (UF/HF/RO) Systems (R. D. Doyle - ATI)
4. Condensate Polishing in BWR by Hollow Fiber Filter (K. Yamada, T. Shirai - NIPPON Atomic Industry Group Co., LTD, Japan and F. Tajima - Toshiba Corp., Japan)
5. A Simplified Model for the Dynamics of Multicomponent Ion Exchange System (C. W. Jeong and K. J. Lee - Korea Advanced Institute of Science and Technology)
6. Method of Treating Radioactive Waste Water Containing EDTA and Other Organic Acids (Y. Moriya, N. Kurumada, F. Todo and H. Kuribayashi - JGC Corp., Japan)
7. Removal of TBP From Low-Level Radioactive Wastewater at the Savannah River Plant Using Non-Functionalized Resins (J. P. Bibler - E. I. du Pont de Nemours and Company - SRL)

Session 10 — Radioactive Mixed Waste Treatment
Co-chairs: R. D. Izatt, T. M. Gilliam

1. A Generic Hazardous Waste Management Training Program (R. J. Carter - ORNL and B. Kamofsky - ERC)
2. Criteria for Long-Term Hazard Assessment of Chemotoxic and Radiotoxic Waste Disposal (E. R. Merz - Nuclear Research Center KFA, Julich, FRG)
3. Plans for Disposal of Solid Hazardous and Mixed Waste at the Savannah River Plant (D. S. Browning - DOE-SROO)
4. Behavior and Removal of Organic Species in the Savannah River Plant Effluent Treatment Facility (S. B. Oblath and G. K. Georgeton - E. I. du Pont de Nemours and Company - SRL)
5. Mixed and Chelated Waste Test Programs with Bitumen Solidification (S. I. Simpson - ATI, H. Vidal - CEA and M. Morris - Martin Marietta)
6. Development of a Mixed Waste Management Facility at the Nevada Test Site (R. L. Dodge - Reynolds Electrical & Engineering Co., Inc. and R. F. Brich - DOE-Nevada)
7. Test Program for Closure Activities at a Mixed Waste Disposal Site at the Savannah River Plant (J. R. Cook - E. I. du Pont de Nemours and Company - SRL, M. A. Katz and C. B. Stevens - SRP)

Session 11 — Experience in Decommissioning Nuclear Reactors
Co-chairs: J. J. Schreiber, K.-D. Kuhn

1. Physical Decommissioning of the Shippingport Atomic Power Station (F. P. Crimi - GE Nuclear Energy)
2. Safety Analyses for Disposal of Decommissioning Wastes (T. Vieno, H. Nordman, K. Rasilainen and V. Suolanen - Technical Research Centre of Finland)

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3. Disposal of Low Activity Radioactive Wastes from the Decommissioning of the RB-1 and RB-2 Research Nuclear Reactors (G. Cucchi - ENEA, Italy)
4. Cutting Processes: Their Nuisances and Protection Techniques (G. Pilot, M. Pourprix and R. Rouviere - France)
5. Technology, Safety and Costs of Decommissioning a Reference PWR and BWR - Technical Support for Decommissioning Matters Related to Preparation of the Final Decommissioning Rule (G. J. Konzek and R. I. Smith - PNL)
6. Planning for the Decommissioning of a Research Reactor (W. Dodson, P. Trinoskey, J. Munro, H. Isakari - Kaiser Engineers, Inc., S. Adams - U.S. Ecology, T. Lim, M. Denton and P. Vernig - University of California Berkeley)
7. NRC Rule on Decommissioning: What is the Role of Quality Assurance? (A. Z. Pusztai - Wisconsin Electric Power Company)

* 12:00 p.m. **Lunch — Open**

* 1:30 p.m. **Technical Sessions:**

Session 12 — Construction & Maintenance of Nuclear Facilities
Co-chairs: D. L. Ketcham, M. Lung

1. The Role of Integrated Logistic Support in Performance Assessment of Nuclear Facilities (G. Prager and J. F. Munro - Kaiser Engineers, Inc.)
2. Thermal and Structural Response of Underground Waste Storage Tanks (R. J. James - ANATECH Research Corp.)
3. Tests and Developments on the German Remote Maintenance Concept (H.-R. Oeser - KEWA, FRG and W. Issel - DWK, FRG)
4. Construction of a Large Span Concrete Roof Over a Vitrification Building Canyon (I. K. Ghosh, H. W. Tom and C. D. Alexandrou - Bechtel National)
5. Remote Crane Control Techniques and Closed Circuit Television for the U.S. Department of Energy, Defense Waste Processing Facility (D. A. DaSilva - Bechtel National)
6. Fabrication of Remote Steam Atomized Scrubbers for DWPF Off-Gas System (M. G. Nielsen - Bechtel National and J. Lafferty - Lawrence Pumps, Inc.)
7. Use of CADD in a Construction Setting (D. L. Ketcham - Bechtel National)
8. Construction of the Sellafield Thermal Oxide Nuclear Fuel Reprocessing Plant (M. J. Bullock - British Nuclear Fuels PLC, U.K.)

Session 13 — Disposal Facility Siting & Construction
Co-chairs: M. R. Adams, E. Dettileux

1. Use of the CREAMS Model to Represent Soil Moisture Under Various Trench Cover Designs for Waste Burial (M. Devaurs - LANL)
2. Operating Experience and Environmental Impact Assessment Study for Lan Yu Low-Level Radwaste Storage Site (R. Y. C. Leung - PECL, C. M. Tsai, R. T. Lee - AEC and C. Chung - Tsing Hua University, Taiwan)

3. The Vaalputs National Radioactive Waste Disposal Facility in South Africa (H. J. vd Weschuizen, P. E. Moore and B. B. Hambleton-Jones - Atomic Energy Corp. of South Africa Limited)
4. Recommendations to the NRC for Review Criteria for Environmental Monitoring and Surveillance Programs at LLW Sites (D. H. Denham - PNL and B. Jagannath - U.S. Nuclear Regulatory Commission)
5. Design, Development and Safety Assessment of the IRUS Repository for Disposal of Low-Level Radioactive Waste (D. G. Hardy, K. E. Philipose and R. G. Jarvis - Atomic Energy of Canada Limited)
6. The New York State Energy Authority's Strategy for Meeting the January 1993 Deadline for Establishing a LLRW Disposal Facility (J. D. Randall - New York State Energy R & D Authority)

Session 14 — Waste Minimization
Co-chairs: J. D'Ambrosia, J. Vrijen

1. Reduced Waste Arise in a Reprocessing Plant by the Use of Remote Control (W. A. Issel - DWK, FRG)
2. Waste Minimization at Department of Energy Facilities (K. Knudtsen - IT Corp.)
3. Charging Generators for Waste Management Costs (J. B. Berry and F. J. Homan - ORNL)
4. Hazardous Waste Reduction at the Savannah River Plant (P. F. McIntyre, H. F. Sturm Jr. and E. G. Orebaugh - E. I. du Pont de Nemours and Company - SRL)
5. Treatment of ORNL Process Waste (J. B. Berry, C. H. Brown Jr., V. L. Fowler and S. M Robinson - Martin Marietta, ORNL)
6. Sorptive Removal of Technetium from Alkaline Heavy Metals Sludge Filtrate Containing Nitrate Ion (W. D. Bostick and B. S. Evans-Brown - Martin Marietta, ORNL)
7. Characterization and Treatment of Low-Level Radioactive and Hazardous Wastes (L. W. McClure and R. E. Schindler - WINCO, INEL)
8. Self-Stripping Decontamination Polymers for the Separation of Contaminated Lead Oxides from Lead Shielding (S. Lefkowitz - Pentek, Inc.)

Session 15 — Decommissioning Nuclear Facilities
Co-chairs: H. F. Daugherty, K.- D. Kuhn

1. Experience of Decommissioning Waste Management (P. Lourme -Technicatome, France)
2. Decommissioning of Nuclear Fuel Facilities: Technological Experiences and R & D (T. Mano, M. Shiotsuki, H. Miyao and T. Tsuboya - Power Reactor & Nuclear Fuel Development Corp.)
3. Initial Decommissioning Activities for the Radiochemical Processing Plant at Oak Ridge National Laboratory (J. K. Johnson and D. W. Holladay - ORNL)
4. Consolidation and Disposal of Nuclear Test Debris at the Nevada Test Site (R. L. Dodge and C. C. Neagle - Reynolds Electrical & Engineering Co., Inc.)
5. SMANT: A Computer Program to Determine the Minimum Occupational Doses Pathways in Dismantling Operations (M. Conti and M. Mincarini - ENEA, Italy)
6. Status of Industry Standards for Decommissioning of Nuclear Facilities (D. R. Steffes - Dames & Moore)

Tuesday, Sept. 13, 1988

*	6:00 p.m.	**No-Host Poolside Reception**
*	7:00 pm.	**Banquet** — Guest Speaker T. E. Wade Jr., Assistant Secretary for Defense Programs, DOE-HQ

Wednesday, September 14, 1988

*	7:00 a.m.	**Speakers Breakfast**
*	7:30 a.m.	**Registration**
*	8:30 a.m.	**Technical Sessions:**

Session 16 — Waste Management Practices Around the World
Co-chairs: C. Chan, L. T. Lakey

1. Today's Situation and Prospects with Regard to Radioactive Waste Management in Belgium (E. Detilleux, F. Decamps and R. Heremans - ONDRAF/NIRAS, Belgium)
2. Radioactive Waste Management in the Federal Republic of Germany (W. Weinlander - DWK, FRG)
3. ENEA-NUCLECO Role in the Radwaste Operational Management in Italy (O. S. Cao, A. Costa, A. Gandellini, D. Filoni and P. G. Mantovani - ENEA/NUCLECO, Italy)
4. The Dutch Waste Management System (J. Vrijen and R. M. Van Kleef - COVRA N. V., Netherlands)
5. Licensing of a Central Treatment and Long-Term Storage Facility (H. D. K. Codee - COVRA N. V., Netherlands)
6. Radioactive Waste Management Research at CEGB Berkeley Nuclear Laboratories (D. Bradbury - CEGB, U.K.)
7. The Austrian Concept of a Geological Disposal of Low-Level Radioactive Waste and Hazardous Industrial Waste (P. Krejsa - Austrian Research Centre Seibersdorf)
8. U. S. DOE Defense Waste Management Program Implementation Plan (T. C. Chee - DOE-HQ and K. E. Hain - BDM Corp.)

Session 17 — Disposal of Defense LLW
Co-chairs: T. H. Row, J. J. Blakeslee

1. Department of Energy Plan for the Permanent Disposal of Low-Level Waste (E. A. Jordan, T. C. Chee - DOE-HQ and A. D. Rodgers - EG&G Idaho)
2. Low-Level Waste Disposal and Stabilization Activities at the Idaho National Engineering Laboratory (R. M. Brown - EG&G Idaho)
3. Hanford's Grout Disposal Program (G. J. Bracken - DOE-RL)
4. Defense Waste Management Operations at the Nevada Test Site (R. E. Williams and E. W. Kendall - Reynolds Electrical & Engineering Co., Inc.)
5. Low-Level Waste Disposal Facilities and Operations at the Savannah River Plant (J. R. Jansen and P. N. Brandt - DOE-SR)
6. The DOE Model and Interactive Approach to Waste Management (L. J. Mezga and B. M. Eisenhower - Martin Marietta)

Wednesday, Sept. 14, 1988

Session 18 — TRU Waste Processing & Treatment
Co-chairs: M. H. Raudenbush, S. P. "John" Mathur

1. Near-Quantitative Recovery of Actinides from Nitric Acid Waste Streams by Solvent Extraction Using DHDECMP (S. F. Marsh and S. L. Yarbro - LANL)
2. Separation of Trivalent Actinides and Lanthanides by Extraction Chromatography in the DHDECMP-HNO_3 System (T. Kimura and J. Akatsu - Japan Atomic Energy Research Institute)
3. In-Line Monitor for Transuranic Elements (V. B. Subrahmanyam - WHC)
4. Los Alamos TA-55 Solid Waste Certification Facility (M. E. Lazarus, C. L. Foxx and R. L. Price - LANL)
5. The Waste Handling and Packaging Plant (D. W. Turner and S. P. DuMont - Martin Marietta, ORNL)
6. In Situ Grouting for Improved Confinement of Buried TRU Waste at the Idaho National Engineering Laboratory (G. G. Loomis and J. O. Low - EG&G Idaho)

Session 19 — Decontamination Techniques
Co-chairs: W. F. Heine, P. Lourme

1. Development of Decontamination Techniques at the Winfrith Atomic Energy Establishment (M. J. Sanders and R. D. Bond - Winfrith Atomic Energy Establishment, U.K.)
2. EDF Guide Book for Decontamination at Power Plant (C. Glorennec and J.-P. Bemer - EDF, France)
3. Recent Developments in Gel and Foam Decontamination Processes Applied to Decommissioning (J. R. Costes, M. Montjoie - IPSN/UDIN, France and J. P. Gauchon - DRDD/SDFMA, France)
4. Decontamination Technology Assessment (R. P. Allen, G. J. Konzek, K. J. Schneider and R. I. Smith - PNL)
5. Kinetic Analyses of Chemical Decontamination Processes (A. P. Murray - Westinghouse R&D Center)
6. Large Scale Chemical Decontamination Using Transportable Decontamination Plant (P. M. Hawes - Winfrith Atomic Energy Establishment, U.K.)

* 12:00 p.m. **Lunch - Open**

* 1:30 p.m. **Technical Sessions:**

Session 20 — Performance Assessment
Co-chairs: N. A. Norman, C. Jantzen

1. Reflections on Performance Assessment in the Civilian Radioactive Waste Management Program (K. R. Fecht, T. W. Woods and J. C. Sonnichsen - WHC)
2. The Use of Performance Assessment in Repository Facility Design (N. A. Norman and L. J. Jardine - Bechtel National)
3. The Use of Performance Assessment for Repository Ventilation Systems (W. E. Wowak - R. F. Weston, Inc., D. A. Gardner - Impell Corp. and F. C. Cheng - Jacobs Engineering Group, Inc.)
4. Performance Assessment for Spent Fuel Waste Packages in Hydrologically Unsaturated Geologic Media (A. M. Liebetrau, M. J. Apted, D. W. Engel and P. W. Reimus - PNL)
5. Mathematical Modeling of Radionuclide Release from a Partially Failed Container (C.-L. Kim and I.-S. Suh - Korea Advanced Energy Research Institute)
6. Variable Temperature Effects on Release Rates of Readily Soluble Nuclides (C.-L. Kim - Korea Advanced Energy Research Institute, W. B. Light, P. L. Chambre, W. W.-L. Lee and T. H. Pigford - University of California)
7. Where Do We Go From Here on Waste Management Performance Assessments? (D. A. Waite, N. P. Kirner and S. P. Pavlou - Envirosphere Company)

Session 21 — LLW Treatment And Disposal Plans
Co-chairs: R. D. Wojtasek, B. G. Kitchen

1. Characterization Activities for Radioactive Waste from Garigliano and Alto Lazio NPPs (V. De Crescenzo and G. Eletti - Italian Directorate for Nuclear Safety & Health Protection)
2. Treatment Needs for Greater-Than-Class C Low-Level Wastes (W. A. Ross, R. A. Brouns and H. C. Burkholder - PNL)
3. Improving Postcombustion for Incineration of Hazardous and/or Radioactive Wastes (S. Carpentier - SGN, France, J. C. Faure - CEA, France and P. Saverot - Numatec)
4. The Conditioning of Low-Level Waste and of Hazardous Waste in Austria (P. Krejsa - Austrian Research Centre Seibersdorf)
5. First Results on Quality Control of Conditioned Radioactive Wastes (R. Odoj - Julich, FRG)
6. The Design and Development of Effluent Treatment Plants for the Sellafield Reprocessing Factory (M. Howden - British Nuclear Fuels PLC, U.K.)
7. The Spanish Low and Intermediate Radioactive Waste Repository Project (P. Zuloaga and J. Alonso - ENRESA, Spain)

Session 22 — Public, State and Agency Interaction
Co-chairs: S. M. Nealey, D. A. Stewart-Smith

1. Beyond the NIMBY Impasse II: Public Participation in an Age of Distrust (E. Peelle - ORNL)
2. A Perspective on Department of Energy - State Cooperation on Remedial Action Projects (S. A. Mann - DOE-HQ)
3. Shippingport Station Communications Program (J. J. Stote - GE Nuclear Energy)
4. The Development of the Waste Isolation Piolot Plant (WIPP) Project's Public Affairs Program (L. H. Walter - Westinghouse Electric Corp.)
5. Public Involvement in the Selection of the California Low-Level Radioactive Waste Disposal Site (R. K. Gaynor and S. A. Romano - U.S. Ecology)
6. Proactive Media Relations: Perspective from the West Valley Nuclear Cleanup (W. D. Hoffman and M. V. Andrus - West Valley Nuclear Services)
7. Audience Information Needs Assessment: What Does the Public Need to Know About Radioactive Waste Management? (S. M. Nealey and A. B. Sutthoff - Battelle/HARC)

Wednesday, Sept. 14, 1988

Session 23 — Transportation (Packaging & Shipping)
Co-chairs: M. M. Heiskell, G. Eletti

1. The Independent Development of a Multi-Modal, Multi-Waste Type Transport System for Transuranic Wastes (C. W. Pennington and T. J. Neider - Transnuclear, Inc.)
2. Design Programs and Development for Transportation of Transuranic Waste (K. L. Ferguson - Westinghouse Electric Corp.)
3. Waste Management (Truck & Rail Shipments to Hanford) (J. P. O'Donnell and R. C. Culbertson - GE Nuclear Energy)
4. Preparation and Transport of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank Package (D. M. Yannitell and P. J. Coughlin - GE Nuclear Energy)
5. Licensing and Regulatory Process for the Shipment of the Shippingport Reactor Pressure Vessel Package (G. E. Van Sickle - WHC/Shippingport)
6. Design Considerations for the Next Generation of Spent Fuel Transportation Casks (B. R. Nair and C. C. Little - Westinghouse Electric Corp.)
7. Cost and Risk Tradeoff for Routing Nuclear Spent Fuel Movements (S.-M. Chin - ORNL and P. D.-M. Cheng - Vanderbilt University)

Thursday, September 15, 1988

Technical Tours of Hanford Site

Two half-day tours at the U. S. Department of Energy Hanford reservation will be offered on the morning of Sept. 15.

* 8:40 a.m.-12:00 p.m. **Tour B**
* 9:00 a.m.-12:30 p.m. **Tour A**

The "A" tour will visit the portable food irradiation demonstration unit, the Grout Treatment Facility and the In Situ Vitrification Demonstration Unit. The food irradiation unit uses gamma radiation to prolong the shelf life of certain foods. The Grout Treatment Facility immobilizes waste as grout and places it in lined concrete vaults for long-term disposal. The vitrification project is an in situ thermal process that uses joule heating to destroy and/or immobilize waste that is in the soil. Cost: $5.

The "B" tour will visit research and development facilities of the Pacific Northwest Laboratories. Presentations will be made in robotics, artificial intelligence and other technologies under development at Hanford. Cost: $5.

3-4　各技術セッションの要旨

複数のセッションが並行して実施されたため限られたセッションの聴講であったが、出張者の専門分野、及び動燃より発表した論文に対する反響も含めて、以下に本会議での特記事項をまとめる。

なお、会議での発表論文は既に“Proceedings of SPECTRUM'88, Nuclear and Hazardous Waste Management International Topical Meeting, Sep. 11～15, 1988, Pasco, Washington” としてまとめられ、会議に際して既に発行されているので参考にされたい。また、動燃からの発表資料をAppendix-Bに添付する。

Session 1. (U.S. HLW VITRFICATION)

米国内では現在、高レベル廃液のガラス固化プロジェクトとしてウエストバレー固化プロジェクト（WVDP）、サバンナリバー（DWPF）、ハンフォード固化プロジェクト(HWVP)が進行中である。

本セッションでは、各プロジェクトの最近の状況について紹介があった。WVDPでは、コールドでのプロセス特性のチェックを約80トンの模擬ガラスを処理して終了し、1991年にホット運転を開始すべく準備中である。

DWPFは現在、約90％施設が完成し、1990年のホット運転を目標としている。本セッションでの発表は貯槽での前処理がテーマであったが、ポスターセッションでガラス溶融炉の製作について製作担当のベクテル社が発表するなど、着実に完成が近づいている。　HWVPは現在基本設計中であり、建設開始が1990年（ホットイン1990年）ということもあって、他のプロジェクトの進展やＲ＆Ｄの状況を見きわめているという状態である。それだけに日本でのTVF の状況にも大きな関心を持っているようで、施設訪問の項で述べるように、動燃でのセラミックメルターの開発状況や問題点について、今後の情報交換の意志表示があった。

また、このセッションでは、各プラントで製造される固化体の品質保証に関する発表がWVDP、HWVPからあり、固化体に要求される品質が明確化されつつある米国で、プラント側からいかに要求に合わせた固化体とするかの検討が綿密に行われていることをうかがわせた。

Session 4 (INTERNATIONAL HLW VITRIFICATION)

本セッションでは、米国以外でガラス固化を進めている各国から固化技術の現状が報告された。

西ドイツからは、ＰＡＭＥＬＡプラントの約２年半にわたる操業の経験をホット運転の立場からActivity Balance等を主体に紹介し、更にコールド運転を通算して３年稼動したメルターの交換の概要についても報告があった。また西ドイツからはもう一件、バッカースドルフのガラス固化施設設計の現状について設計を担当するＮＵＫＥＭ社から報告があった。

また、フランスからはラ・アーグの固化施設の現状について紹介があり、Ｒ７と呼ばれる固化施設はほぼ 100％建設が完了し、楕円の断面形状をした高周波加熱金属メルターの構造についても説明があった。フランスＳＧＮは固化の現状を紹介した10ページ程度の印刷物を会議室の入口に置くなど、組織としてこのようなミーティングの場をＰＲに有効活用していると感じられた。

イタリアは自国でのガラス固化は行わないが、ドイツ、フランス等の固化施設を利用する上で、廃液の前処理として遠心分離やゼオライトを利用したプラント（ＳＥＲＳＥ）のコールドテストの結果が報告された。

動燃からは、ＬＦＣＭ法によるガラス固化プロセスに向けて開発を行った直接通電ガラス溶融炉の開発の経緯について報告を行った。

日本でのＬＦＣＭ開発のポイントとして、白金族主成分の導電性スラッジの抜き出しを考慮したこと、ガラスせんいを原料とする供給法でオフガスへの粉塵発生を低減したこと、高周波二段加熱流下ノズルの採用及び廃メルター解体技術開発を主眼に報告を行った。

発表後の質疑には、ガラスせんいを原料としたことで、ＬＦＣＭの処理能力の低下を来たさないか、せんいが吸湿して供給量管理に問題を起こすことはないかの２点があった。

その他白金族の挙動については個別に質問を受け、特に西ドイツ、米国では本件に関し一歩先にＲ＆Ｄを実施した動燃の技術情報に関心を寄せていた。

Session 8 (HLW PRACTICES AND PROPOSALS)

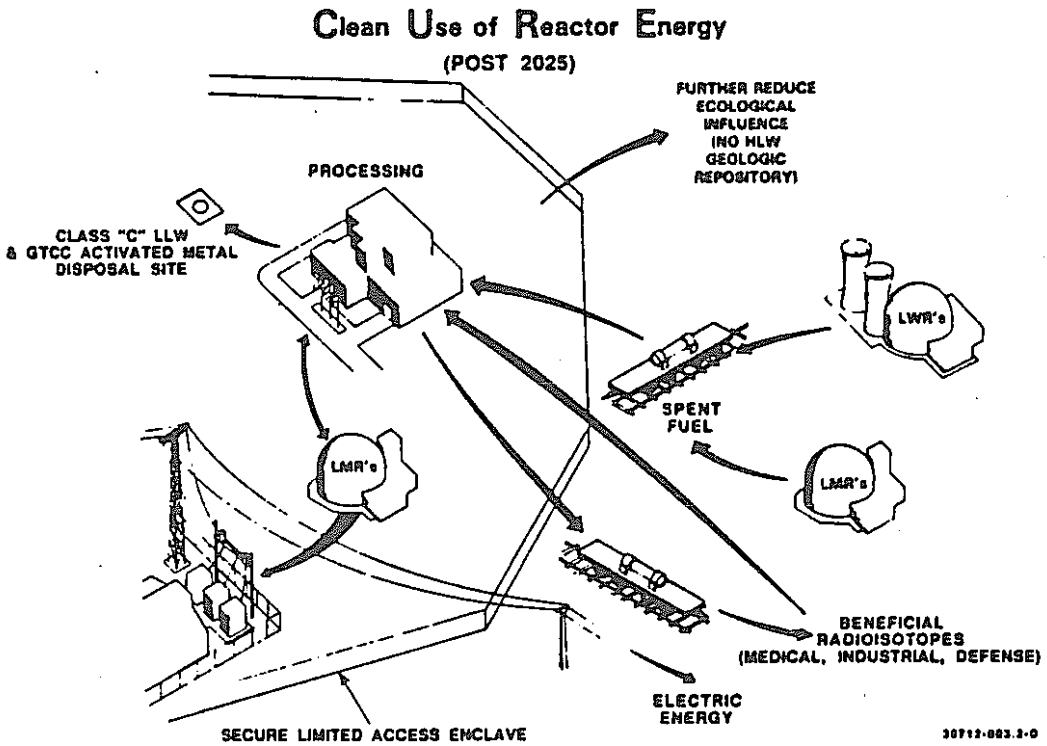
本セッションでは巾広い観点からの高レベル廃棄物の処理について米国内各機関より報告があった。

内容は、固化体組成の改良、経済性コスト評価を踏まえた固化プラントの最適稼動条件の解析（ＤＷＰＦ）、アイダホ国立研究所におけるフッ化物を含む高レベル廃液仮焼のためのコールドプロセス試験など技術的なもの、政策的なもの種々であった。

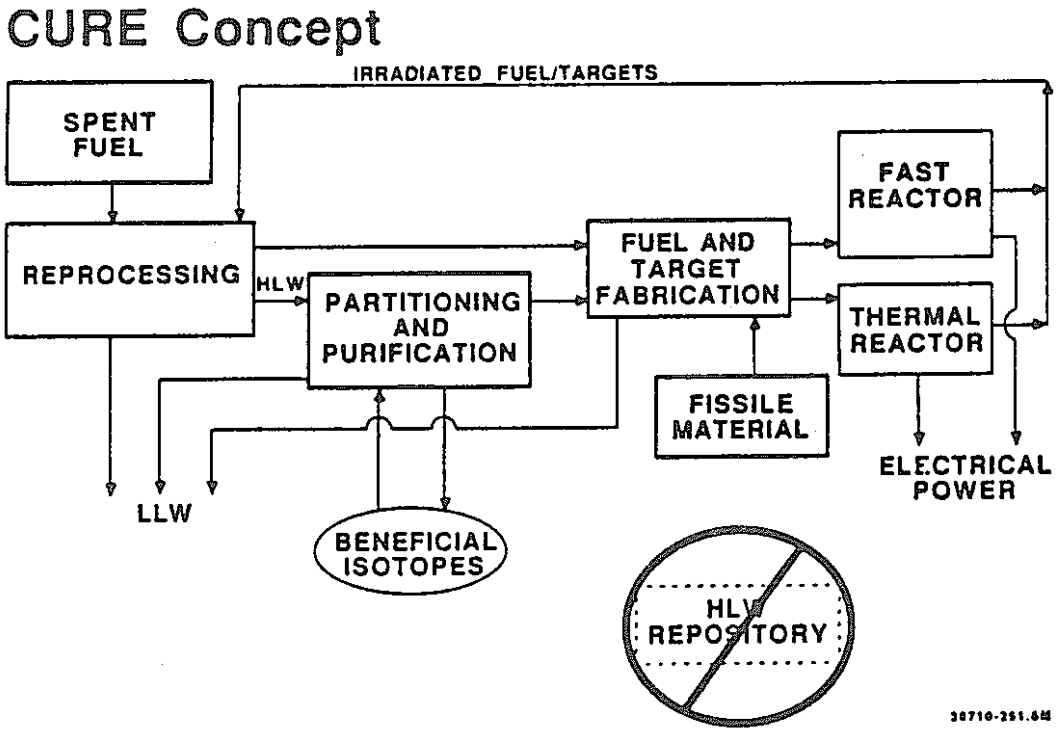
ＨＬＷ management に対するproposalとして興味深いものとしては、ＣＵＲＥ（Clean Use of Reactor Energy)と称する再処理、高速炉、消滅処理を含めたエネルギーサイクルの概念（第１図）が提起されていたことで、再処理を含むサイクルを考えＨＬＷの処分を無くし高速炉、熱中性子炉でトランスミューテーションをはかってゆくなど動燃での燃料サイクルの将来計画と共通点も多い。米国では商用の再処理が停止していることもあって、会議では全く質疑もなく関心が低いように思えたが、今後この概要に沿ってコスト評価や長期の公衆被曝の評価を行う計画があり、今後も注目しておくに価するであろう。なお本発表はウエスチングハウスハンフォード及びバッテルＰＮＬの共同で行われた。

又、キャニスタの表面除染に関して米国ウェストバレープラントから硝酸溶液中のＣｅ（Ⅳ）の電気化学的作用に利用する、いわゆるＲＥＤＯＸ除染法の概念が報告された。本除染法はＴＲＵ廃棄物に対する除染及びデコミッショニングに係わる除染技術として動燃においても技術開発をしているものであり、高い除染効果を期待できるものの除染装置の構成材料、廃液の処理等の未解決の課題も有している手法である。今後設備化にあたっての本除染法の動向について着目していきたい。

なお、キャニスタの除染としてホットの実績を有するワシントン州ハンフォードのBattelle ＰＮＬにおいても、除染効果の高いリン酸系の電解研摩法を採用し、良好な結果を報告していること等堪案すると、現在ＴＶＦにて採用したスプレー法が固化処理後の貯蔵等において安全性を確保するための必要充分な除染効果を有しているか否か、今後評価することが必要であると考えられる。



An implementation vision of the CURE concept



CURE concept flow sheet

第１回　CURE概念図

Session 15 (DECOMMISSIONING NUCLEAR FACILITIES)

本セッションは原子力施設のデコミッショニング及びデコミッショニングに伴う廃棄物の管理等広い視点からのデコミッショニング技術開発についての報告であった。

フランスからは三施設のデコミッショニングから発生する廃棄物の処理について発表があった。第一には現在 Stege－２（遮蔽隔離）の段階にある18Mw熱出力の重水冷却型研究炉ＥＬ－３であり、80ｔに及ぶトリチウム汚染廃棄物のセメント固化に関して、第二には黒鉛減退CO_2冷却炉Ｇ２の冷却系統のデコミッショニングから発生した90ｔもの解体大型パイプのin-sitn除染に関して、第三にはLa Hagueの密封線源製造用の化学セルＥＬＡＮ２Ｂ施設のデコミッショニングの概念に関してであった。仏国ではＡＮＤＲＡサイトの廃棄物受入基準が明確に示されており、デコミッショニングに伴い発生する廃棄物を区分管理できる体制にあり、デコミッショニング廃棄物の管理についてシナリオ策定及びコスト減量等が可能である。

米国ネバダサイトからは24エリア 935,000㎡に及ぶ汚染機材、土壌、デブリの処理処分、イタリアＥＮＥＡからはデコミッショニング時の作業者の被ばく線量評価コードＳＭＡＮＴ、また米国ウェストバレープラントからは核燃料施設のデコミッショニングに係わるＡＳＴＭ、ＡＳＭＥ等の規格の状況について報告があった。

ＰＮＣからは核燃料サイクル施設のデコミッショニングに係わる除染、解体遠隔、測定技術開発等の基盤技術開発の現状報告を中心に、東海ウラン旧生産棟、大型ＧＢの解体撤去再処理工場での再回収蒸発缶の除染等の実績を紹介した。

Session 19 (Decontanination Technigues)

本セッションは標題のとおり、除染技術の開発に関する報告である。

日本と同様に原子炉、再処理、ＰＩＥ施設等核燃料サイクル全般を開発利用している英国からは、Winfrith研究所より高圧水、フレオン、ウンクトブラスト、バレル研摩、硝酸電解研摩及び化学除染等様たる技術開発が行われている旨報告があった。ここでの試験の規模は、ＰＮＣのＷＤＦとほぼ同等であった。

フランスＥＤＦからは原子炉施設の除染に係わるガイドブックの概要について、米国ウエスチングハウス、ピッツバーグからは化学除染の反応挙動に関する評価研究が発表された。

本セッションで着目すべき発表は、バッテルＰＮＬ、R.P. Allew氏からの広範囲にわたる除染技術の調査及び評価の報告であった。同氏は10数年にわたり個々の除染技術の開発に携っており、現在ＷＤＦにて開発中の電解研摩除染及びセリウム（Ⅳ）イオンを利用したＲＥＤＯＸ除染等のStart は同氏らのＧｒによるものである。

今後、施設デコミッショニング開発に向けて適用化研究、システム研究が必要となる除染技術の開発にとって同氏の報告は貴重な情報源となり得る。

尚、報告終了後、同氏に詳細レポートの紹介をお願いしたところ、上記報告の元となる以下の原稿を送付いただいた。早急に内容の翻訳を行いたい。

・Assessment of Foreign Decommissioning Technology with Potential Application to U.S. Decommissioning Needs.

Poster Session

本ポスターセッションは、9月12日PM5：45から約2時間にわたりレセプションを兼ねて行われた。

発表件数は約40件で、米国から以外にもヨーロッパ各国をはじめ日本からの発表も見うけられた。

内容は高レベル廃棄物ガラス固化、低レベル廃棄物処理、除染、減容、測定、リモートメンテナンス、輸送、処分、評価コード等、廃棄物全般にわたり発表されていた。

高レベル廃棄物関係では1990年から運転予定のサバンナリバープラントから2件発表されたのを始め、高レベルガラス固化体の処分場として選択されたユッカマウンテンでの施設設計、大学並びに国立研究所からの核施移行参考評価コード等の報告が見られ、低レベル廃棄物関係ではいくつかのメーカからの除染技術報告、核種測定評価技術、輸送容器等の報告があり、明確化されてきた処分サイトに対応した米国での技術開発の方向性を感じられた。

3-5　ＳＰＥＣＴＲＵＭ'88に関連したプレスインタビューへの出席

本ミーティングはＡＮＳ主催の国際会議で、原子力開発を行う主要国が殆んど顔をそろえていた事、またハンフォード地区が一時米国内の高レベル廃棄物の第１次処分場の有力候補地となった経緯もあり、地域的にも本会議への関心は高かった。会議には地域選出の下院議員や、ＤＯＥ本部の担当官のスピーチがあり、連日の新聞記事となっていた。

会議のプレス取材の一環として、主要国からの代表参加者に対し各国の廃棄物管理とＰＡの現状をインタビューしたい旨プレスより会議事務局に要請があった。事務局はバッテルＰＮＬとウェスチングハウスのメンバーで構成され、虎田が一年間ＰＮＬに滞在中の知人も多かったため、日本の参加者代表として出席を依頼された。

９月13日に行われた新聞・ＴＶとのインタビューには

英　国	：	Fred Passant	ＣＥＧＢ（英国中央電力庁）
西　独	：	Walter Weinlander	ＤＷＫ（ドイツ再処理会社）
フランス	：	Claude Sombret	ＣＥＡ（仏原子力庁）
米　国	：	Don Wodrich	ＷＨ（ウェスチングハウスハンフォード）
日　本	：	虎　田	

の５名がパネラーとして質問を受けることになった。

質問は主として原子力と廃棄物のPublic Acceptance の各国の状況に関するもので、チェルノブイリ事故後の欧州の状況に始まり、虎田への質問には広島・長崎が引き合いに出されたりもした。

日本の現状については、広島・長崎を知る世代のnext generation が日本の大多数を占め、原子力の反対運動も単に原爆を掲げたものではなく、原発事故を引き合いに出した具体的なものであり、ＰＮＣのような公的な開発機関が主体となって、正しい理解を得るための教育を推進しているところである旨、回答した。

本件に関する新聞記事は第２図のように掲載された。

Waste

Continued from Page A1

proponents from [redacted]many, France and Japan.

Each said his country is moving ahead with various plans to dispose of nuclear wastes permanently starting as early as the 1990s. But winning public support has not been accomplished, several said.

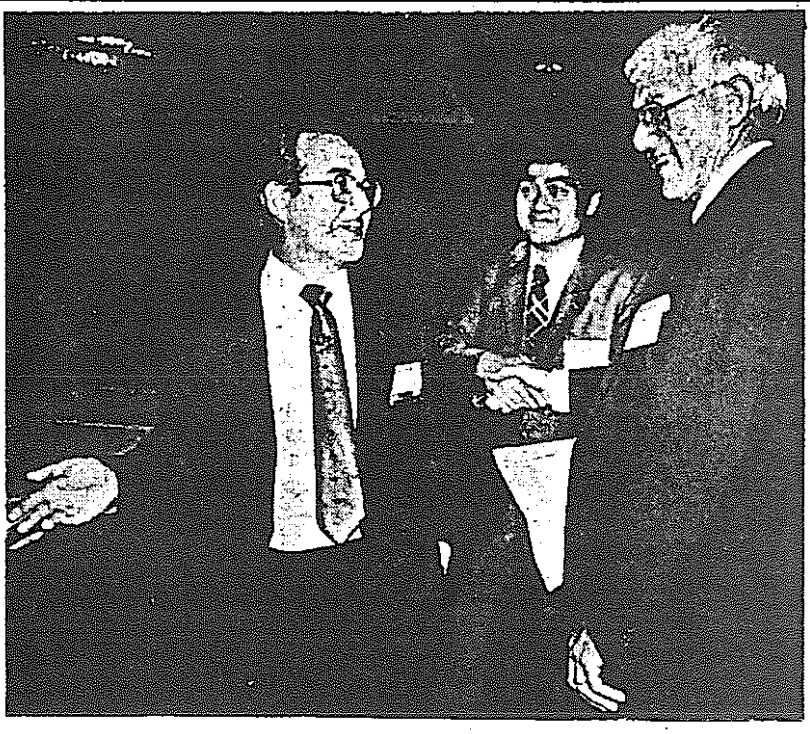
"The most severe problem to be solved is making sure the operation of nuclear plants is acceptable to the public," said Dr. Walter Weinlander, a nuclear expert from West Germany. "(Another) problem is to show that radioactive wastes can be disposed of indefinitely and safely."

Weinlander said tne 1986 Chernobyl accident in the Soviet Union sparked a wave of anti-nuclear sentiment in West Germany that may have reached its peak.

Shin-Ichiro Torata, a waste management technician from Japan, where 20 percent of the country's electricity is generated by nuclear plants, said a government-financed education program has lessened public fears about the atomic industry and its waste products.

Passant said the nuclear industry needs to tell the public more about what it is doing, how it is doing it, and why it is doing it.

"We have not done a good job in the past and we are suffering the consequences now," he said. "We hope to do a better job in the future. ... The education process will take a long time. I believe in 15 or 20 years there will be a greater public understanding."



Herald/Dorothy Adcock

Fred H. Passant, head of nuclear waste technology for the Central Electricity Generating Board in Great Britain, left, and Shin-Ichiro Torata, of Tokai Works waste management technology development division in Japan, talk with Don Wodrich, of Westinghouse Hanford who helped organize a worldwide conference on radioactive waste management. The three discussed nuclear waste problems in their countries during a press conference held at Cavanaugh's Motor Inn in Kennewick.

Passant and Weinlander said their countries have not seriously considered the Soviet Union's offer to accept, for a fee, nuclear waste from some places in Europe.

Weinlander said too little is known about the Soviets' offer. Passant said selling nuclear waste to the Soviet Union could undercut efforts to gain public confidence the material can be disposed of safely.

"That would really convince the public this stuff must be dangerous if we are willing to spend all this money to ship it to the USSR," Passant said. He also said it is unlikely an international nuclear waste facility would be developed, although countries share ideas on waste management.

The nuclear and hazardous waste conference continues through Thursday.

第２図　会議でのプレスインタビューの新聞記事

（1988年９月14日）

4. 米国内関連施設の訪問

4-1 概 要

訪問した施設での情報内容の区分を第１表に示す。

第１表 各機関からの情報内容区分

訪問日	訪問先	機 関	HLW ｶﾞﾗｽ固化	HLW 処理技術	ﾃﾞｺﾐｯｼｮﾆﾝｸﾞ	低ﾚﾍﾞﾙ処理	測 定	貯 蔵
9.16	ｳｪｽﾁﾝｸﾞﾊｳｽﾊﾝﾌｫｰﾄﾞｵﾌｨｽ	DOE-ﾘｯﾁﾗﾝﾄﾞ ｳｪｽﾁﾝｸﾞﾊｳｽ Battelle -PNL	○					
9.19	Battelle PNL. 324ビル	DOE-ﾘｯﾁﾗﾝﾄﾞ Battelle -PNL	ｷｬﾆｽﾀ 除 染		○			
9.20	アイダホ ＩＣＰＰ	DOE-ｱｲﾀﾞﾎ ｳｪｽﾁﾝｸﾞﾊｳｽ		假焼体 ＨＩＰ				見 学
9.21	アイダホ ＲＷＭＣ	DOE-ｱｲﾀﾞﾎ EG&G				焼 却 減 容	○	見 学

① ウェスチングハウスハンフォード（WH）

〔ＤＯＥ－ＲＬ〕 Cesar E. Collantas　Philip E. Lamont

〔ウェスチングハウス〕 Jerry Scott　Robert C. Baungartel

Richard A. Sexton　Robert A. Smith

Owen L. Kruger　Brad Wolfe

Carl Cox

〔Battelle-PNL〕 Chack Allen　Dan H. Siemens

Monte R. Elmore　Chris Chapman

Don Larson

（ウェスチングハウス・Wolfe） ハンフォードガラス固化プロジェクト（ＨＷＶＰ）の全体概要を紹介

（虎 田） 高レベルガラス固化技術に関してNoble-Metal を中心とした開発全体報告を実施。活発な質疑応答。

（Battelle. Chapman） ＨＷＶＰのメルター設計について報告。

(Battelle. Allen)　　銅とＳＵＳの熱膨張率の差を利用した切断技術紹介。

② Battelle-PNL.324ビル

〔Battelle-PNL〕　Langdon Holton　J.E. Surma

Jack L. McElroy　Chris Chapman

(J.E. Surma)　　ＨＬＷキャニスターの電解研摩除染について報告。

(Langdon Holton)　　３２４ビルのデコミの状況及び計画に関する報告。

(虎　田)　　動燃における廃メルター解体技術及びメルター遠隔技術についてＶＴＲを使った説明。

☆　３２４ビル見学 (Holton)

③ ウェスチングハウスアイダホ　ＮＷＣＦ

〔ＤＯＥ－アイダホ〕　M.C. Enos

〔ウェスチングハウス〕　D.A. Knecht　R.S. Baker　B.A. Staples

B.R. Albin

(D.A. Knecht)　　ＩＮＥＬの概要及び假焼技術に関する報告。

(R.S. Baker)　　假焼技術及びＨＩＰ技術に関する報告。

(塩　月)　　ハル等のＨＩＰ技術開発の概要説明。

(虎　田)　　高レベルガラス固化技術の全体概要の説明。

☆　ＮＷＣＦ、假焼体貯蔵エリアの見学。(Albin)

④ ＥＧ＆Ｇアイダホ　ＲＷＭＣ、ＷＥＲＦ

〔EG & G〕　L.A. Rowett

☆　低レベルβγ廃棄物の焼却・減容施設の見学。

☆　ＴＲＵ廃棄物の測定・貯蔵施設の見学。

(※) ＰＮＣ　天野、宮田　両氏等と合流。

4-2　ウェスチングハウスハンフォード (ＷＨ)

<u>ハンフォードにおける廃棄物Ｒ＆Ｄ関係者との討論</u>

ハンフォードガラス固化プロジェクト (ＨＷＶＰ)

９月16日リッチランド市内ウェスチングハウスビル内のＨＷＶＰオフィスにおいて、ＨＷＶＰ関係者 (ＤＯＥ－リッチランド２名、ウェスチング７名、バッテルＰＮＬ５名) と

溶融炉技術について終日意見交換を行った。（ＷＨ及びＰＮＬの所在地については、Appendix－Ｃに添付）

ＨＷＶＰでは、米国従来のＬＦＣＭプロセスを採用するが、西独（ＰＡＭＥＬＡ）での白金族スラッジ問題を考慮し、白金族対策を施したボトムドレン方式のメルターに変更する意向である。このため日本での試験の実情を詳しく聞き、討論したいということで先方の現状及び日本の状況をそれぞれプレゼンテーションし合い討論を実施した。主たる論点は、炉底勾配を持つメルターの試験結果及び高周波加熱流下ノズルであった。先方は１週間前にも西独関係者（ＫｆＫ、ＤＷＫ？）と同様の論議を行ったばかりで、出来れば近日中に三者を一同に会してこの問題についての交換会議が出来ないかという申し出があった。（これはバッテルＰＮＬのJ.L. McErloyからも別に打診された。）

会議は全体的には先方がいろいろ教えて欲しいという姿勢で進められ、日本がこの問題について一歩先に試験を手がけていることに対し、その経験を十分参考にしたいという意向があり、今後１年間の間に人の派遣等の申し出など更に情報交換のための動きがあると思われる。

本会議で入手したＨＷＶＰの現状説明資料をAppendix－Ｄに添付する。

以下に会議での主要な質疑、討論の内容を示す。

１．ガラス溶融炉関係

ａ．フラットな床のメルターで白金族を供給したときの運転状態の変化はどうであったか。これまでのＰＮＣのメルターの構造特徴とそのような設計をした理由は。

ｂ．ＰＮＣで炉底勾配を有するメルターの試験は、どのような原料を用いてどのような供給方法を行ったのか。

30°、45°の試験に加え、それ以上の勾配を有する炉との比較は行わなかったのか。

ｃ．白金族を含むスラッジの基本的特性を評価した結果はどうであったか。スラッジ中の白金族の含有率は、炉底に静置しておくと更に含有率の高い部分が形成されてゆくのか。

ｄ．白金族スラッジは、炉内ガラスの流動では撹拌できないのか。どの程度撹拌すれば動かすことができるのか。

ｅ．ＫｆＫのボトム流下ノズルでは、ガラスがノズル側面にまで“拡散”してコイルに

付着するトラブルがあったが、ＰＮＣでは同じような現象はあるのか。

ｆ．キャニスタ結合装置内の負圧はどのような方法でコントロールするのか。（米国ではキャニスタ全体を負圧チェンバに入れる方式をとっている）

ｇ．以前はノズルを分割して遠隔交換を考えていたのではなかったのか。

２．その他固化プロセス関係

ａ．高レベル廃液中のCorrosion Product にはどんな成分が含まれるのか。

ｂ．供給槽に設けたChemical Reagentのラインは何のためのものか。

ｃ．固化プロセスで回収したHNO_3は再処理に戻すのか。

ｄ．ＨＥＭＥはどのくらいの頻度でバックウォッシュするのか。

ｅ．キャニスタのデザインは将来のコマーシャルプラントでも同じか。

ＰＮＣの現状紹介質疑のあと、ＨＷＶＰのための炉構造開発を目的とした各種試験予定の紹介があり、ボトムドレンノズルの開発、物理モデルを使った炉構造の検討、1989年夏以降に予定している40％スケールのメルターの概念などが説明された。現在はウエストバレイプラントのメルターの炉底勾配を更に大きくし、炉底電極を貫通した流下ノズルを設置することを考えているが、エアリフトを用いたオーバーフローのラインも残すような設計を行っているとのことであった。（Appendix－Ｅ参照）

4-3　バッテルＰＮＬ

９月19日ハンフォードサイド、Battelle　ＰＮＬ３２４ビルにおいてＰＮＬ関係者４名とキャニスタの電解研摩除染及び３２４、３２５ビルセル内内装設備撤去計画の２項目について報告を受けるとともに、３２４ビル内でのデコミ状況の見学を行った。

①　キャニスタの電解研摩結果

３２４ビル内では現在までに工学規模にて 120ℓキャニスタ32本のガラス固化体を製作している。固化後のキャニスタの貯蔵工程の前後としては、密封溶接、除染及び chracterization の工程が不可欠である（第３図）。密封溶接法はコントロールされたＴＩＧ法を採用し、検査手法としてはヘリウムリーク検査法をとり入れている。chracterize としては表面線量、温度、重量計量及び軸方向に対するγ線スキャニングデータを採取している。

Battelleの工程での特徴は、電解研摩除染法の利用である。ＴＲＵ表面汚染廃棄物に

対する効果的除染法として現在ＰＮＣにおいても選考されている本除染法をBattelleでは1970年代からキャニスタの除染法として評価対象してきており、多くの基礎的、工学的データの蓄積の後、ホットの工程に組み込んでいる。（第４図）

電解液としては85％リン酸を用い、ガラスへのサーマル・ショックを避けるため、処理温度は 120℃としている。表面の研摩量はコールド経験での知見を基に、電流密度及び電解時間にてコントロールしており、10～50μｍの内に均一化を図っている。

又、キャニスタ底部に生じるガス溜まり（電解時に発生するH_2及びO_2）部についても研摩が可能となる様、スプレーノズルを配し、電解液の接触を促進している。

尚、除染プロセスでの大きな課題である廃液（劣化電解液）の処理は、ＨＬＷと混合しキャニスタ内にガラス固化してしまうことで解決を図っている。

現在までの除染効果の実績としては、除染前において２×10^8 dpm ／ 100㎠βγであったのが、除染後 2,000 dpm／ 100㎠βγ以下（平均300dpm／ 100㎠βα）が達成されており、ＤＦ10^3 ～10^5 を得ている。

ＴＶＦにおけるキャニスタ除染法としては現在スプレー法が採用されており、今後除染効果が必要充分となるか等、早急に検討をすることが必要であると考える。

② ３２４、３２５ビル内装設備撤去計画

Battelle ＰＮＣ３２４、３２５ビルにはそれぞれ３セル、合計６セルあり、1966年から1987年にかけて、使用済燃料再処理及びオフガス処理、ＨＬＷガラス固化等、数々の研究を行ってきた。

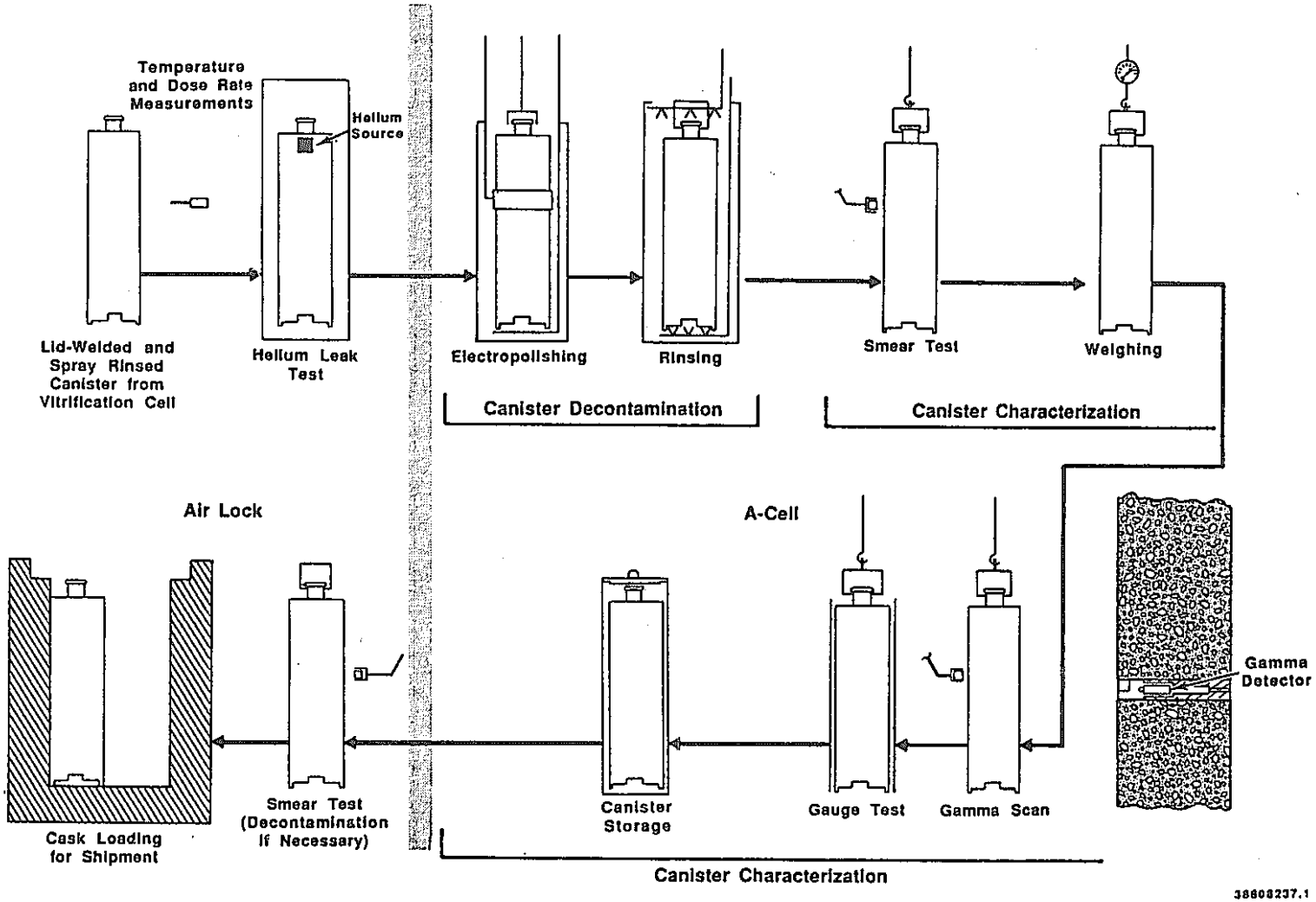
1987年より1992年にかけてこれらのセル内装設備を撤去し、セル内をClean out する計画が策定され、現在進められている。第５図に３２４ビルセル内平面図を示す。

このデコミッショニングは、安全性の確保、発生廃棄物の低減、区分管理並びに全体コストの低減の考え方の下に実施されているが、10,000Ｒ／ｈの空間線量、10ＭＣｉの含有放射能量を示すメルター設置の３２４ビルＢセルの除染、解体、及びＣＰＦの様に所せましと配置された内装機器の解体等、課題も顕在化している。

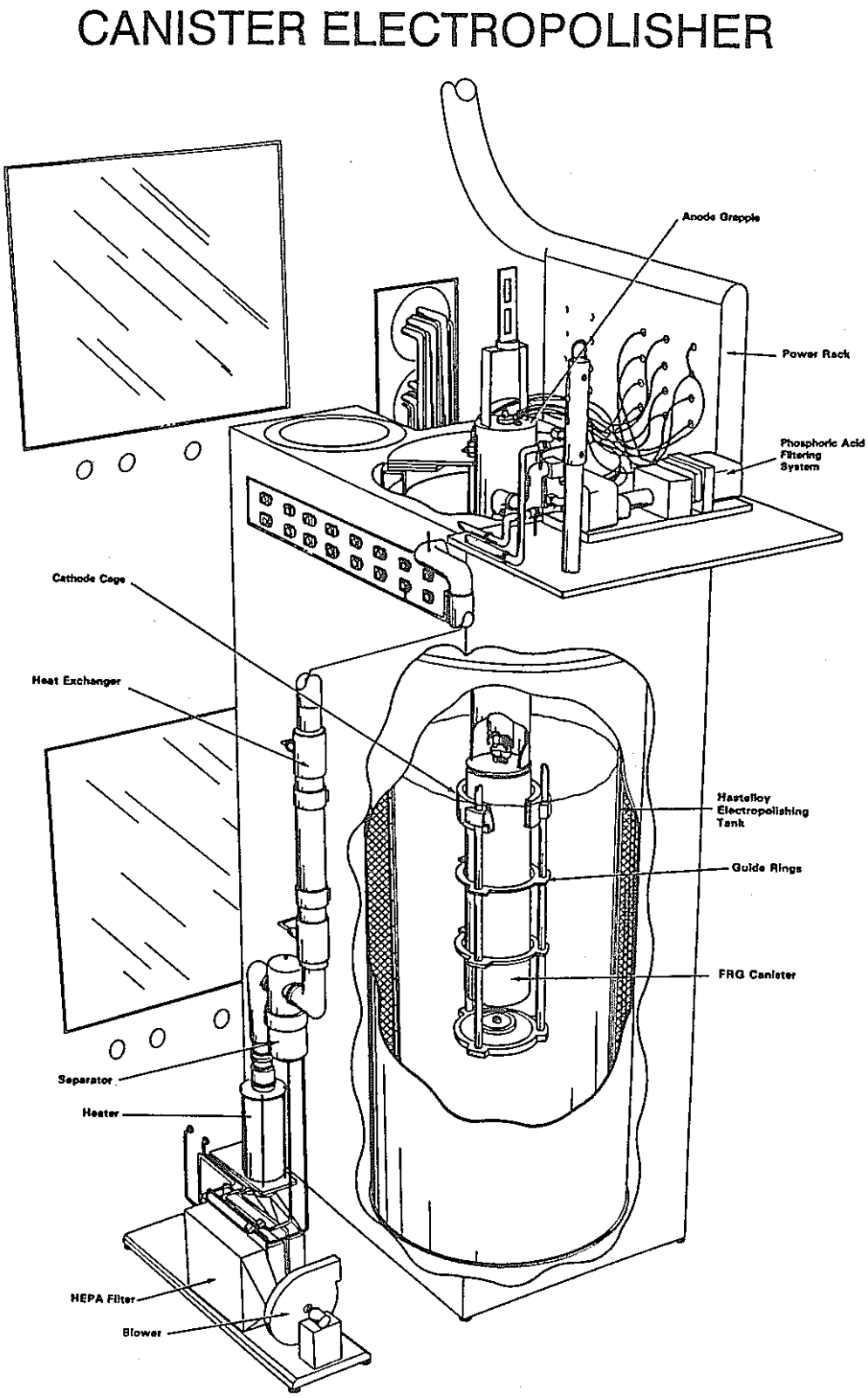
本件の様な高線量セル内機器のデコミッショニングは、世界的に見ても経験の不足している分野であり、ＰＮＣとしても今後情報交換及び人的交流等積極的な対応が必要であると考えられる。

又、米国ではハンフォードサイト及びＷＩＰＰ等低レベル廃棄物の受入れ（処分）サイトが明確化しているとともに受入れ区分、コスト等も設定されており、デコミッショ

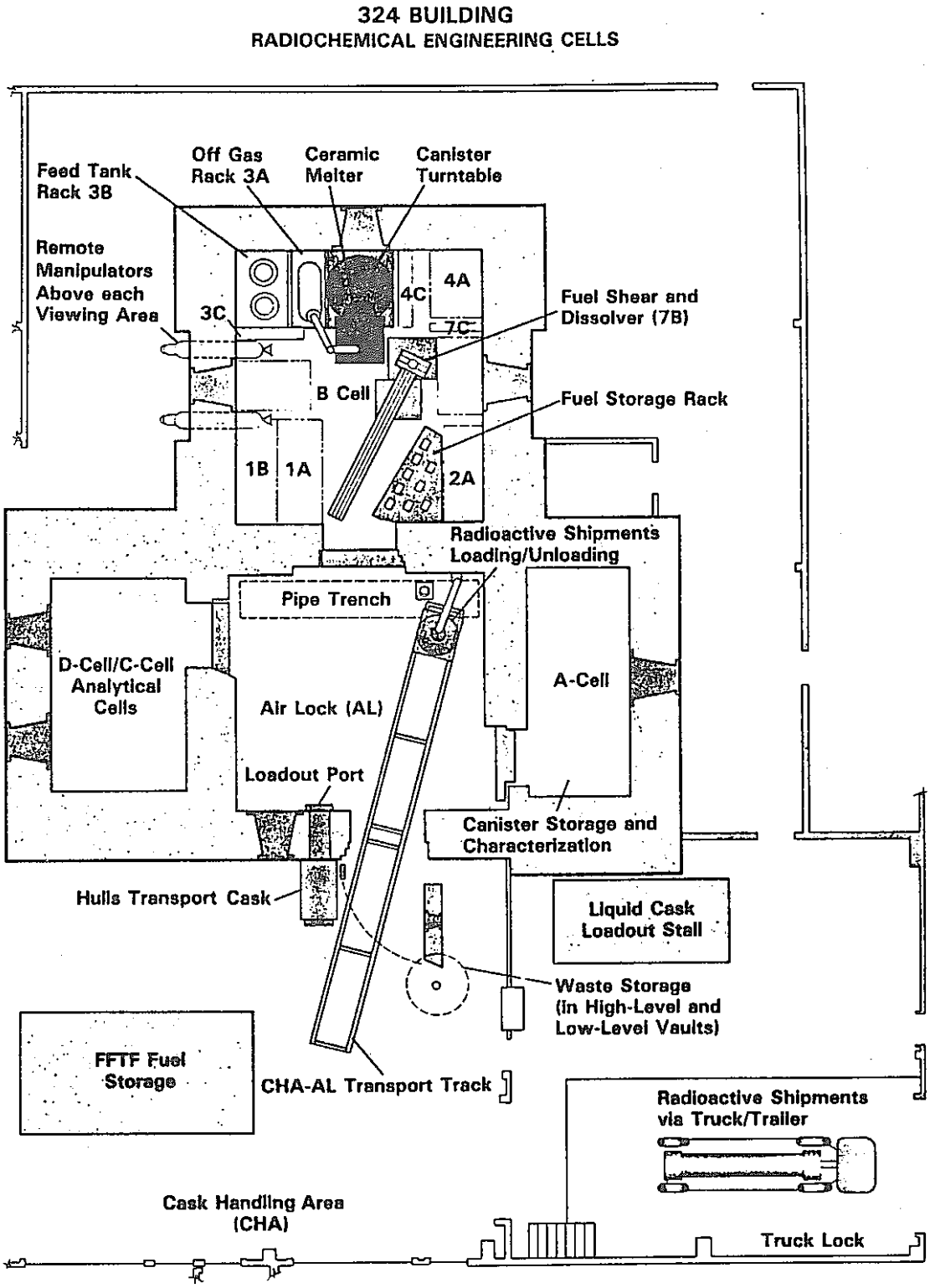
ニングの大きな課題である廃棄物のシナリオ及び全体コストの減算等を実施することが可能であることが計画策定の大きな基礎となっていることを感じた。



第３図　バッテルＰＮＬにおけるキャニスタ処理工程



第４図　キヤニスタ電解研摩除染装置



第５図　324ビルセル内平面図

4-4　アイダホ国立研究所（Idaho National Engineering Laboratory:INEL）

ＩＮＥＬはＤＯＥとの契約により、主としてウェスチングハウスアイダホ（ＷＩＮＣＯ）及びＥＧ＆Ｇが施設を運用し、50以上の原子炉（うち半数以上は既にシャットダウン）、再処理（ＩＣＰＰ）、廃棄物処理及び関連研究施設を持つ。施設のレイアウト等サイトの概要をAppendix－Ｃに添付する。

4-4-1　ＨＬＷ仮焼施設（NWCF）及び研究施設（ウェスチングハウスアイダホ：WINCO）

82年からホット稼動を続けている仮焼施設の概要説明及び最終固化体としてＲ＆Ｄを行っているセラミック固化体のホットプレス技術について討論及び見学を行った。

ＮＷＣＦは、軍用再処理を中心とするＩＣＰＰ（Idaho Chemical Processing Plant)に付属する廃棄物処理施設で、ＩＣＰＰで発生する高レベル廃液の仮焼を行い、粒状の仮焼体としてステンレススチールのビン詰めにして貯蔵する工程を持つ。施設の規模は約75m×40m×高さ22mである。

仮焼方法は、ケロシン燃焼による流動床仮焼法である。

第６、７図に施設及びプロセスの概要を示す。

廃液の処理能力は、 3,000～4,000 ガロン／日で、廃液の種類にもよるが減容比は６～８程度である。

仮焼炉は直径約２ｍのベッセルで材質はＳＵＳ－３４７、廃液及びケロシン供給ノズルが水平に取り付けられていた。

１基で充分な処理能力を有し、20年程度は稼動できると考えている。運転温度は約 600℃である。

隣りのセル窓からはオフガス機器のクエンチャスクラバーが見えた。

この他にシリカゲル充填のルテニウム吸着塔があるが、５～６年の運転によってもアクティビティのビルドアップは殆んど無く、これは廃液の組成及び処理温度がガラス固化に比べて低いためであろうという事であった。

施設外には円形の貯蔵建屋があり、１建家あたり７～８本の貯蔵ビンを内蔵している。最初の建屋は地下式であったが、最近のものは半分地上に出た構造である。これは地下の固い岩層まで掘り下げた施設とするのに技術的、コスト的問題があるためである。

<u>照射後燃料貯蔵プール</u>

ＩＣＰＰの再処理に送る燃料を一時貯蔵するプールで深さ30～40フィート、プールはウエストバレイ工場で以前見たものと同程度の大きさで、巾30m×60～70m程度の規模。プ

ールは4つの領域に区切られ、Ａｌ合金クラッド、ジルカロイ、ステンレス等燃料の種類によって分類貯蔵されていた。燃料はトラック又は鉄道のいづれでも搬入可能である。このプールから水中を運搬し、壁1つ隔てた再処理セルに持ち上げて再処理を行う。再処理はフッ化水素酸を含む酸で被覆ごと溶解再処理を行う。この結果、アイダホ施設の高レベル廃液には多量のジルコニウム、アルミニウムなどが含まれることになる。

Calcined Wasteに対する固化処理技術開発研究施設

仮焼体を更に固化する技術については、処分の受入れ基準を満足させるという観点から、ウェスチングハウス研究部門のうちdisposal technology section において研究が進められている。

固化体の安全性について、ＭＲＳに発表した報告* にあるように、固化体の組成と基本的特性の評価を行っている段階である。

現在コールドのＨＩＰを用いて直径30mm、長さ 100mmの小規模固化体の作製評価を行っている。（ＨＩＰ装置製作：オートクレーブ社）

アイダホにおけるＨＬＷはジルコニウム、アルミニウムを主成分とし、最終固化形態は、ガラス固化体にすると30～35wt％しか含有させられず、仮焼体に比べ 1.5倍の体積になる。これに対しセラミックでは60％以上含有させられ仮焼体を更に減容することが出来るので、一挙にセラミックとすることとし、その技術の完成まで仮焼体保管となるであろうとの事であった。

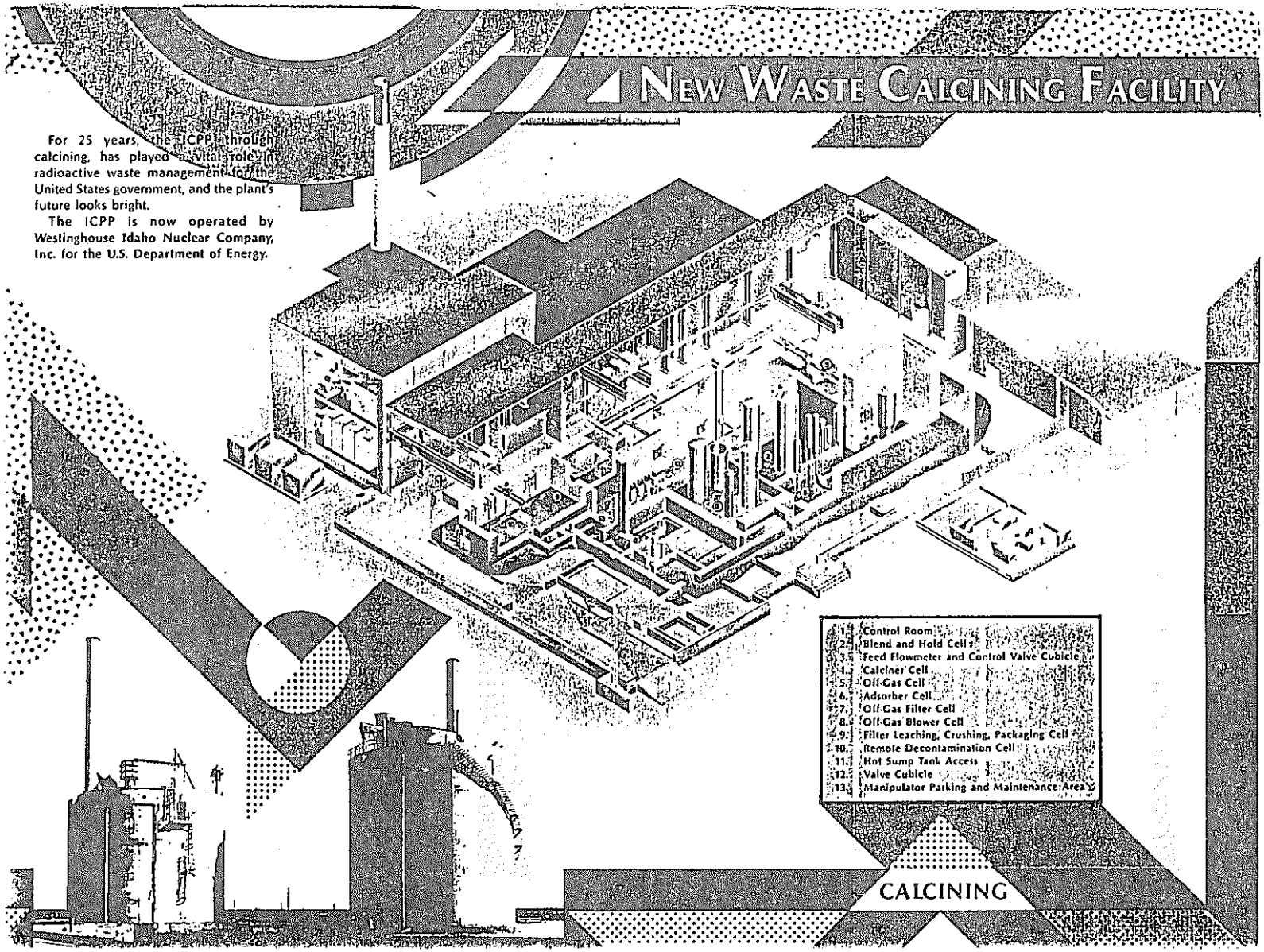
＊ R.S. Baker, B.A. Staples, D.A. Knecht, J.R. Berreth, "Experimental Glass Ceramic Products to Immobilize ICPP HLW"
Scientific Basis on Nuclear Waste Management, MRS Symp. Proc. Vol. 112, 1988.

ＨＩＰ法については現在ＰＮＣにて再処理工程から発生する高線量固体廃棄物であるハルの処理法として適用性を評価しているところであり、このＲ＆Ｄについて固化体のマクと及びミクロの写真回覧を中心に説明を行った。

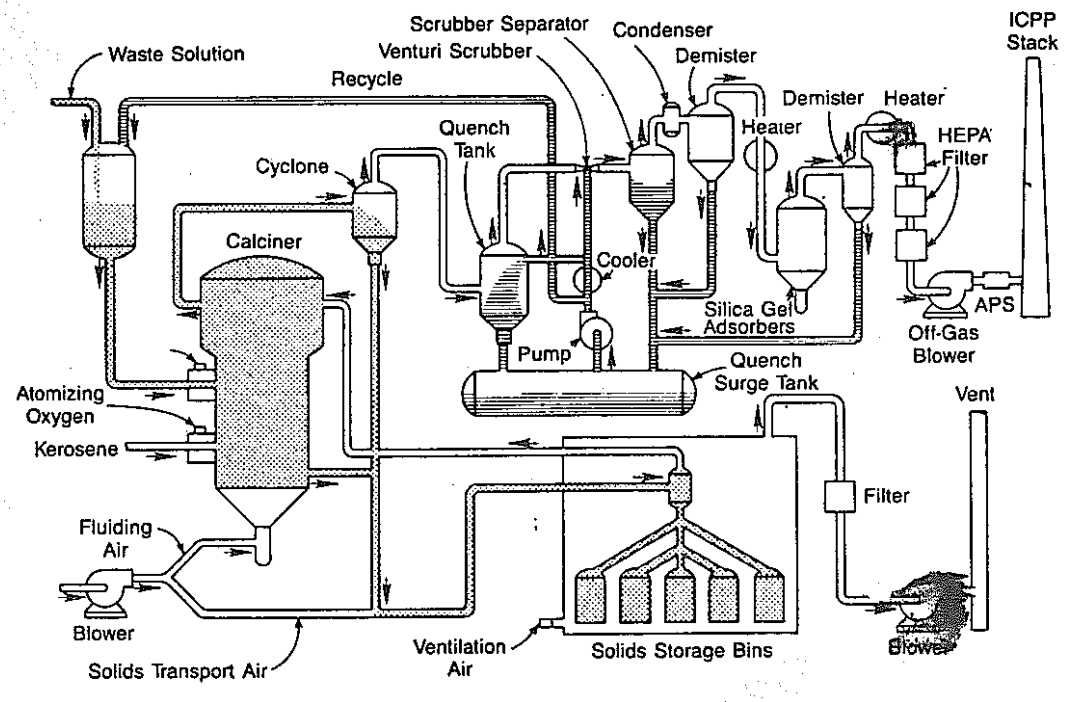
ＨＩＰ装置の管理区域内の設置に関して重要課題となっている高圧ガス設備等ライセンスについては、米国では特段の問題は無いとのことであり、通常の装置に加えてインターロック等の設備は考えていないとの事である。

仮焼体とジルカロイ金属との差異こそあれ、世界的に見ても初めての放射性廃棄物に対するＨＩＰ法の開発をＩＮＥＬ及びＰＮＣが行っており、現在ホット試験に移行していく

ことを計画していることを考慮すると、今後情報交換等行っていくことは有益であると思われる。


NEW WASTE CALCINING FACILITY
For 25 years, the ICPP, through calcining, has played a vital role in radioactive waste management for the United States government, and the plant's future looks bright.
The ICPP is now operated by Westinghouse Idaho Nuclear Company, Inc. for the U.S. Department of Energy.
1. Control Room
2. Blend and Hold Cell
3. Feed Flowmeter and Control Valve Cubicle
4. Calciner Cell
5. Off-Gas Cell
6. Adsorber Cell
7. Off-Gas Filter Cell
8. Off-Gas Blower Cell
9. Filter Leaching, Crushing, Packaging Cell
10. Remote Decontamination Cell
11. Hot Sump Tank Access
12. Valve Cubicle
13. Manipulator Parking and Maintenance Area
CALCINING

第6図　NWCF説明図



Schematic Flowsheet of the New Waste Calcining Facility

第７回　ＮＷＣＦの処理工程

4-4-2　低レベル廃棄物関連施設（ＥＧ＆Ｇ）

９月21日、ＥＧ＆Ｇ運営管理の低レベル廃棄物関連施設であるWaste Experimental Reduction Facility（ＷＥＲＦ）及びRadioactive Waste Management Complex（ＲＷＭＣ）エリア内のStored Waste Experimental Pilot Plant （ＳＷＥＰＰ）を訪問した。本訪問において、別途ＰＮＣからＴＲＵ廃棄物の非破壊測定の調査を目的として出張中の天野（環資部）、宮田（環工部ＣＴＳ）両氏らと合流した。

ＷＥＲＦ

本施設は、ＩＮＥＬエリアから発生する低レベルβγ廃棄物を対象とした減容処理施設である。処理工程としては可燃廃棄物の焼却、焼却灰のポルトランドセメントによる固化、難燃物の200tonコンパクタによる圧縮減容並びに金属廃棄物のプラズマ及びエアーアーク切断後誘導溶融固化となっている。施設の設置付けとしては定常的な処理に主眼が置かれていると思われ、安全かつ低コストでの運営を目指している様である。

ＳＷＥＰＰ

本施設は米国内のDefence Waste 及びＩＮＥＬ内で発生したＴＲＵ廃棄物を検査、一時貯蔵する施設である。

検査内容は、Ｘ線透視による廃棄物ドラムの内容物確認及びアクティブ中性子測定法による含有ＴＲＵ核種量の評価が中心となっている。両検査とも定常化されており、簡便かつ自動に評価が行われている。

ここで取扱われる廃棄物は、1989年よりニューメキシコ州のＷＩＰＰ（Waste Isolation Pilot Plant)に永久保管されることが計画されており、ここＳＷＥＰＰでは前記検査等により個々の廃棄物をＷＩＰＰ受け入れ条件と照合する、あるいは再度コンディショニングする等の処置を行っている。一時貯蔵エリアは、東京ドームの様な加圧シートと鉄骨によるドーム構造を成し（写真２）、貯蔵廃棄物はパレット上に５～６枚に縦積みされている。

訪問の際に見学した１ドームは約４万本のドラム缶が貯蔵されていると概算され、その量はドームの約50％を占めていると思われた。

又、今回見学は出来なかった低レベルの処分サイトの地層標本（ボーリング試料）についてもＳＷＥＰＰ施設内に展示されていた。

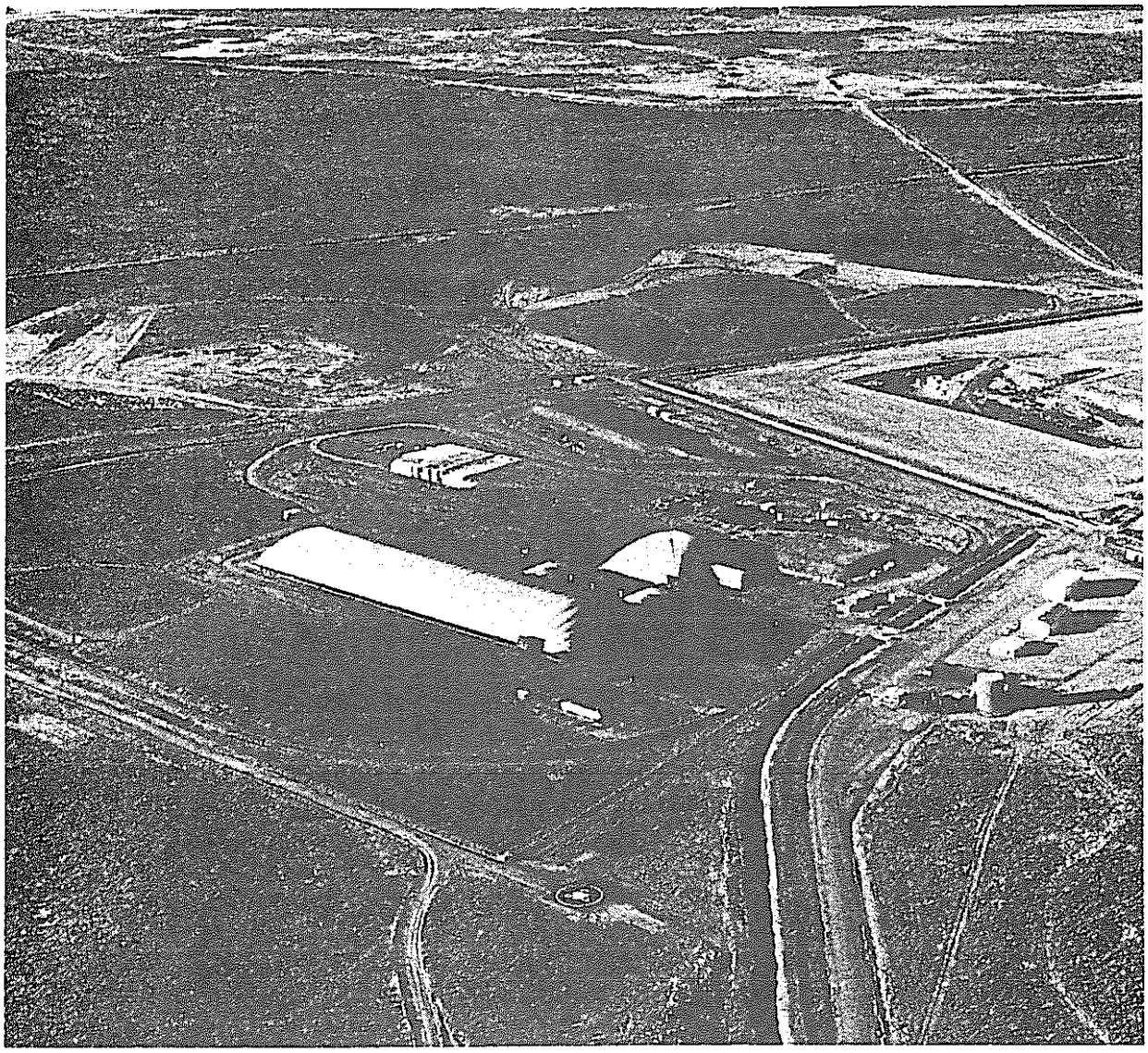


写真2　SWEPP

5. あとがき

今回の海外出張に当り、会議後の各サイトの訪問は廃棄物に関する将来技術開発の動向調査というテーマを主体に考えていたが、各プロジェクトの訪問に際してガラス固化での白金族の挙動、ガラスファイバー原料、機器の遠隔解体等、日本の技術の現状に大きな関心を持って会議が準備されていた。

このため訪問に際しては、当方の技術の紹介、質疑討論で非常に忙しく、しかしＰＮＣのポテンシャルを周知させられた、という意味で有意義な訪問であったと思う。

以下、今回の出張で筆者が特に気付いた点を簡単に列挙する。

o　今回のような国際会議は発表、報告に加え、特に欧米各研究機関の参加者達は個人的な交流・情報交換の場として活用しており、発表の聴講もそこそこに小グループでテーブルを囲む姿が見られた。このような情報交換はマネジャー、研究者それぞれのレベルで行われており、技術面、政策面など自由な立場で意見交換を行っているようであった。

今回は原研からの参加者も１名と少なく、原産会議からの参加はあったものの、研究開発に関しての国際交流という面では少し寂しい感があった。

o　発表に対して質問を行った際、当方の所属氏名を名乗らずに質問に入ったところ、Chairmanより注意を受けた。当方は発表者及びChairmanとも既に面識があり、聴衆も限られた人数であったのでつい簡単に考えたのであるが、理由は今年のTucson会議で報道関係者が質問を行い、後日同様の内容をプレス発表したとき、会議での回答と内容が異ったため問題化し、始めてプレス関係者が質問していたことがわかったという前例がある。これを教訓に会議のルールを徹底させようという主旨であった。今後注意すべきことである。

o　米国ハンフォードでの固化プロジェクトは、90年着工、99年頃ホットイン予定と、他の国内プロジェクトや西独、日本よりも設計・建設の各フェーズが数年遅く、他プロジェクトの動向を見ながらの状況となっている。現状での関心はセラミックメルタ方式での白金族元素の挙動であり、これがスラッジ状で炉底に滞留することを防止する炉構造及びボトムドレンの技術である。

炉底に勾配を持つセラミックメルタの炉構造は既にＰＮＣ及び西独（ＫｆＫ）での開

発試験が進行中であり、ＨＷＶＰを設計しているウェスチングハウス及びバッテルＰＮＬでは早期の情報交換に関心を寄せていると同時に、独自のＲ＆Ｄに着手している。

またボトム流下の技術は、従来の米国方式がオーバーフロー流下の技術を主体としていたこともあり、信頼できるフリーズバルブの開発を行う必要に迫られている。このため、高周波流下ノズル、特にＰＮＣの２段加熱流下ノズルの技術に関心を持っていた。

また高周波加熱ノズルは、もともとＫｆＫで開発に着手されたものであり、以上述べた炉底構造及びボトム流下技術を総合して、西独やＰＮＣ双方からの技術情報の入手を希望していると思われた。

o　バッテルＰＮＬ、３２４、３２５ビルのセル内機器の撤去計画については、当初の計画に沿い着実に進んでいることが見学等の中で確認できた。しかしながら、今後実施が予定されている３２４Ｂセル等廃ガラス固化メルター等の高線量大型機器のデコミッショニングに際しては除染、遠隔解体、廃棄物対策等様々な課題を有しており、ＰＮＣにおける廃メルターのＲ＆Ｄの開発等との情報交換と積極的に行いたい旨の話があった。

o　アイダホ国立研究所での高レベル廃液の仮焼処理及び固化体の開発は全世界的にガラス固化が主流の中にあって独自のものであるが、ＨＦを主体とした廃液の組成を考慮し処分の受入れ基準を満足させながら高減容化を目指している。固化処理の将来技術に結びつくものであるかどうか、現状での判断は難しいところであるが、シンロック固化と同様、今後の開発の動向に注目しておく必要があると思われる。

最後に今回の出張に関して多大な御協力をいただいた本社環境資源部、人事部、国協室、ワシントン事務所及び東海、大洗の関係者各位に対し心より謝意を表します。

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Appendix A

SPECTRUM '88 出席者リスト

SPECTRUM 88

NUCLEAR AND HAZARDOUS WASTE MANAGEMENT
INTERNATIONAL TOPICAL MEETING

SEPTEMBER 11-15, 1988

PASCO, WASHINGTON

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Appendix B

SPECTRUM '88 発表資料

1. Development of Glass Melter for the PNC Tokai Vitrification Facility

2. Decomissioning of Nuclear Fuel Facilities; Technological Experiences and R & D

DEVELOPMENT OF GLASS MELTER FOR THE PNC TOKAI VITRIFICATION FACILITY

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ABSTRACT

Power Reactor and Nuclear Fuel Development Corporation (PNC) has developed Liquid Fed Joule-heated Ceramic Melter (LFCM) for the HLLW vitrification process since 1977. Technology development includes design of melter structure to prevent the accumulation of deposits, induction-heated bottom drain nozzle, liquid-fed process with glass fiber additives, and associated monitoring instruments. Related technology development such as remote maintenance and decomissioning have also been done. In this paper, the fruit of melter development experiences will be described.

I. INTRODUCTION

The vitrification process technologies have been developed in PNC since 1977, PNC process is based on the Liquid Fed Joule-heated Ceramic Melter.

Many activities on LFCM process development have been carried out in the full-scale cold tests through the operations of the Engineering Test Facility (ETF) and Mock up Test Facility (MTF) started in 1980 and 1982, respectively.

Currently, the groundpreparation for the Tokai Vitrification Facility (TVF) was started after completing the detailed design, design improvement and getting the license from regulatory agency of the government. TVF will start operation in 1992. Table 1 shows the masterschedule of TVF.

The joule-heated ceramic melter, which is based on the melter commercially used in glass industry, is a main equipment in the LFCM process. In the developmental work, melter has been modifed to be more suitable for adapting the vitrification process by adding PNC's own improvements and modifications.

Figure 1 shows the PNC experiences of melter construction and operation in relation with TVF schedule.

II. DESCRIPTION OF PNC MELTER DEVELOPMENT

There are several development subjects in the ceramic melter system when it is adapted to the vitrification process. Major development items carried out for the PNC melter system are listed in Table 2.

In the earlier stage of the development, melters with different structures and materials were tested to compare their process characteristics. Then melter design has been modified to improve the LFCM process performance. Melter structure with sloped floor, glass additive using fiberglass frit, and freeze valve drain with two-zone induction heating are the major results being adopted in the final design.

In the mock-up test, melter constructed in 1987 following the TVF final design has started operation in connection with whole process equipments. Photograph 1 is the new mock-up melter placed in the simulated remote cell.

II-1 MELTER STRUCTURAL DESIGN AND OPERATION

In the LFCM process, melter refractory design should be optimized mainly considered with temperature, heat balance, glass flow and also the behavior of immiscible deposits which is electroconductive.

Several experiments, about the slope of melter bottom were performed using lab.-scale melters in order to avoid the operational problem caused by the accumulation of electroconductive deposits which is consist of noble metal elements. The result showed that the melter bottom slope of 45° would evade the operational difficulties by facilitating the discharge of the deposit.

In order to confirm above result, melter operations have been carried out using full scale melters with a bottom drain at 45° sloped bottom. Operation tests using highly simulated waste, each test includes 3 to 8 days of continuous feeding, have been carried out to evaluate the influence of conductive deposit on melter operation.

It was found that no significant change has been observed in joule-heating between main electrodes and more than 90% amount of noble metal elements fed into the melter was discharged through the bottom drain. The short circuit phenomena that cause the operational problem of joule-heating could be eliminated.

II-2 LIQUID WASTE AND FRIT FEED TECHNOLOGY

In the development of liquid waste and frit feed technology, powdered and granular glass (beads) additives have been attempted to use in the LFCM process in the earlier stage of the development.

In view of stable melter operation, new glass additive forms have been developed in considered with reducing the amount of particulate to prevent the off gas line plugging as well as to keep good product glass quality. Glassfiber additive and its continuous feed system have been developed in place of former two types of glass frit.

In Table 3, the specifications of each type of glass frit are described. After the continuous operation tests using glassfiber additives producing more than 10 tons of simulated waste glass, LFCM using cylindrical glassfiber additives was adopted for TVF process.

In the stable feed operation, entrainment of particle in the off gas stream was reduced up to 1/10 compared with that of the feed operation using beads frit, as shown in Figure 2. It was also found that the glassfiber additive made the glass melting be stable and moderate without abrupt evaporation of the water on the melting surface.

The size of the cylindrical glassfiber additive is typically 70mm in diameter and 70mm in length. The fiber diameter is about 10 microns. The liquid holding capacity of glassfiber additive is 4 ml/g at the maximum. The characteristics of the glassfiber additive made by sintering have been optimized with respect to the liquid holding capacity and transportation ability in the feed system.

Photograph 2 shows the outlook of the cylindrical glassfiber additives currently used in the engineering scale process.

II-3 DRAIN SYSTEM DEVELOPMENT

Drain system has been developed to have good operation and maintenance ability. Two types of glass drain freeze valve have been demonstrated. One is a direct current heating type with mechanical stopper for glass flow at the termination of glass drain, the other is an induction heating type. The features of the above two drain systems and test results are summarized in Table 4.

From the standpoint of the simplicity of system and operation and especially of its expected long lifetime of the drain pipe, the freeze valve with induction heating has been further developed and modified.

The point of the development was to eliminate the formation of glass string at the termination of glass drain.

As the result, freeze valve with two-zone induction heating, which gives the heating to the tip of the drain independently, was found to be effective to eliminate the formation of glass string. This concept has also been introduced to the TVF design.

Figure 3 illustrates the present design of the bottom freeze valve with two-zone induction heating.

II-4 HEATING SYSTEM DEVELOPMENT

The melter should have auxiliary heating system for start-up operation besides electrodes for joule-heating. Heater units which have conventional SiC resistance heater inside the Inconel jacket are used in the present design.

Microwave heating is now under development as a promising alternative heating technique in the future. It is expected for both to increase melting capacity when using in feed operation and to simplify melter superstructure by eliminating heater units.

II-5 INSTRUMENTATIONS

Ceramic melter is equipped with several instrumentations to monitor the operation status including temperature, pressure, and electrical conditions which is listed in Table 5.

Instrumentation which is typical for PNC melter is the molten glass surface detection system based on electrical resistance measurement between the detection prove and glass. The system has been developed and improved to get enough reliability in measuring the glass level within 10 mm.

Figure 4 shows the system concept of currently tested detection system. The change of the electrical resistance is analysed based on the time difference of the resistance to eliminate the effect of glass temperature and composition which affect the glass resistance.

II-6 REMOTE MAINTENANCE

Many activities on the remote maintenance have been carried out in the development of LFCM process because that remote maintenance is necessary for melter parts and melter body which are supposed to have short lifetime compared with that of the plant.

Remote maintenance is applied to the following components; the melter components such as the heating units for start-up, connections in the feed line and off gas line, and instrumentations like thermocouples. As the remote handling tools, in-cell cranes and two-armed servo-manipulators will be equipped to be able to make in-situ maintenance. Melter itself can also be replaceable by disconnecting from the supporting frame.

To improve the remote design of the melter components, remote handling tests have been carried out using a simulated melter structure and remote handling tools in a simulated remote cell. As the result of these tests, most suitable remote design and handling procedure for each melter component have been confirmed.

II-7 RELATED TECHNOLOGIES

Ceramic melter will become a new large size solid waste with high radioactivity after its lifetime. Therefore, dismantling technologies for ceramic melter have been developed aiming to be able to handle and store it by the same procedure as the other high-level solid waste by disassembling it into small pieces.

The results of remote dismantling tests using mock-up melter served in actual cold operations have been considered in the design of handling devices in the dismantling cell which is planned to be provided for the TVF.

The thermal and flow analysis of molten glass by computer modeling have been performed to evaluate the melter characteristics, and to utilize it in the melter design work. Extended work in computer analysis is still continued to apply it to the process control of melter system.

As an attempt to extend the operation life of ceramic melter, fundamental research on refractory and electrode materials has been carried out to improve the corrosion resistance to the molten glass. Some improved ceramic materials, which have both adequate high electrical resistance compared with that of the molten glass and more corrosion resistance than presently used Cr_2O_3-Al_2O_3 refractory, have been found in laboratory-scale test.

III. CONCLUSION

Many R&D activities have been carried out on the ceramic melter

technology to attain the most suitable LFCM process for TVF. As the result, the present melter for TVF is designed to eliminate the operational difficulties in liquid fed operation and glass melting with noble metal. A reliable bottom drain with induction heating and remote handling technique has also introduced in the final design.

Table 6 shows the design requirements and the resulted design data for the TVF operation melter. The sketch of the final melter design is shown in Figure 5. The new mock-up melter which is designed following this final design has already started operation in the beginning of 1988 to demonstrate its process performance.

Further development of melter materials and microwave technique for the advanced melter shall be kept up to establish higher process capacity and longer operation life. Minimizing the secondary waste and reducing the total life-cost of melter are the next goal in the future development.

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Table 1 Schedule of TVF

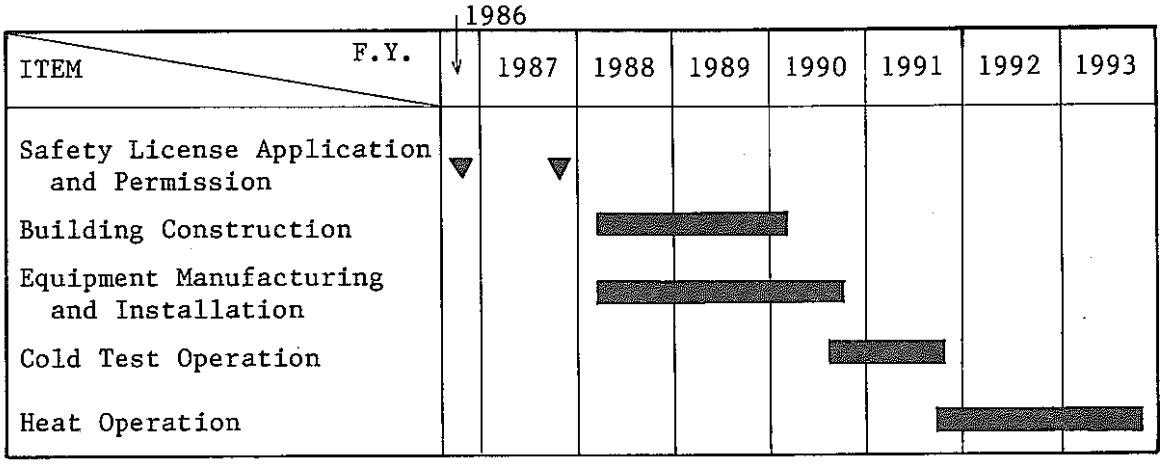


Table 2 Subjects of PNC Melter Development

Melter structural design	Glass pool design to prevent the accumulation of conductive deposit
Glass frit form	Glassfiber frit to reduce particulate entrainment in melter off gas
Glass drain technique	Freeze valve type bottom drain with two-zone induction heating
Auxiliary heating system	Heating-up method with good remotability
Instrumentation	Molten glass level detection
Dismantling of ceramic melter	Dismantling of melter using remote disassembling tools

Table 3 Glass Additive Forms

Spec. \ Form	Powdered Frit	Bead Frit	Fiberglass Frit
Particle Size	~10μ ≧50% 10~40μ <50% 40~44μ < 1% 44μ~ 0%	1~2mm <50% 2~2.8mm ≧50% 2.8mm~ 0%	Fiber diameter 9~12μm Add. form (Cylinder) 70mm dia.×70mm length 60±2g/piece
Density(g/cm^3)	●Glass density 2.4 ●Bulk density 1.0	● ← ●Bulk density 1.65	● ← ●Bulk density 0.2

Table 4 Descrion of Freeze Valve Drain Ever Developed

Heating Method	Direct Resistance-heating	HF Induction Heating
Material	Inconel	Inconel
Termination of Glass Flow	Air Cooling and Mechanical Stop	Air Cooling and Mechanical Stop ⇓ Air Cooling and Two-zone Heat Control without Mechanical Stop
Results	·Thin Pipe Structure for Resistance-heating is not Compatible with Required Lifetime and Strength- Necessity of Stop Mechanism	·Elimination of Stop Mechanism by using Two-zone Heating ·Maintenance of HF Heating Coil

Table 5 Monitoring for Safety Operation of Melter

Monitoring Items	Methods
Refractory Temperature	·Thermocouples in Glass-Contact Refractory
Electrode Temperature	·Thermocouples in Electrode
(Glass Temperature)	·(Estimation from Refractory/Electrode Temperature)
Feed Rate and Melt Condition of Feed	·HLW Feed Rate : Feed Tank Level ·Frit Feed Rate: Count the Number of Glassfiber Frit ·Plenum Temperature ·ITV Observation
Joule-Heating(Power)	·Voltage ·Current ·Resistance
Plenum Pressure	·Pressure Gauge
Molten Glass Leakage	·Metal Shell/Glass Electrical Resistance
Molten Glass Level Detection	·Electric Resistance between Detection Probe

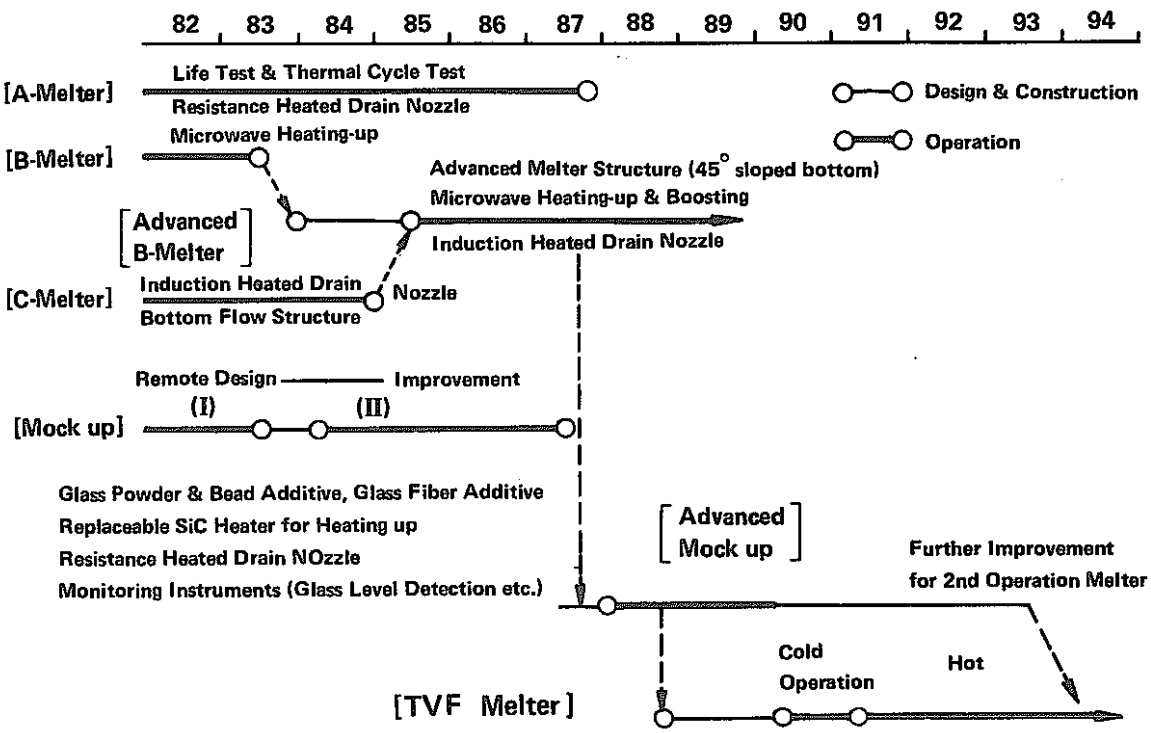


Fig. 1 Melter Development Schedule

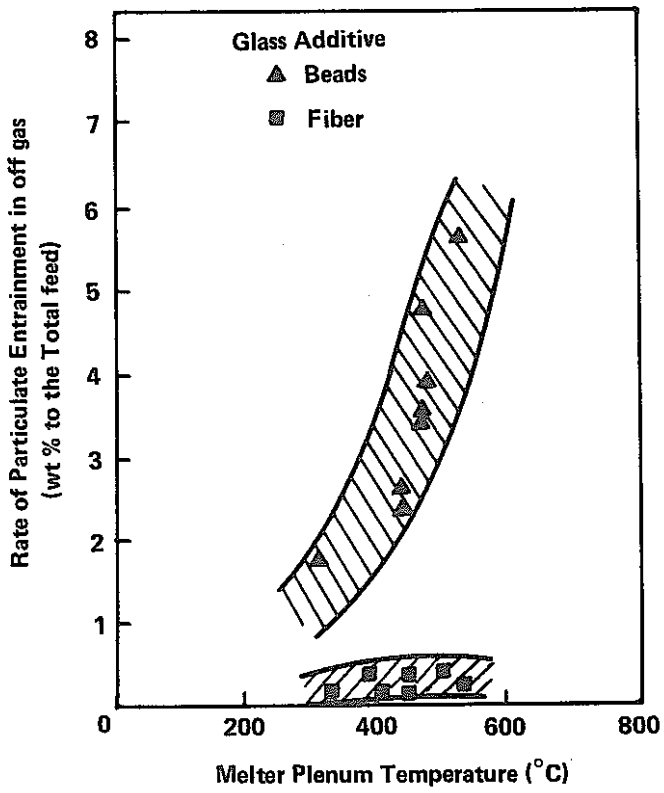


Fig. 2 Effect of the Glass Additive Form on the Particulate Entrainment in Melter Off-Gas

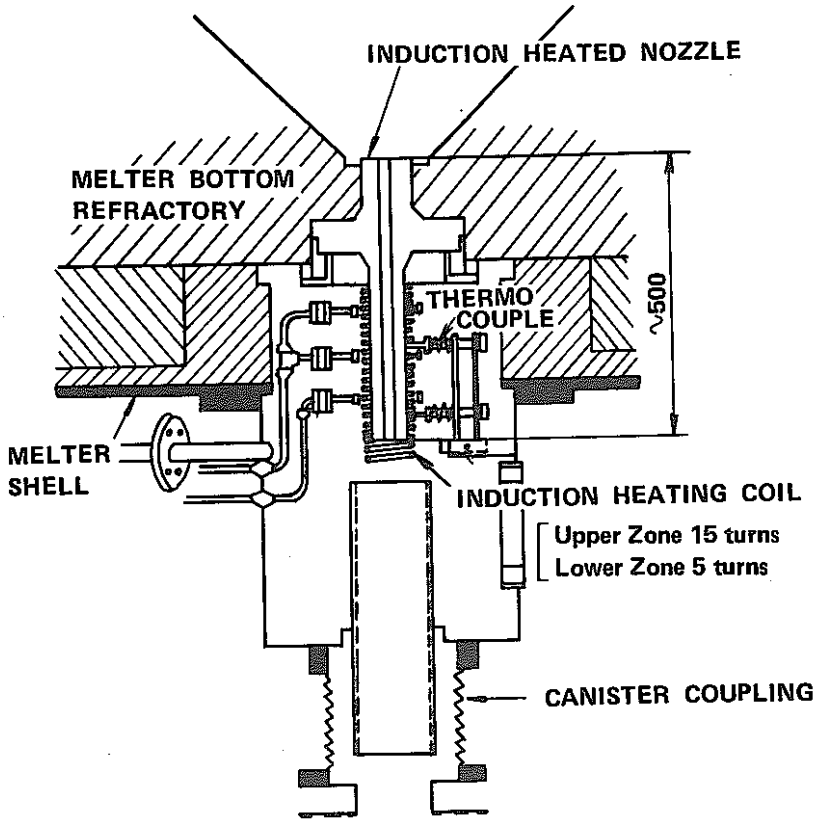


Fig. 3 Two-Zone Induction Heated Drain Nozzle

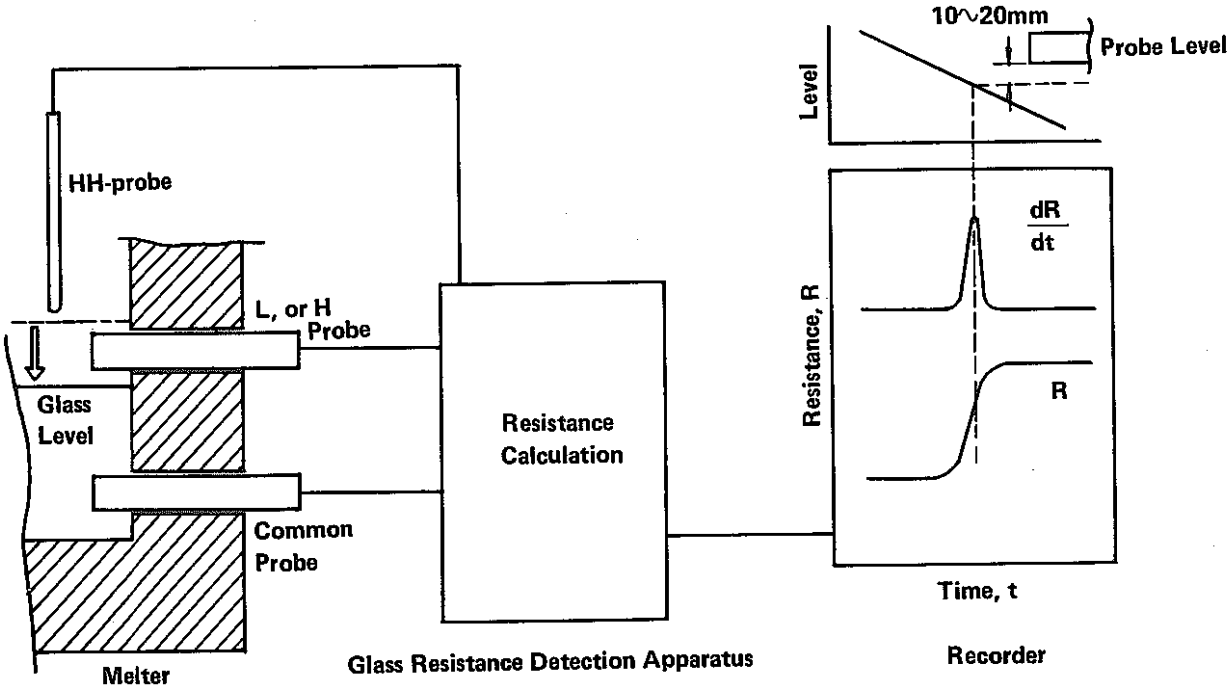


Fig. 4 Glass Level Detection of Melter

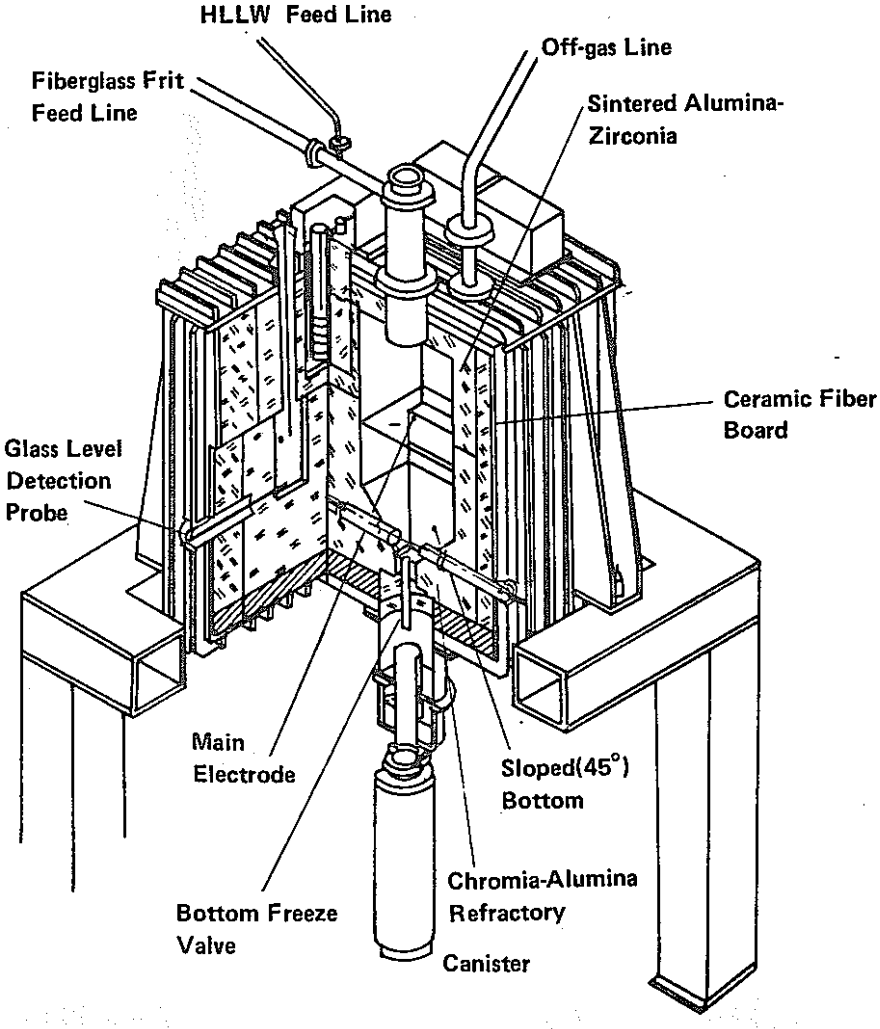
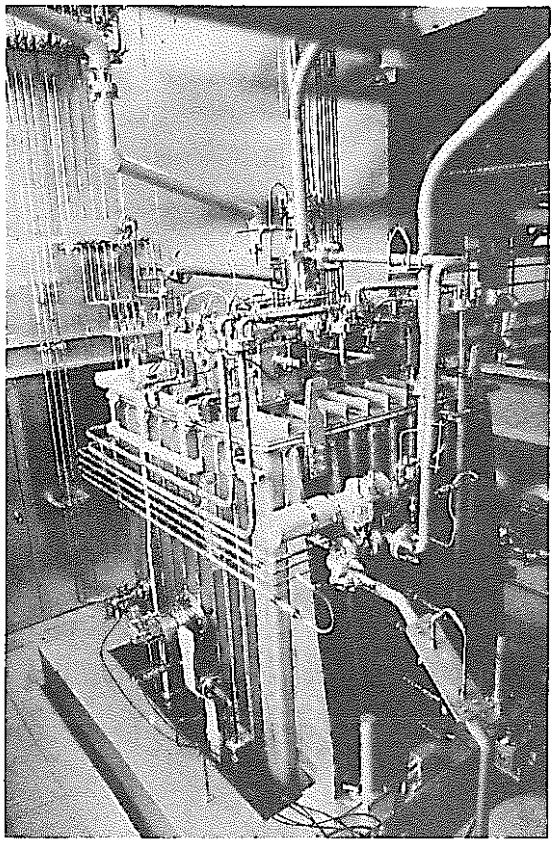
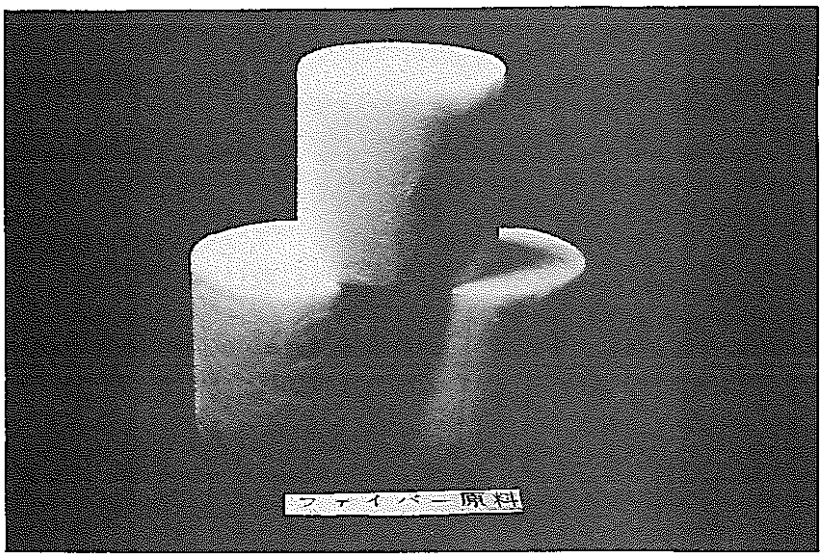


Fig. 5 Structure of Melter



Phote. 1 Mock-up melter placed in the simulated remote cell



Phote. 2 Glassfiber Additive

DECOMMISSIONING OF NUCLEAR FUEL FACILITIES

TECHNOLOGICAL EXPERIENCES AND R & D

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I. INTRODUCTION

Power Reactor and Nuclear Fuel Development Corporation (PNC) has been developing nuclear fuel cycle technologies since 1956. Tokai Uranium Refining Plant was completely decommissioned. Some of the facilities such as Tokai plutonium fuel facilities, Tokai Reprocessing Plant and O-arai post irradiation experiment facilities have been partially decommissioned. This is because their initial objectives have been accomplished or superannuated.

Decontamination and dismantling techniques of large-size waste contaminated by TRU nuclides have been developed and partly demonstrated at the waste Dismantling Facility (WDF) of PNC's O-arai Engineering Center (OEC) since March 1984. In comparison with reactors, the decommissioning of nuclear fuel facilities has distinctive features that objects to be removed are contaminated with TRU nuclides and their conditions of contamination, structure, configuration and materials differ according to the fields of cycle. These features have been considered in developing decommissioning techniques of PNC's nuclear fuel facilities.

II. DECOMMISSIONING EXPERIENCES

Large portion of the wastes from Tokai Uranium Refining Plant, operated 1965–75, were decontaminated to a undetectable level. Vessels such as an acid recovery evaporator and a plutonium concentration evaporator of the reprocessing plant were replaced. Several hundreds cubic meters of glove boxes of the plutonium facilities have been replaced with little trouble.

A variety of techniques have been applied to the decontamination of an acid recovery evaporator of the reprocessing plant. Critical nuclides in the acid recovery process were determined to be Ru-106 and Sb-125, and chemicals such as NAOH, KMnO and EDTA Na were proved to be effective for decontamination.

The WDF has been operated to treat large-size wastes generated in the OEC since 1984. At the WDF, the wastes with a maximum dimension of 2m×2m×2m are decontaminated by ice/dry-ice blasting or electropolishing, and cut by plasma arc or hacksaw. Operation of the plasma torch with a master slave manipulator and preliminary plasma cutting robot have been demonstrated.

III. DEVELOPMENT OF TECHNIQUES

(1) DECONTAMINATION TECHNIQUES

Conventional decontamination methods using water sprays and chemicals sometimes raise problems in attaining effective decontamination and treating secondary waste. Ice/dry-ice, electropolishing and REDOC decontamination methods have been developed to replace these methods. Ice/dry-ice decontamination methods have been developed to reduce secondary waste generated during decontamination. Ice/dry-ice blasting system consists of a blaster and a pelletizer (see Fig. 1). Only a blasting nozzle and a hose are installed in the cell. Compressed air (6kg/cm^2) is used to blast particles to contaminated surfaces at high velocity. The impact energy of the particles were measured to be several hundreds kg/cm^2. Ice/dry-ice particles, which are dry-ice pellets with a water content of 0–20wt%, are produced by the pelletizer at a rate of 200Kg/hr. Almost the same decontamination effect was obtained and the amount of generated secondary waste was small than by water sprays.

Electropolishing causes high decontamination on metal wastes. 5% H_2SO_4 solution was selected among several types of electrolyte considering electropolishing efficiency and secondary waste treatment. Metal ions dissolved into electrolyte reduce electropolishing efficiency. Electrodeposition technique is used to regenerate depleted electrolyte. This technique enables recovery of dissolved metal ions and contaminant nuclides on a metal plate. When ion concentration reaches 30g/1, electropolishing efficiency will be reduced to 1/4–1/3 of the initial condition. This condition. This condition can be monitored by electrolyte conductivity. Electropolishing decontamination technique has been demonstrated for metal waste in the WDF. High decontamination factor (DF) has been confirmed. This high DF is considered to owe to preferential dissolution at grain boundaries in sulfuric acid electrolyte.

REDOX decontamination using cerium nitrate has been developed not only for its high decontamination effect but also for wider applicability to complex configurations.

Almosthomogeneous resolution was observed in the test for stainless valves. At the temperature about 60°C, a resolution rate higher than electropolishing decontamination was obtained. Tests are under way on the treatment of spent solution and the selection of materials for equipment components.

(2) DISMANTLING TECHNIQUE

In-situ dismanting is indispensable to remove large vessels from the cells. A plasma cutting robot has been developed as one of the remote handling tools for dismanting. Conventional playback robots take much time for teaching. This makes it difficult to apply the robots to the dismanting of equipment and vessels with a variety of configuation. To improve this difficulty, sensors to detect the distance between the torch and the object and the robot body have been designed and tested, including operation method, to develop a plasma robot which is non-teaching, portable and easily operable.

The distance between the torch and the object is generally kept in the range of 5–15mm during the cutting. A laser spot sensor was used to detect this distance. Tests are conducted for flat, cylindrical and other complicated surfaces and the tracing height of b2mm was obtained.

Multiarticulated system was used for easy transportation, installation and maintenance as well as for minimizing mounting space and weight. A new type of master arm is used for a remote controller. It is cyclindrically coordinated with three shafts and two joint vector shafts.

(3) MONITORING TECHNIQUE

Efficient and safe decommissioning of nuclear facilities necessitates information on the density and distribution of radioactive contamination. This will consume less decontamination effect with less safety cost.

To replace conventional smear or direct survey method, a radiation image display unit (RID) has been developed for a quick measurement of the distribution and the level of contamination in the cells or on the equipment. The RID is composed of a detector in the shield with a collimator, an ITV camera, a distance meter and a data processor. (Net of radiation dose at each point makes a radiation dose map which can be seen by a TV monitor.) Time necessary to obrain a map is 10–60 minutes depending on radiation level. It can identify radiation sources with a surface dose rate of 1mR/hr at a distance of 2m. The weight of the detector including the shield is about 45kg. This enables easy handling of the detector using a power manipulator in the cell. One of the image obraineed by applying the RID to the liquid waste tank containing solid suspension is shown in the photo 1.

VI. CONCLUSION

Vessels, incinerators and glove boxes from nuclear facilities to be decommissioned are anticipated to increase in the future. Safe and effective decommissioning of nuclear facilities with least possible radioactive wastes generation and cost would be achievable with an integration of the above mentioned techniques.

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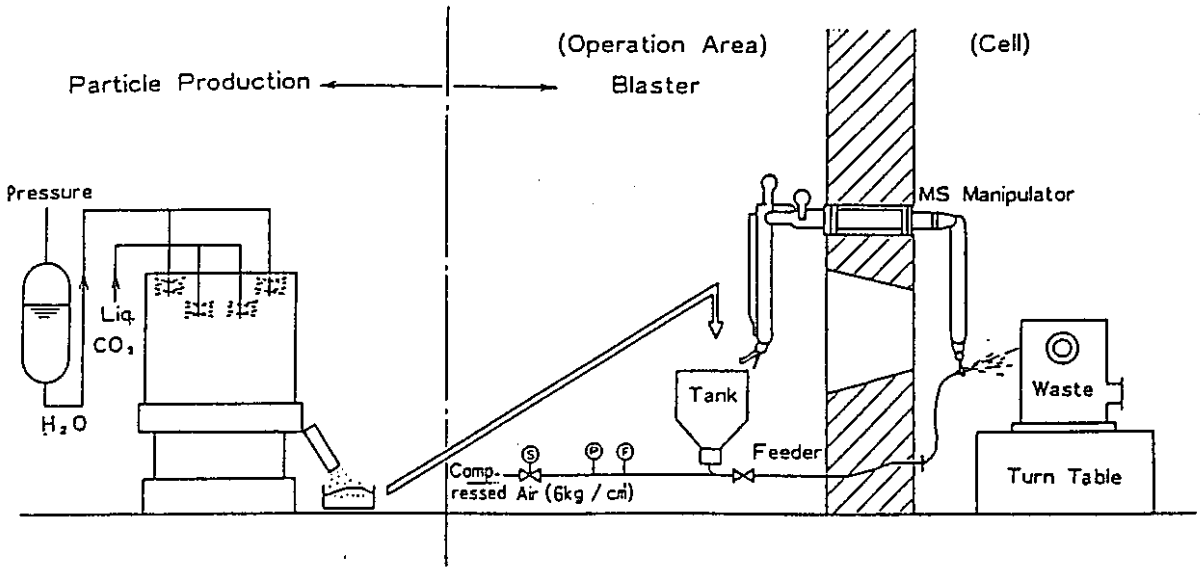
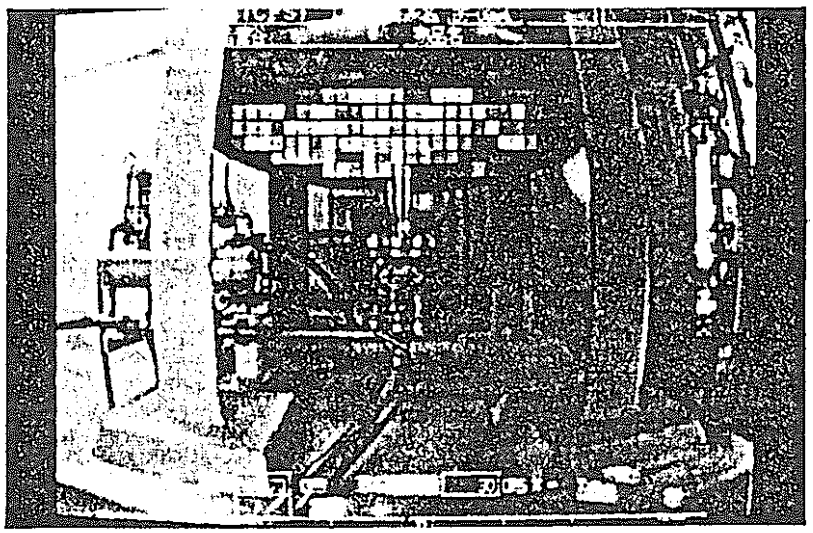


Fig. 1 Ice/dry-ice blasting system



Phote. 1 Radiation image for a liquid waste storage tank

DECOMMISSIONING OF NUCLEAR FUEL FACILITIES

TECHNOLOGICAL EXPERIENCES AND R&D

MASAO SHIOTSUKI

Power Reactor and Nuclear Fuel Development Corporation
(P N C)

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② Pu-Contaminated Glove Boxes ('78～'86)

③ Replacement of an Acid Recovery Evaporator in Tokai Reprocessing Plant ('79,'83, '88～'89)

R&D in Waste Dismantling Facility (WDF) ('84～)

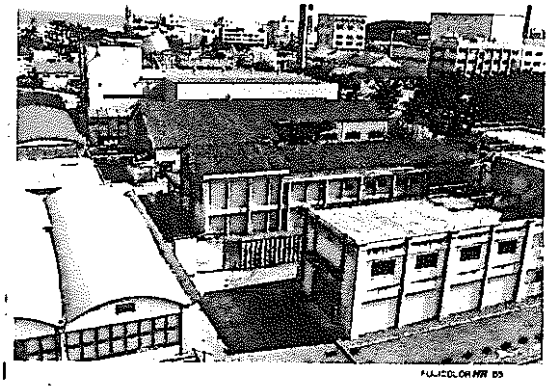
① Decontamination Technique

② Dismantling Technique

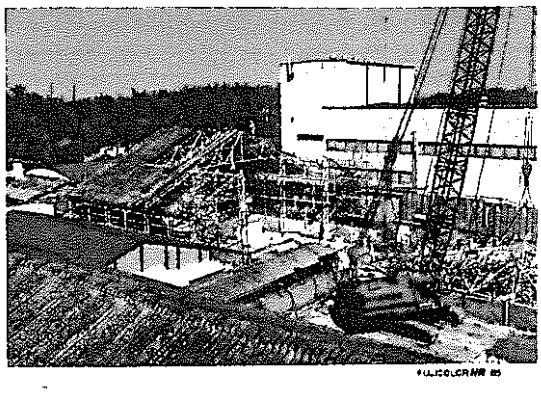
③ Monitoring Technique

Uranium Metal Fuel Production Plant

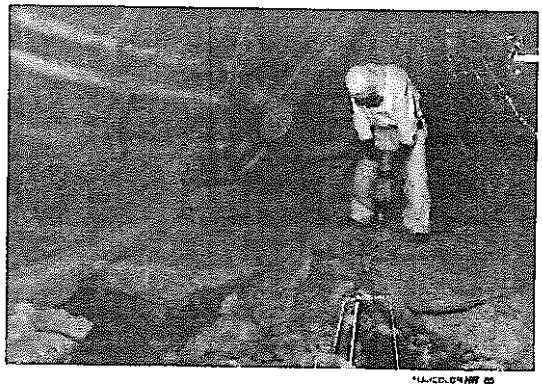
Purpose	: Refining and Reduction Process for Uranium Metal Fuel
Operation Period	: 1958 -1970
Structure	: Steel - Frame, Slate Wall (Roof)
Equipments	: Press, Milling Machine, Ducts, Dust Collector
Dimmension	: 50m × 15m × 10mH
Contamination	: $2\times10^{-2}\mu Ci/cm^2$~B.G. (Equipments) : $4\sim7\times10^{-6}\mu Ci/cm^2$ (Floor)



BEFORE DECOMMISSIONING



REMOVAL OF BUILDING

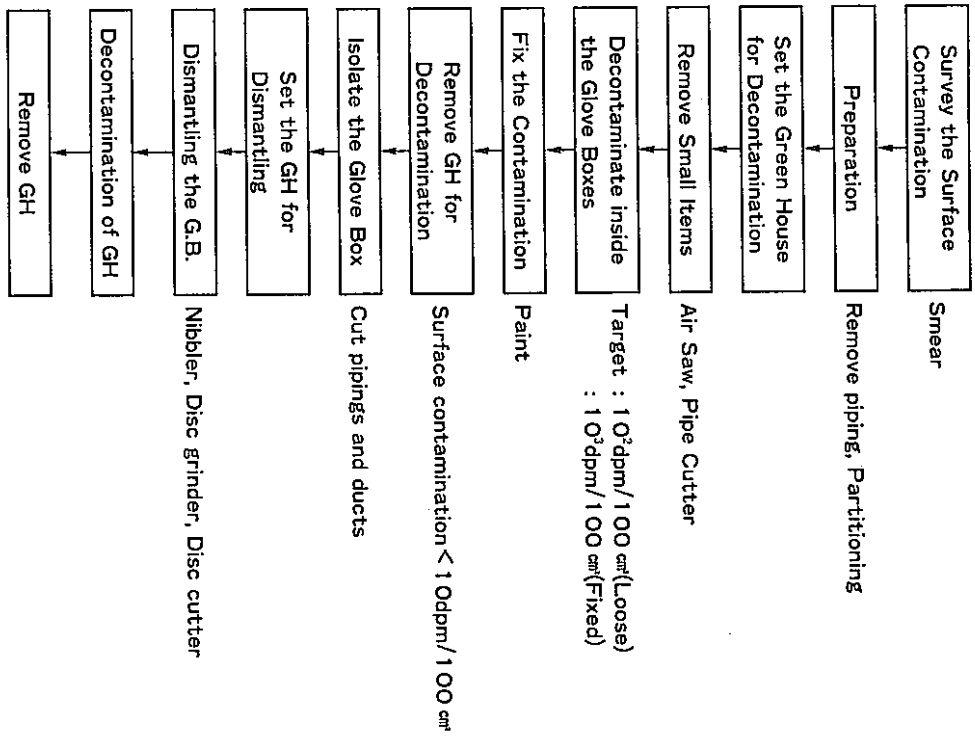


FLOOR SEPARATION

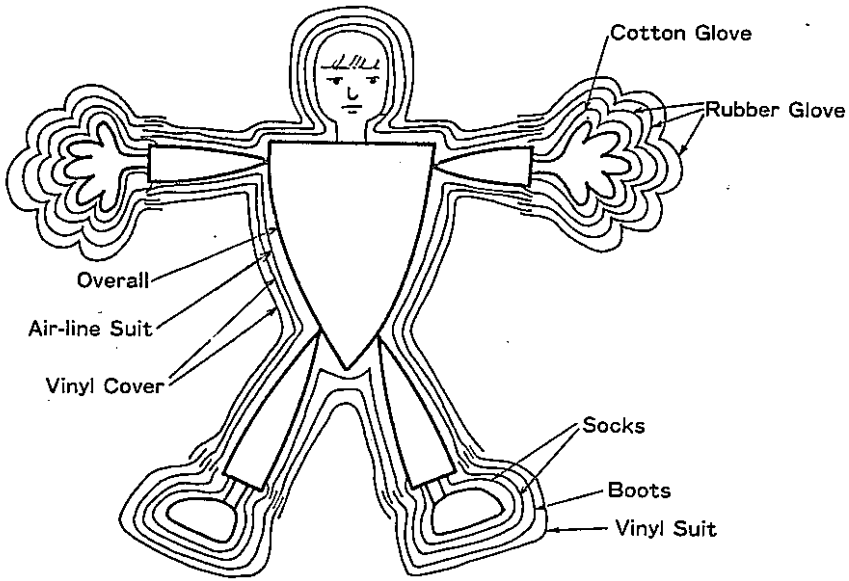
LAND READJUSTMENT

Dismantling of the Pu-Contaminated Glove Boxes

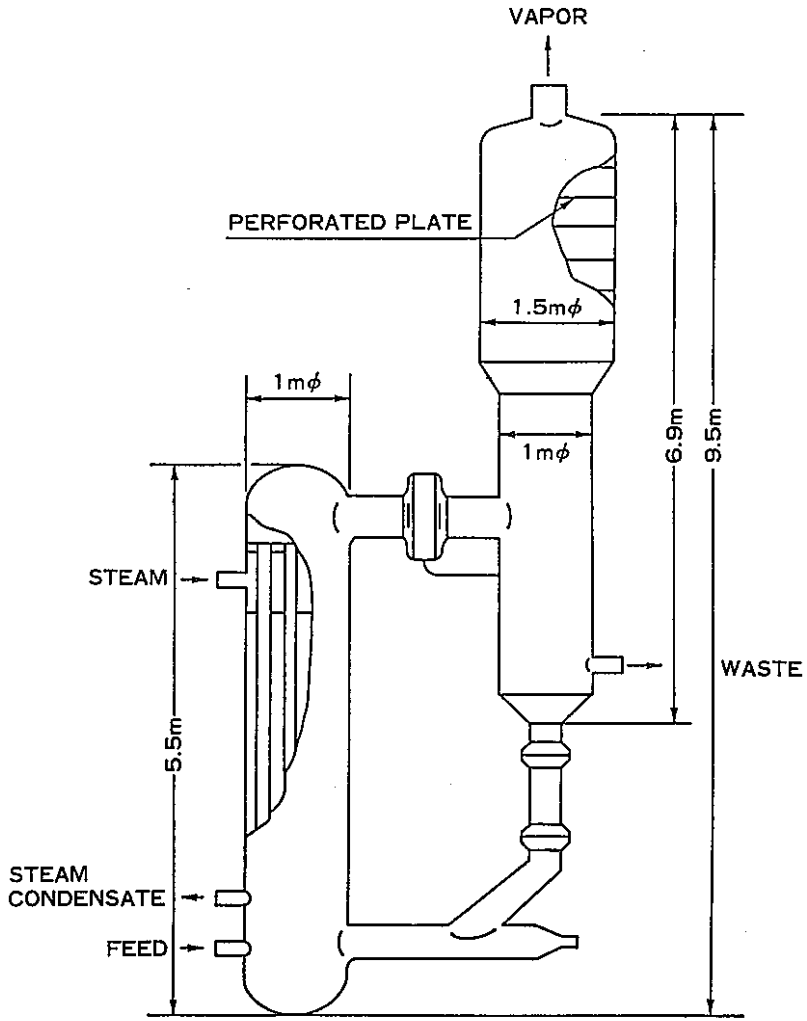
G.B. No.	Volume	Dismantling Time	Purpose for use
W－1 W－3 W－11	108 m³	1978	Pu-recovery process (Wet)
G－61～63	12 m³	1979	Pu-recovery process (Wet)
G－1～	65 m³	1979～80	Mox fuels fabrication for irradiation test
W－2 W－3	58 m³	1980～81	Pu-recovery process (Wet)
G－42, 43 G－13	10.5 m³	1981	Chemical analysis
T－6 W－5 W－6 W－8	69 m³	1983	Pu-recovery (dry) Waste treatment
C－1～13	11.5 m³	1986	Analysis



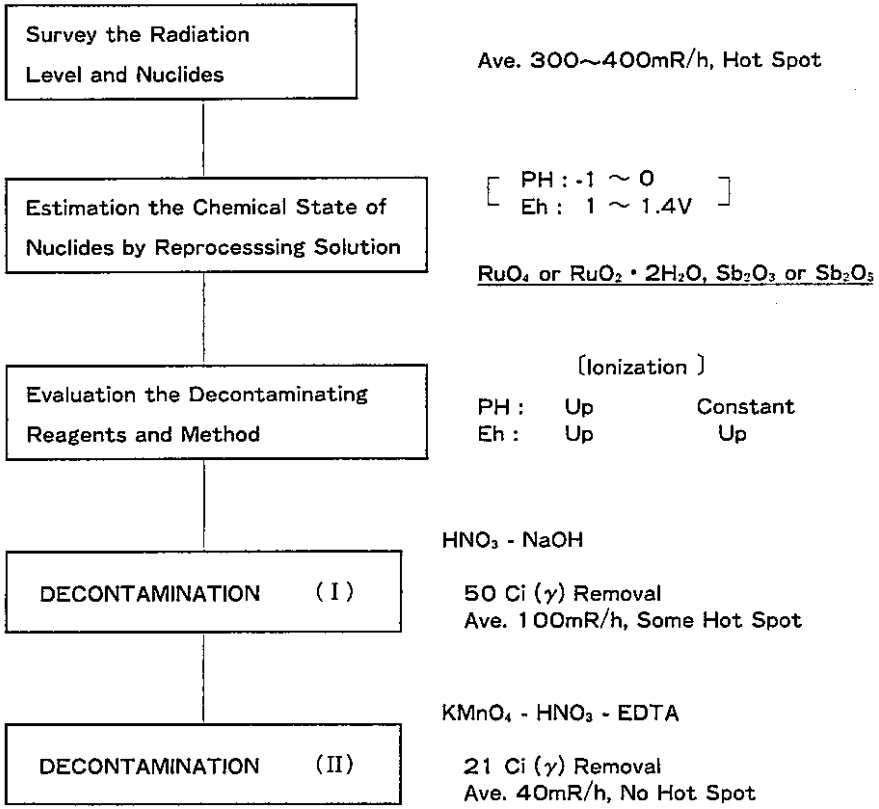
Dismantling Flow Sheet



RADIATION PROTECTION EQUIPMENT



Schematic Drawing of Acid Recovery Evaporator



DECONTAMINATION OF ACID EVAPORATOR

SUMMARY OF DECOMMISSIONING EXPERIENCES

	OBJECT	MAN-DAY	EXPOSURE	SECONDARY WASTE
Uranium Refining Facility	50mL × 15mW × 10mH	10months	Non Detect γ<10mrem n<20mrem	1260 m³
Pu-Contaminated Glove Boxes (W-1, 2, 3)	- 89m³	10months 3,680man・days [Decon : 1453 Disma : 2002]	Ave. 10mrem MAX. 60mrem	170 m³
Acid Evaporator in Reprocessing Plant	9.5mH 7.5ton	(Dismantling) 3 months 9,000man・days	(Dismantling) Ave. 120mrem MAX. 360mrem	—

R&D of DECOMMISSIONING TECHNIQUES

DECONTAMINATION

- High Decontamination Factor (DF)
- Reduction of Arising Secondary Wastes
- Applicable to Complicated Form
- Cost Effectiveness

→ ICE-BLASTING / ELECTRO-POLISHING / REDOX PROCESS

DISMANTLING

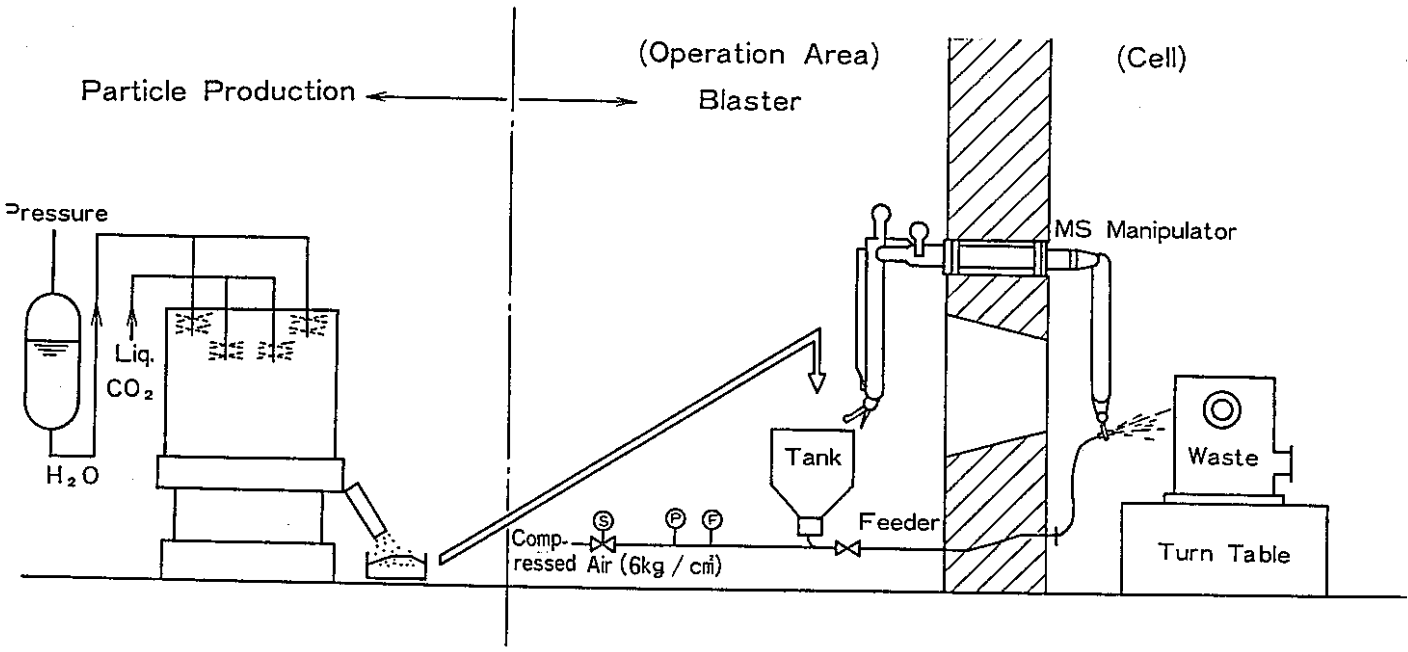
- Applicable to Miscellaneous Items
- Remote Handling Superior to Contact Handling in Economics and Safety

→ PLASMA CUTTING / ROBOTTICS / LASER CUTTING

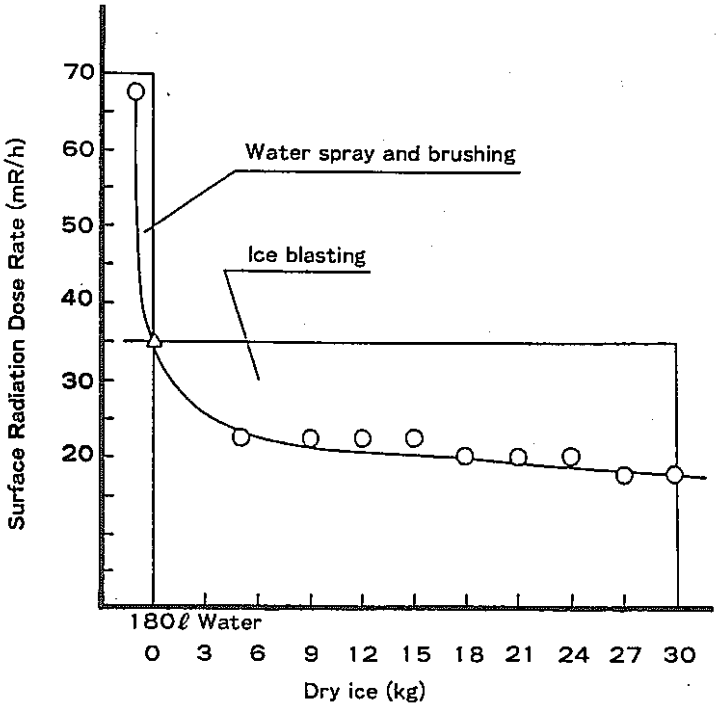
MONITORING

- Remote Measurement
- High Reliability
- High Efficiency

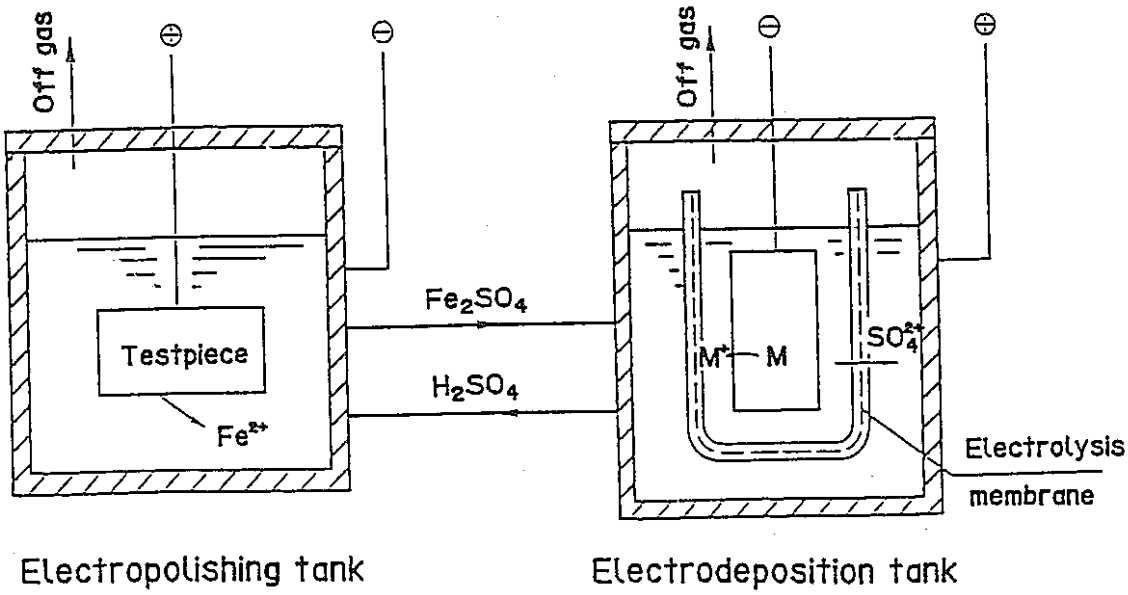
→ RADIATION IMAGE DISPLAY



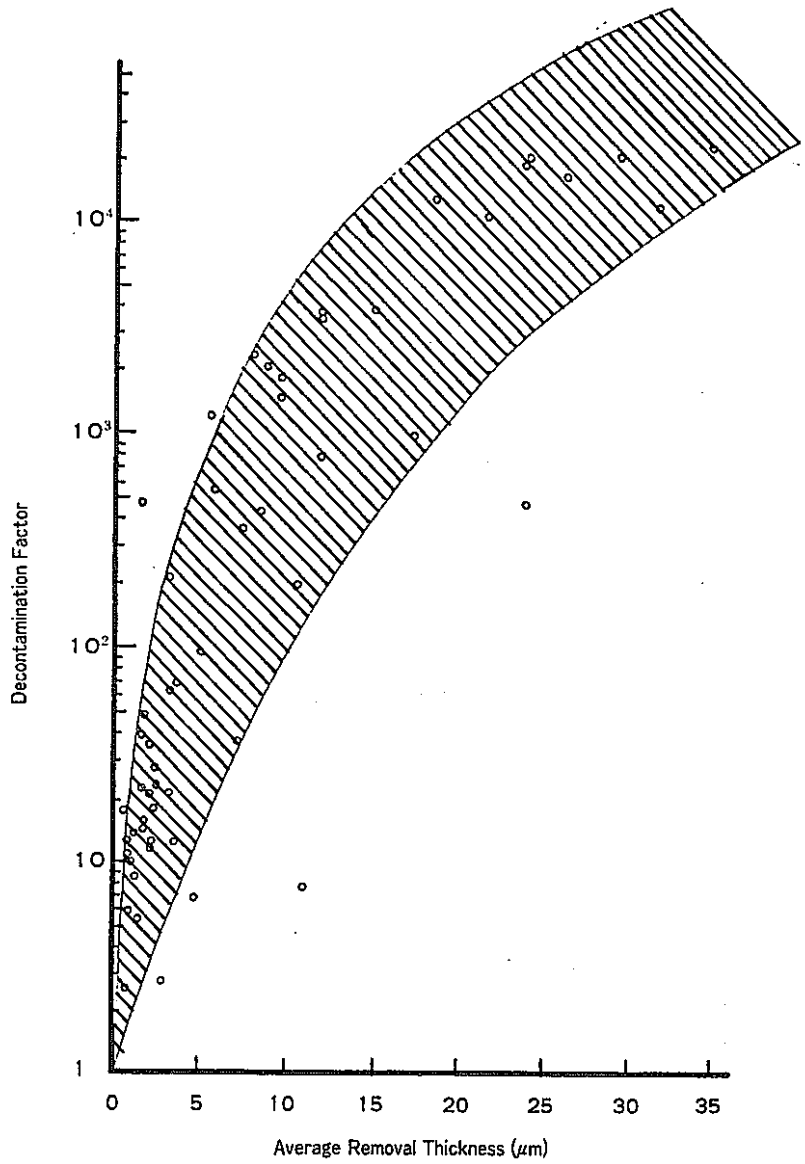
Ice Blasting Decontamination System



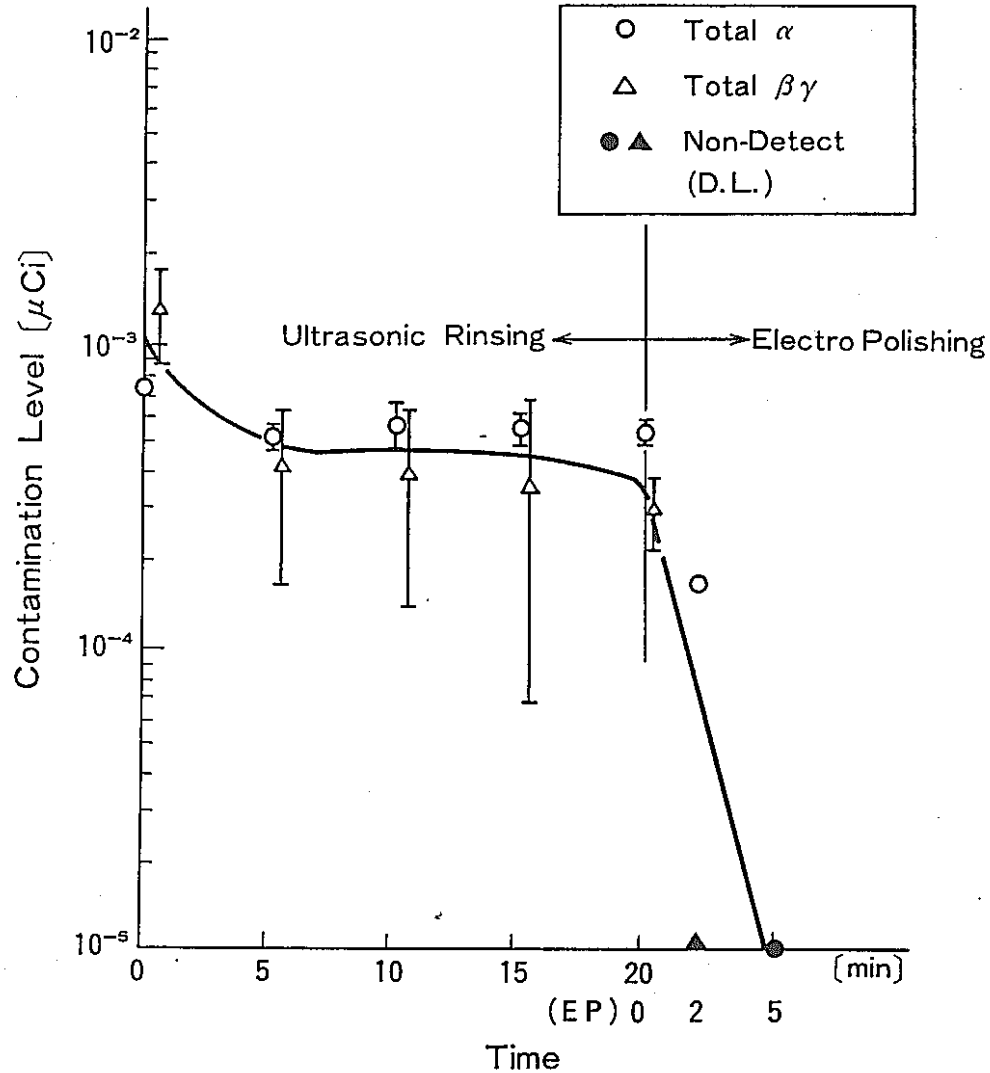
DECONTAMINATION EFFECT BY WATER SPRAY AND ICE BLASTING



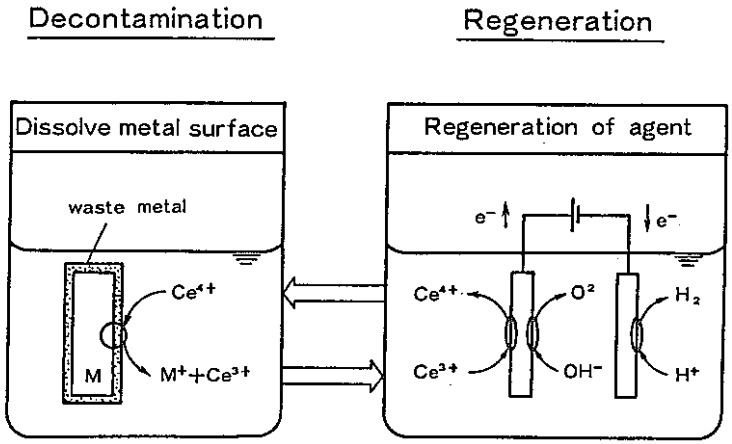
SCHEMATIC OF ELECTROPOLISHING



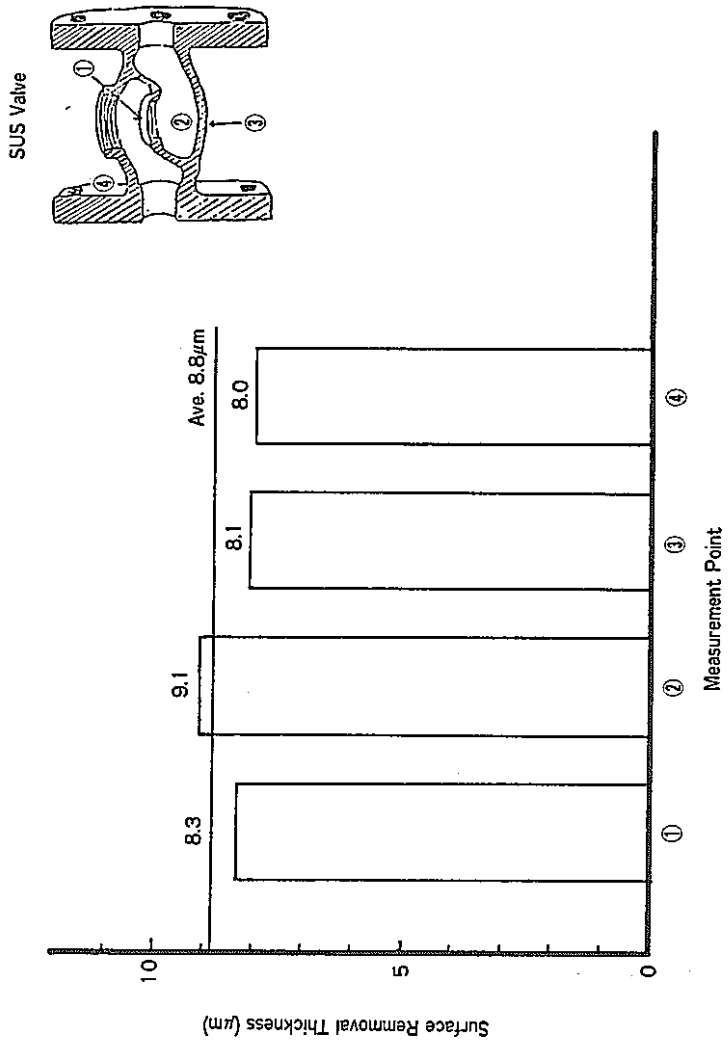
RELATIONSHIP A.R.T. and DF



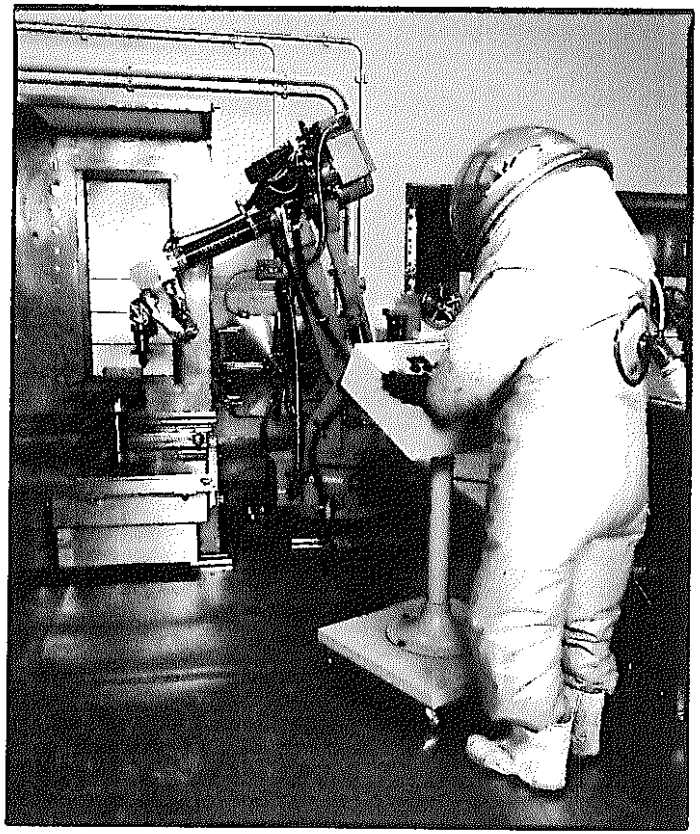
Decontamination Effect by Ultrasonic Rinsing and Electro Polishing

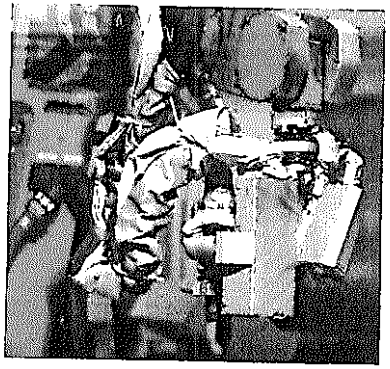


Principle of REDOX Decontamination

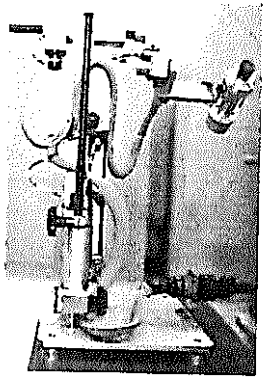


THLOWING POWER FOR A COMPLICATED FORM OBJECT BY REDOX





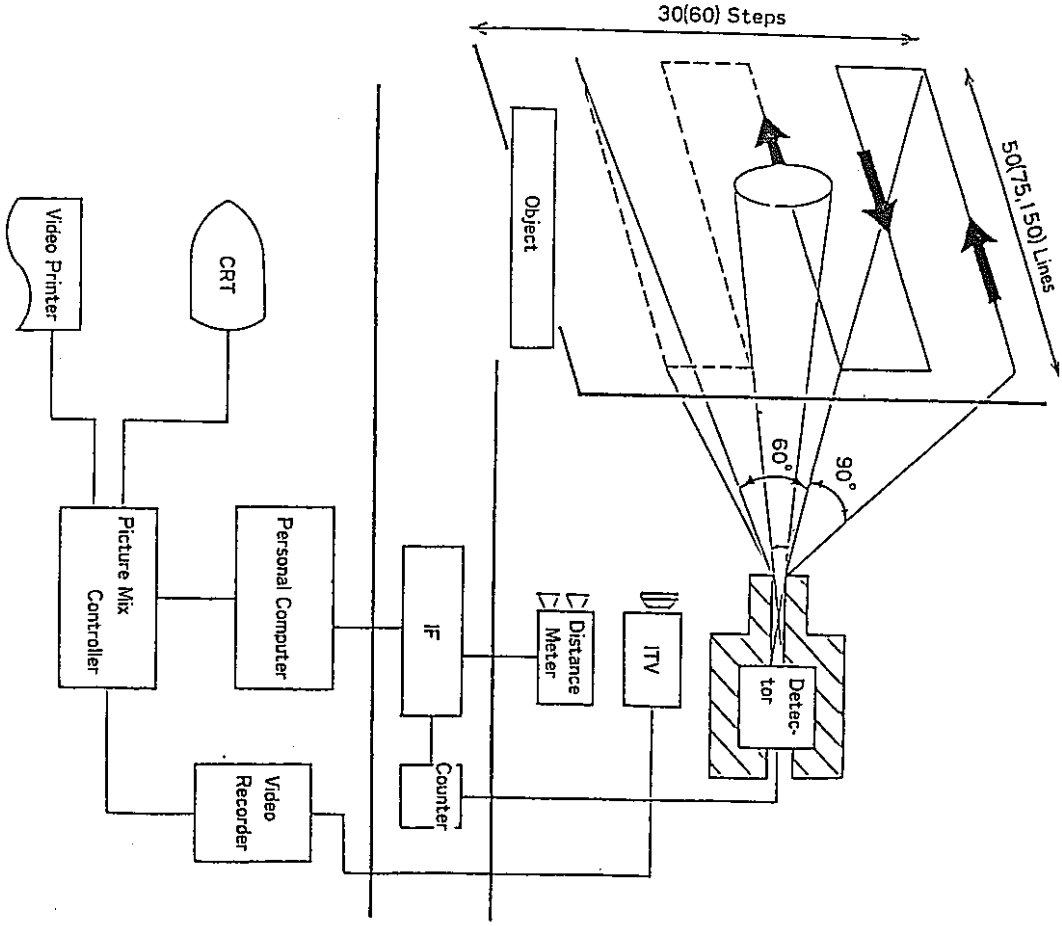
LASER EXTENSOMETER



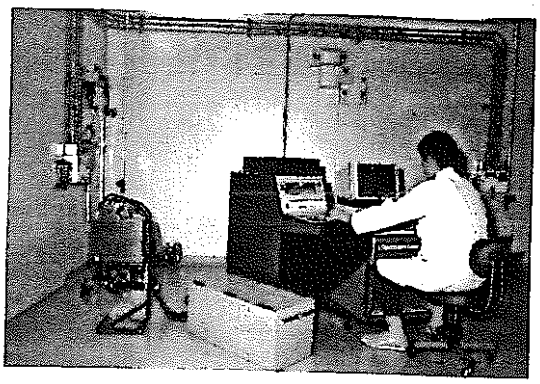
MASTER ARM

CONTROLLER

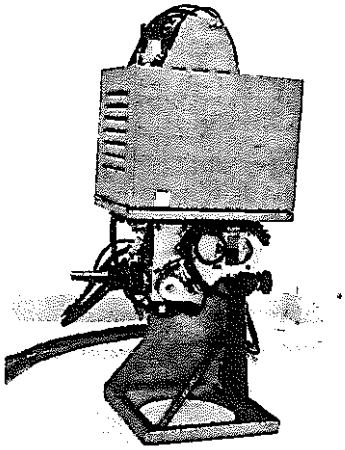
IMPROVEMENT OF PLASMA ROBOT



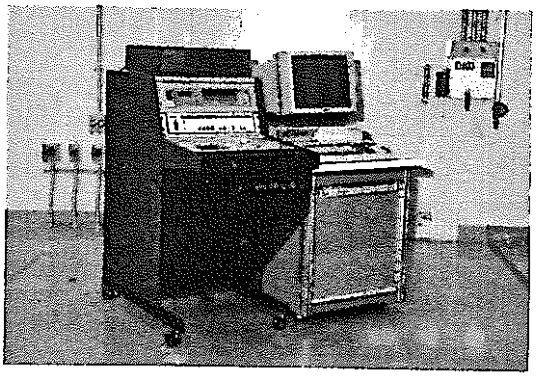
COMPOSITION OF RADIATION IMAGE DISPLAY



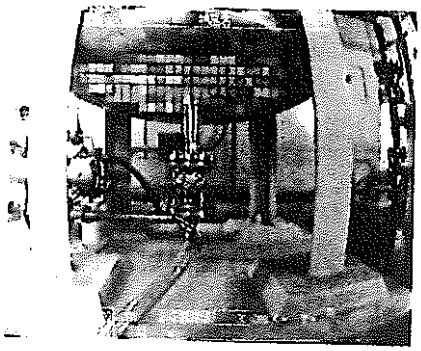
A Whole View of Radiation Image Display



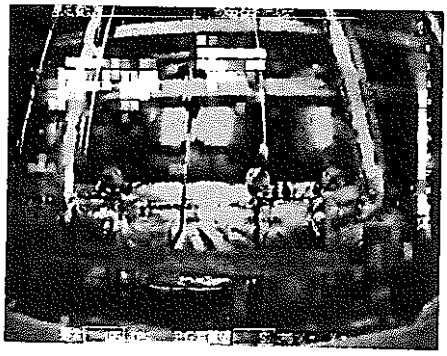
Detector



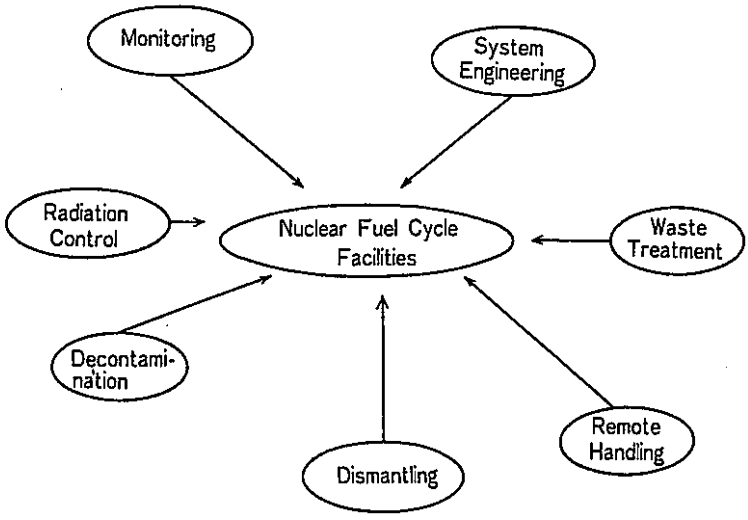
Data Processer



LIQUID WASTE TANK



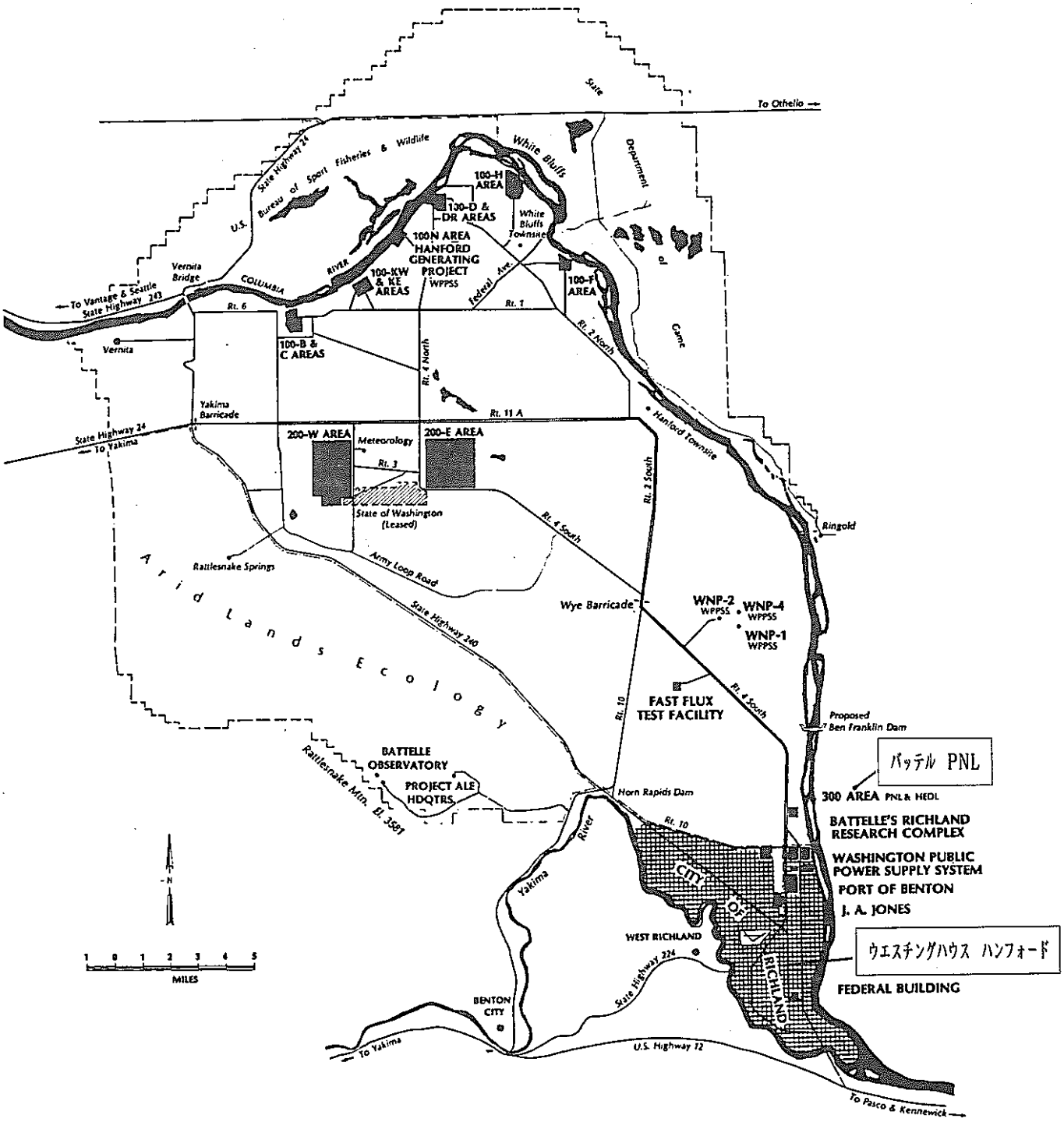
LARGE SIZE EQUIPMENT
in REPROCESSING PLANT



Development of Technolologies on Decomissioning of Nuclear Fuel Cycle Facilities

Appendix C

訪問した各サイトの施設概要



HANFORD SITE

Department of Energy

Other Facilities in Use

	Name	Page	Abbreviation	Operating Contractor
1.	Argonne National Laboratory-West Area	7	ANL-W	ANL
2.	Central Facilities Area	24	CFA	EG&G Idaho
3.	Coal-Fired Steam Generating Facility	*	CFSGF	WINCO
4.	Computer Science Center (in Idaho Falls)	25	CSC	EG&G Idaho
5.	CFRMF Neutron Radiography Facility	*	—	EG&G Idaho
6.	Expended Core Facility	21	ECF	WEC
7.	Experimental Field Station	*	EFS	DOE-ID
8.	Fluorinel Dissolution and Fuel Storage Facility	14	FAST	WINCO
9.	Hot Cell Facility (TRA)	18	—	EG&G Idaho
10.	Hot Fuel Examination Facilities	8	HFEF	ANL
11.	Hot Shop Facilities (TAN)	18	—	EG&G Idaho
12.	Idaho Chemical Processing Plant	12	ICPP	WINCO
13.	INEL Research Center (in Idaho Falls)	26	IRC	EG&G Idaho
14.	Naval Reactors Facility	20	NRF	WEC
15.	New Waste Calcination Facility	13	NWCF	WINCO
16.	Process Experimental Pilot Plant	16	PREPP	EG&G Idaho
17.	Radiation Measurements Laboratory	10	RML	EG&G Idaho
18.	Radioactive Waste Management Complex	15	RWMC	EG&G Idaho
19.	Radiological and Environmental Sciences Laboratory	4	RESL	DOE-ID
20.	Reactor Training Facility	*	RTF	EG&G Idaho
21.	Remote Analytical Laboratory	14	RAL	WINCO
22.	Semiscale Test Facility	33	STF	EG&G Idaho
23.	Standards Calibration Laboratory (CF-698)	24	SCL	EG&G Idaho
24.	Stored Waste Examination Pilot Plant	16	SWEPP	EG&G Idaho
25.	Technical Services Center (CF-688, 689)	24	TSC	EG&G Idaho
26.	Technical Support Buildings A&B	2	TSA, TSB	EG&G Idaho
27.	Test Area North	17	TAN	EG&G Idaho
28.	Test Reactor Area	9	TRA	EG&G Idaho
29.	Waste Experimental Reduction Facility	16	WERF	EG&G Idaho
30.	Willow Creek Building (in Idaho Falls)	2	WCB	EG&G Idaho

Facilities Under Construction

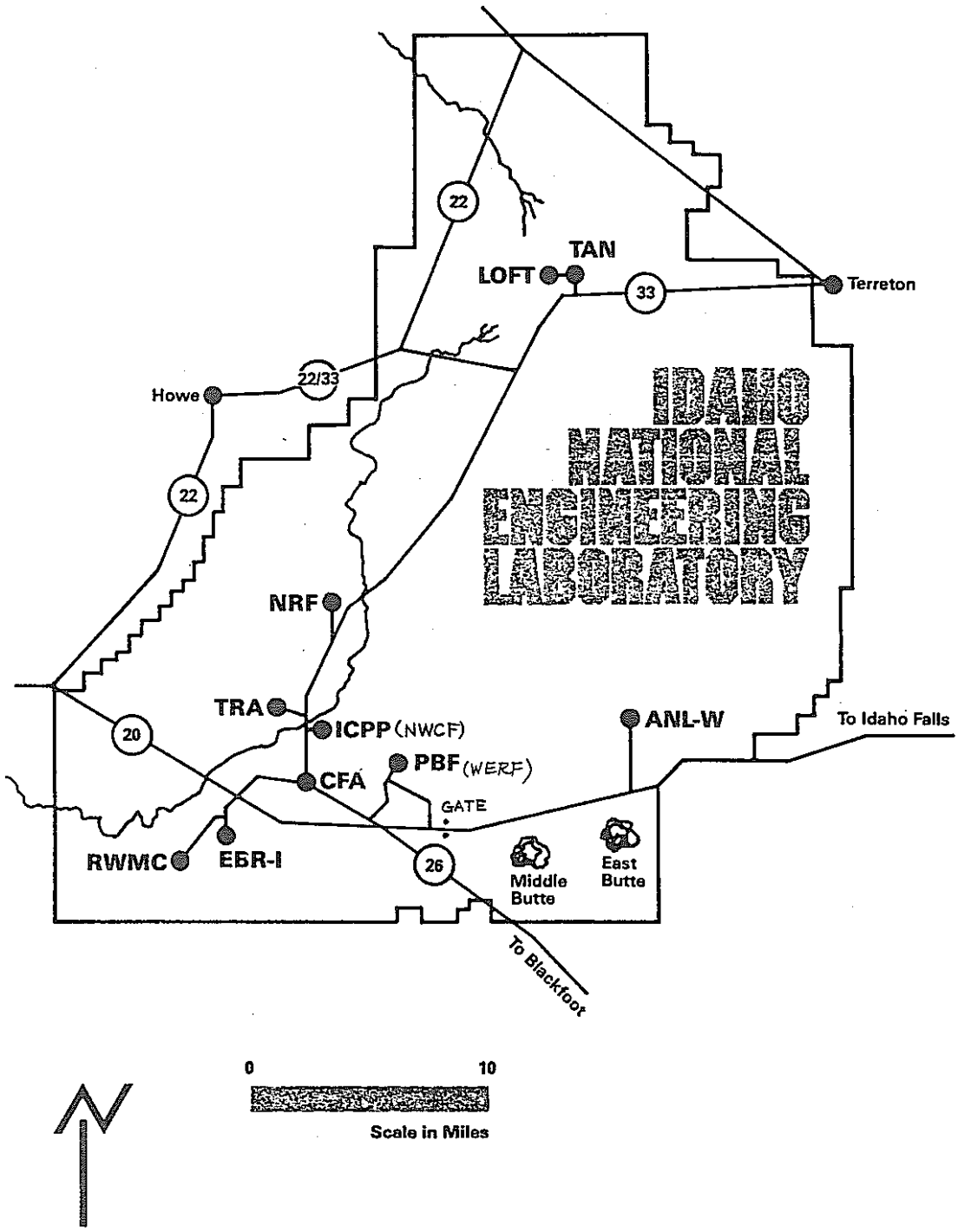
1.	Fuels Processing Facility Project	14	FPF	WINCO

Facilities Dismantled, Transferred, or on Standby Status

1.	Alcohol Fuels Plant	*	—	EG&G Idaho
2.	Raft River Geothermal Project	*	—	EG&G Idaho
3.	Waste Calcining Facility	13	—	PPCo, AL, ENICO
4.	Semiscale Test Facility	33	STF	EG&G Idaho

* Not covered in this brochure.

IDAHO NATIONAL ENGINEERING LABORATORY



BP380-R-0788-5M-A

Appendix D

Hanford Waste Vitrification Plant の概要

9月16日ウェスチングハウスハンフォードにて紹介

説明者　Brad Wolfe

WHC-SA-0287-S

Hanford Waste Vitrification Plant Briefing Booklet

Prepared for the U.S. Department of Energy
Assistant Secretary for Defense Programs

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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WHC-SA-0287-S

Hanford Waste Vitrification Plant Briefing Booklet

Hanford Waste Vitrification Plant Division

Date Published
May 1988

Prepared for the U.S. Department of Energy
Assistant Secretary for Defense Programs

Westinghouse Hanford Company | P.O. Box 1970
Richland, Washington 99352

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U.S. Department of Energy under Contract DE-AC06-87RL10930

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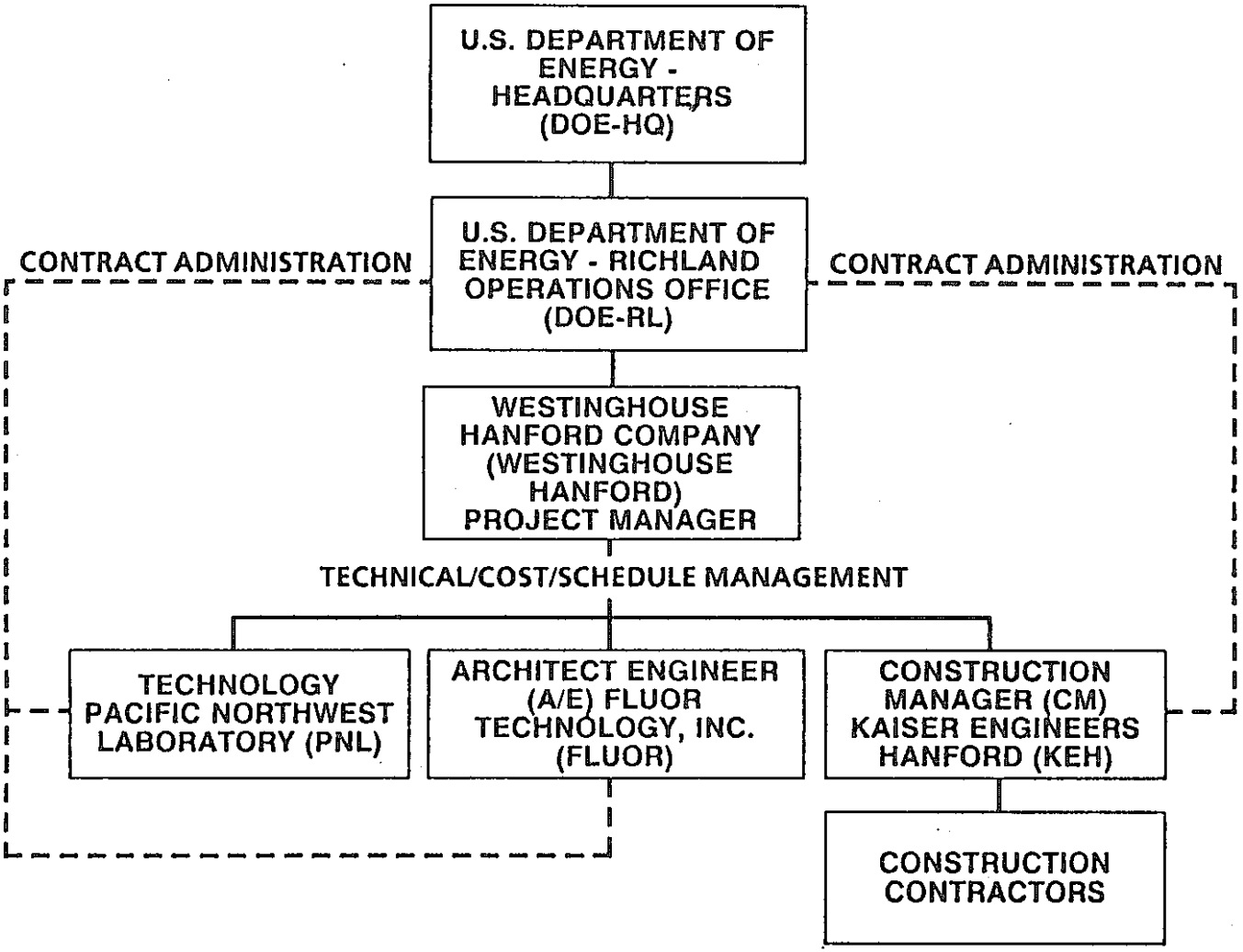
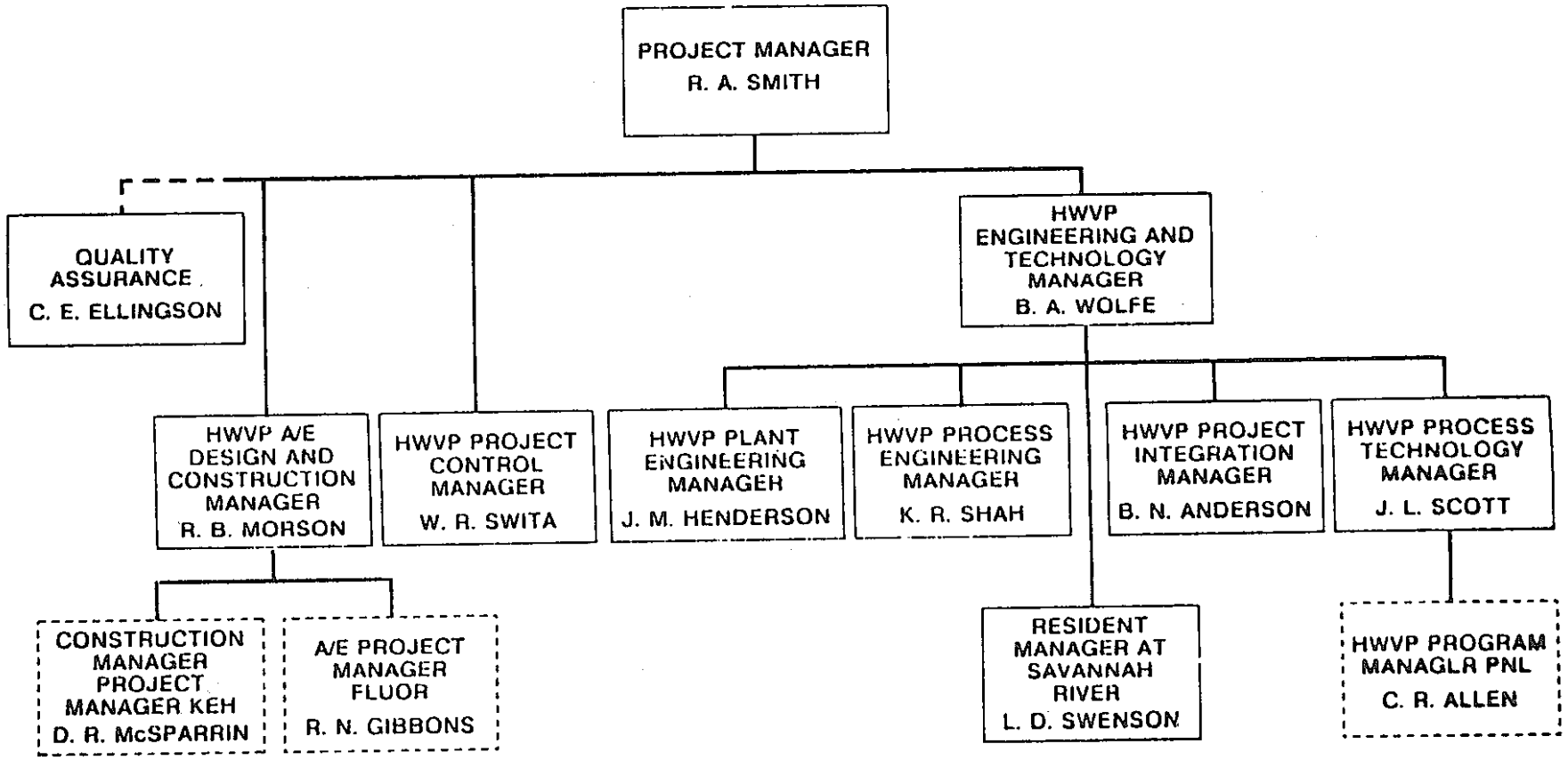
DOE/HWVP Contractor Relationships



HWVP Project Structure



*COST, SCHEDULE, AND TECHNICAL MANAGEMENT

PS88-0038-1

Hanford Waste Vitrification Plant Fact Sheet.

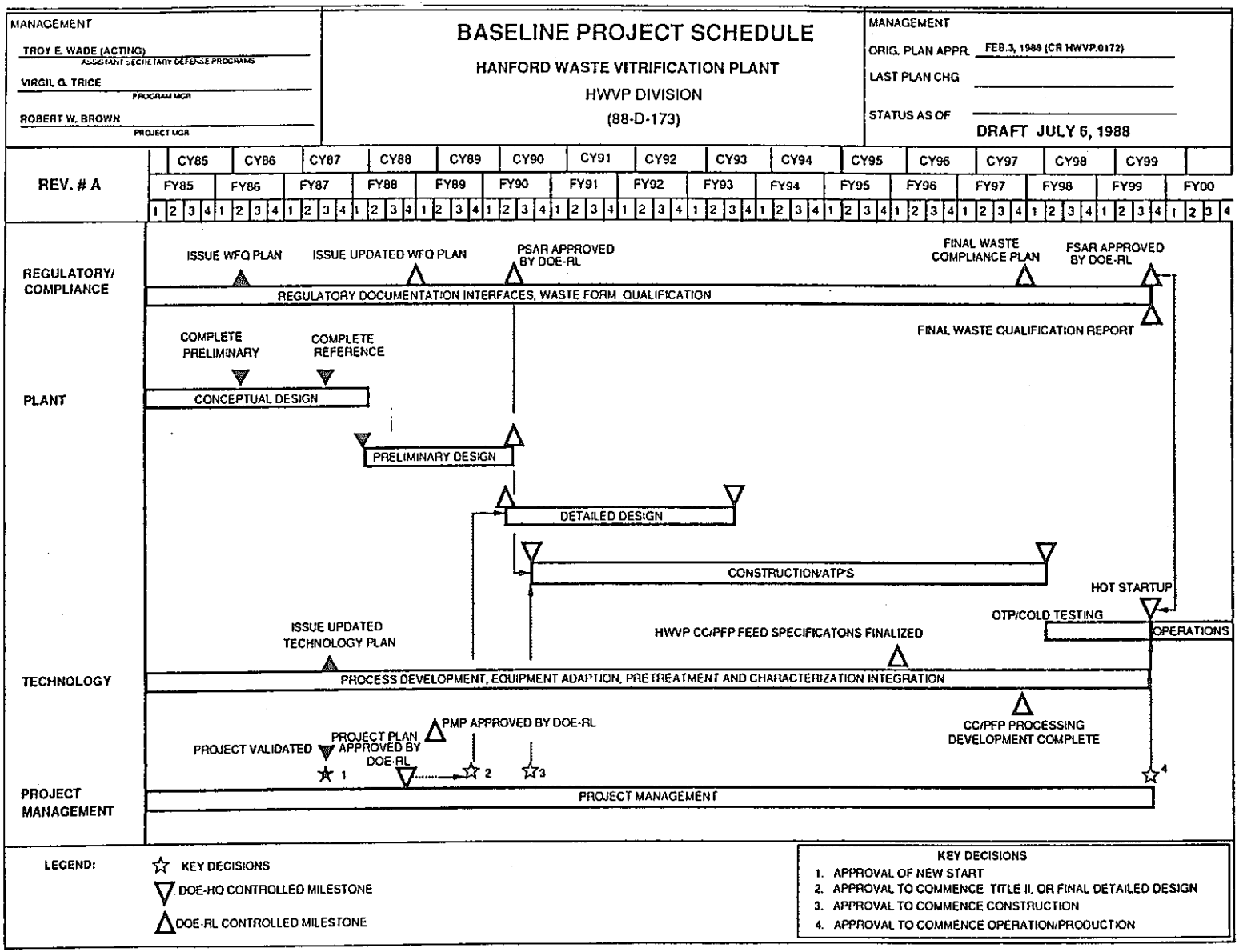
Vitrification building	
L x W x H, feet	362.5 x 119.5 x 94
Volume, cubic feet	4.1 million
Concrete, cubic yards	64,000
Reinforcing steel, tons	10,500
Embedded piping, feet	100,000
Base slab	
L x W x D, feet	362.5 x 119.5 x 5
Concrete, cubic yards	8,500
Reinforcing steel, tons	2,800
Glass melter	
Feed rate, gal/min	0.5
Feed composition, % (water and volatiles, frit, waste oxide)	62, 28, 10
Production rate, lb/h	100
Operating temperature, C (F)	1,150 (2,100)
Power requirements	400 kW
Filled glass canister	
Production rate, year	145
Weight, lb (empty)	1,000
Material of construction	304L stainless
Contents (ref. canister):	
Glass, lb	3,630
Radionuclides, lb	95 -120
Curies	2.75E + 05-4.5E + 05
Waste loading, wt% oxide	25
Decay heat, watts	750 -1,400
Exposure at surface, rads/h	11,600

88-8049 WHC-SA-0287-S-32

Budget by Fiscal Year (millions)

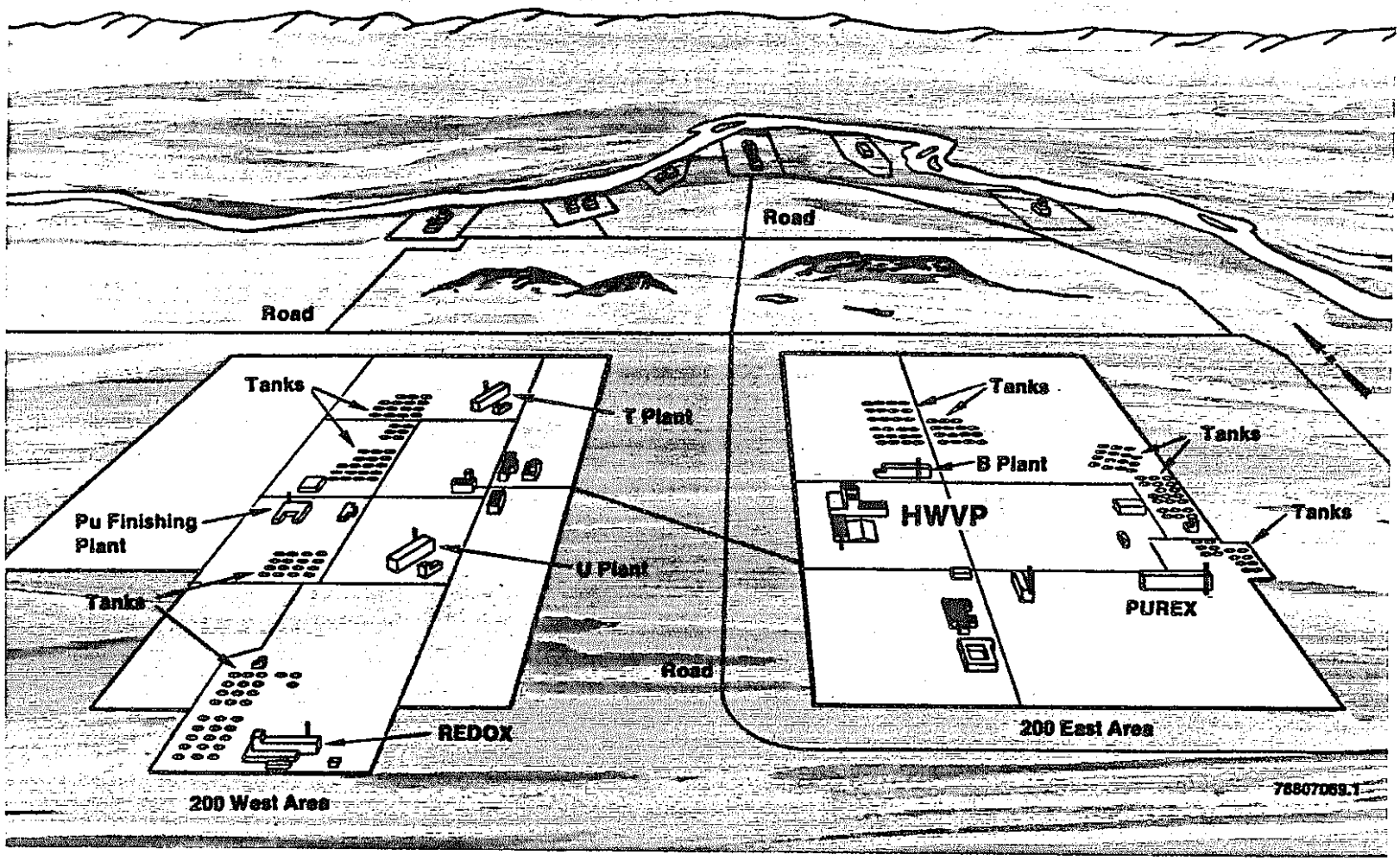
Budget Authorization

FUNDING SOURCE	PRIOR YEARS	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	TOTAL
OPERATING	37.8	6.9	9.4	17.0	12.4	16.4	19.1	24.0	26.1	29.5	36.6	46.2	37.3	318.7
CAPITAL	0	7.5	22.5	34.1	94.5	126.3	224.0	204.8	103.2	67.1	28.4	7.6	0	920.0
CENRTC	--	--	--	--	3.3	4.7	6.1	7.7	--	--	--	--	--	21.8
TOTAL	37.8	14.4	31.9	51.1	110.2	147.4	249.2	236.5	129.3	96.6	65.0	53.8	37.3	1,260.5

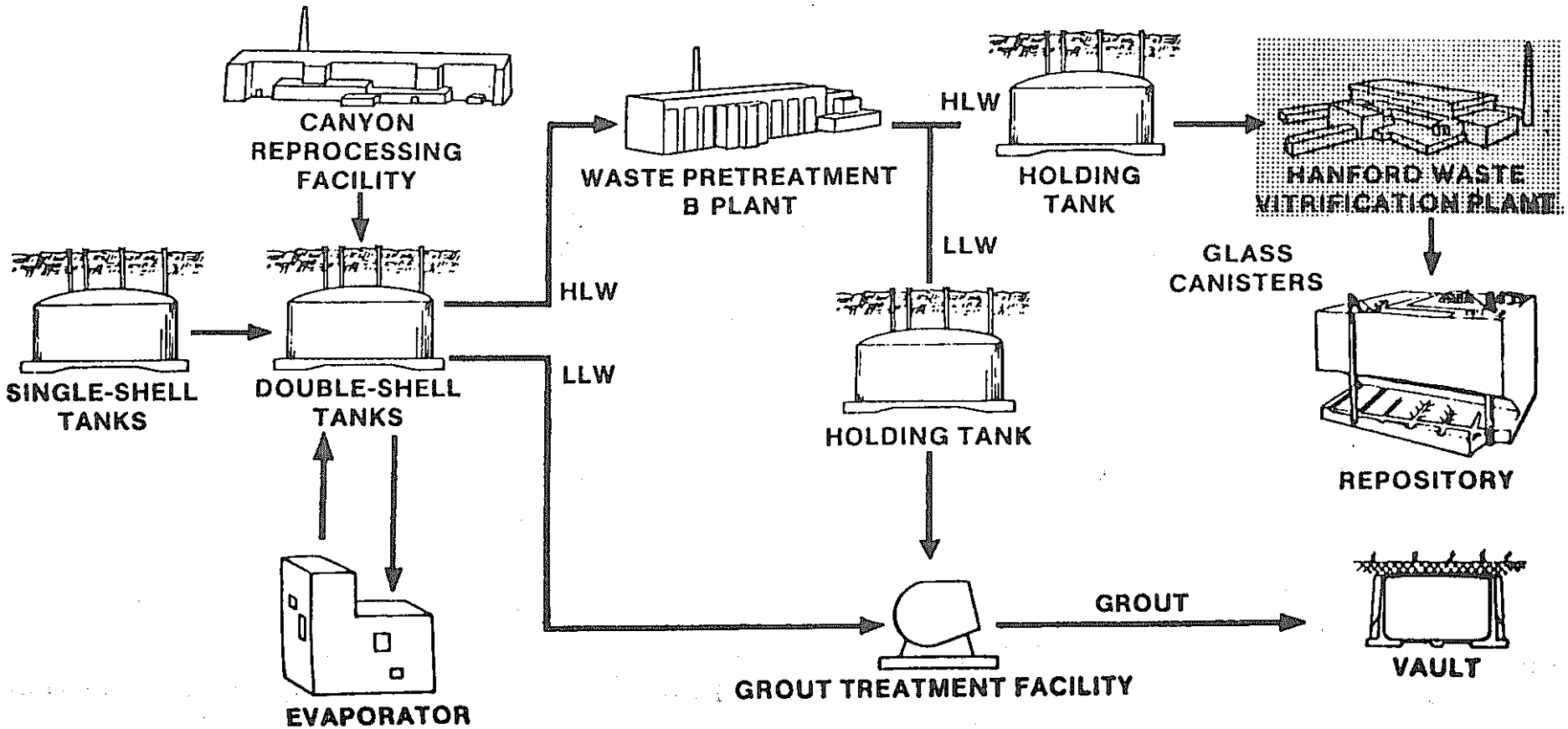


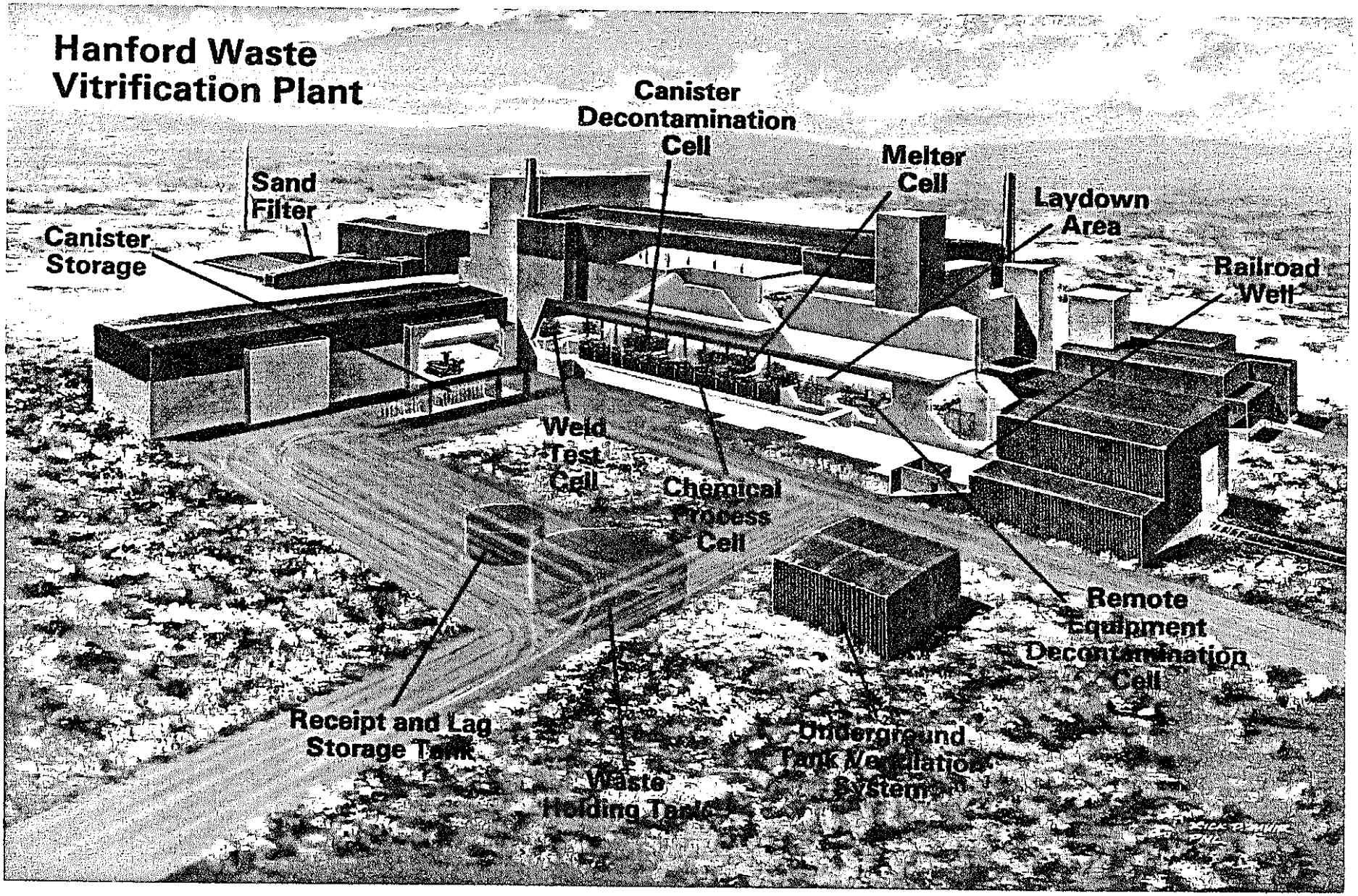
88-8049 WHC-SA-0287-S-33

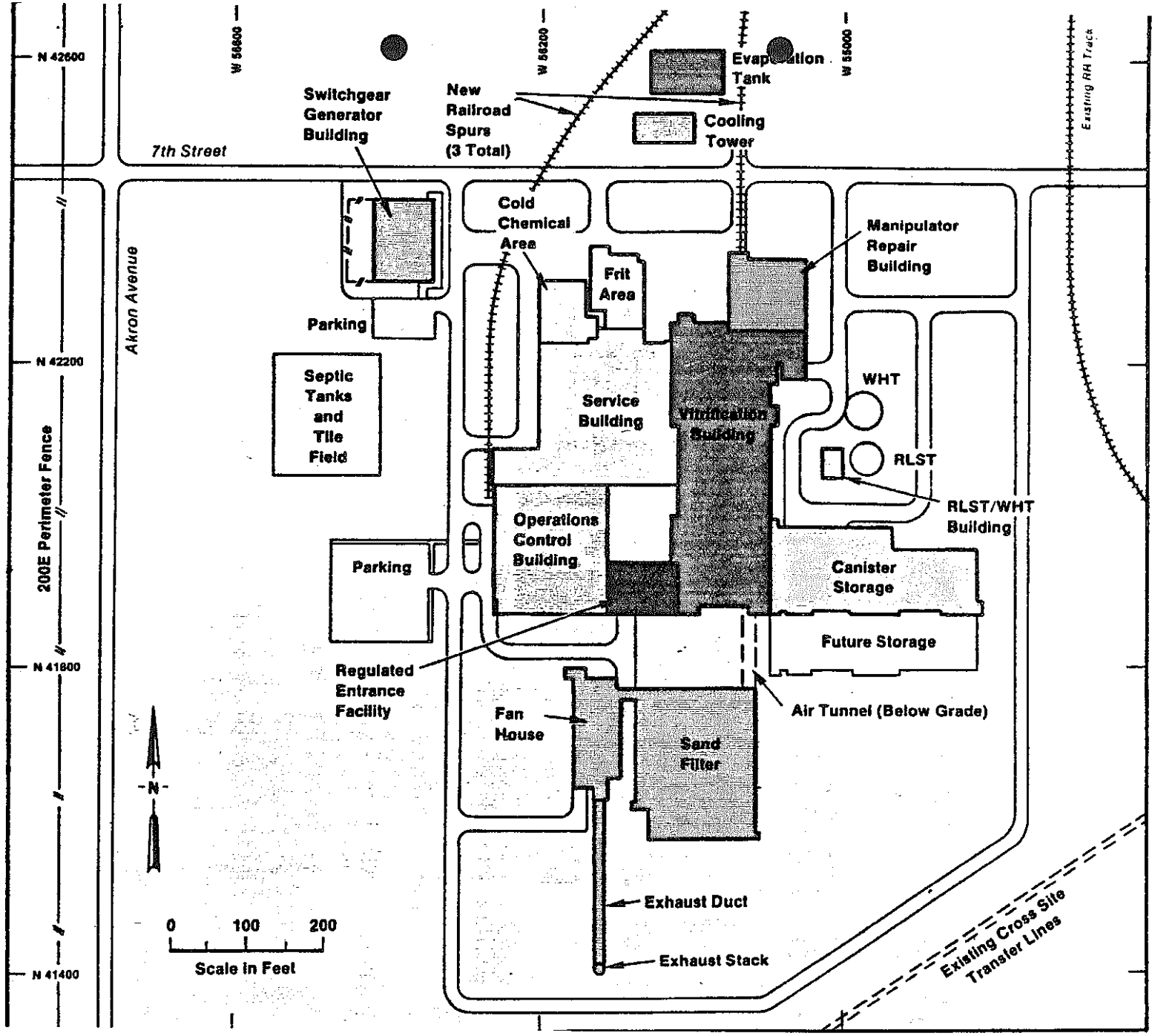
Location of HWVP at Hanford



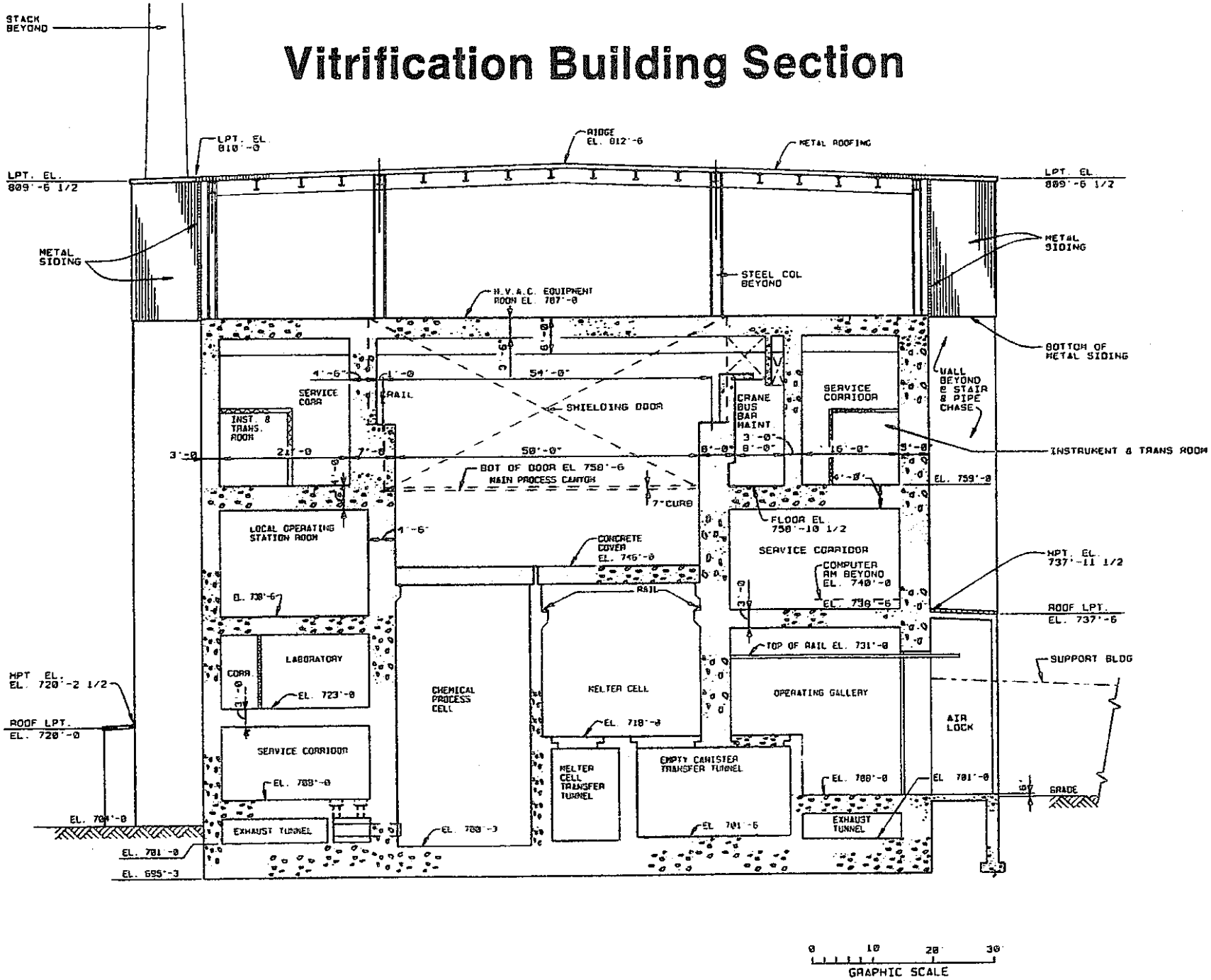
HWVP Role in Hanford Defense High-Level Waste Disposal



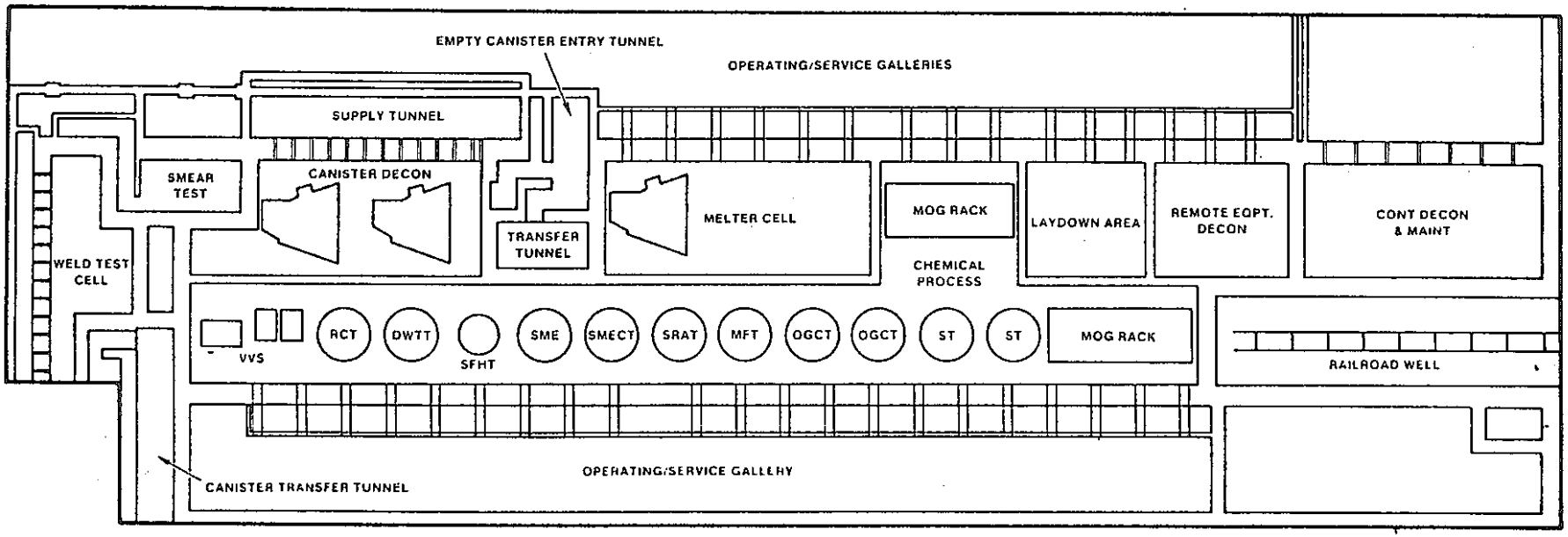

Hanford Waste
Vitrification Plant
Canister
Decontamination
Cell
Melter
Cell
Sand
Filter
Laydown
Area
Canister
Storage
Railroad
Well
Weld
Test
Cell
Chemical
Process
Cell
Remote
Equipment
Decontamination
Cell
Receipt and Lag
Storage Tank
Underground
Tank Ventilation
System
Waste
Holding Tank


N 42600
N 42200
N 41800
N 41400
W 56800
W 56200
W 55600
200E Perimeter Fence
Akron Avenue
7th Street
Existing RR Track
Switchgear Generator Building
New Railroad Spurs (3 Total)
Evaporation Tank
Cooling Tower
Cold Chemical Area
Frit Area
Manipulator Repair Building
Parking
Septic Tanks and Tile Field
Service Building
Vitrification Building
WHT
RLST
RLST/WHT Building
Operations Control Building
Parking
Canister Storage
Future Storage
Regulated Entrance Facility
Air Tunnel (Below Grade)
Fan House
Sand Filter
N
0 100 200
Scale in Feet
Exhaust Duct
Exhaust Stack
Existing Cross Site Transfer Lines

Vitrification Building Section



HWVP Cell Layout

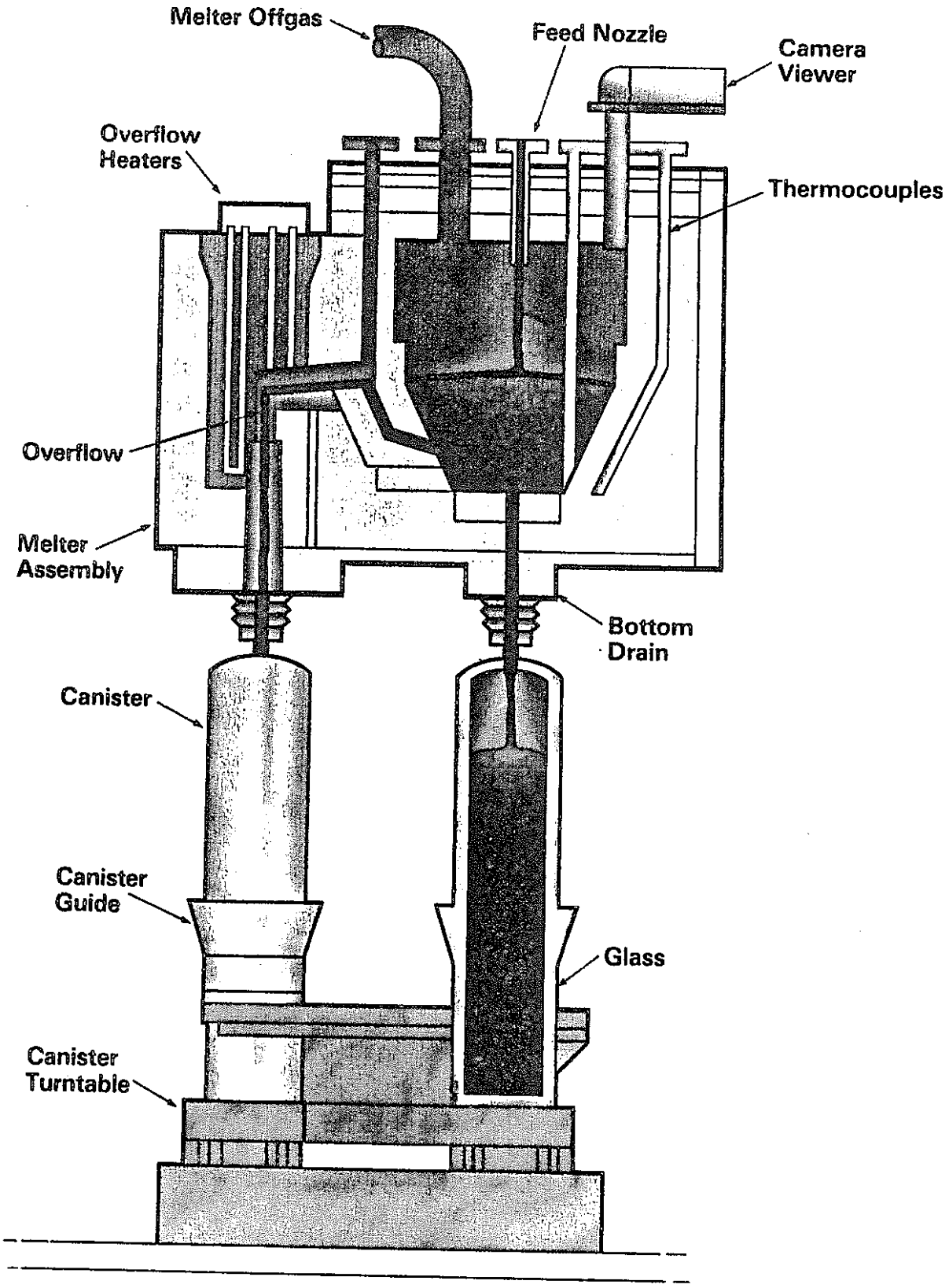


LEGEND -

MOG	MELTER OFF GAS
VVS	VESSEL VENT SYSTEM
RCT	RECYCLE COLLECTION TANK
DWTT	DECON WASTE TRANSFER TANK
SFHT	SLURRY FRIT HOLDING TANK
SME	SLURRY MIX EVAPORATOR
SMECT	SLURRY MIX EVAPORATION COLLECTION TANK
SRAT	SLURRY RECEIPT AND ADJUSTMENT TANK
MFT	MELTER FEED TANK
OGCT	OFF GAS COLLECTION TANK
ST	SCRUB TANK

88-8049 WHC-SA-0287-S-19

Conceptual Melter/Turntable

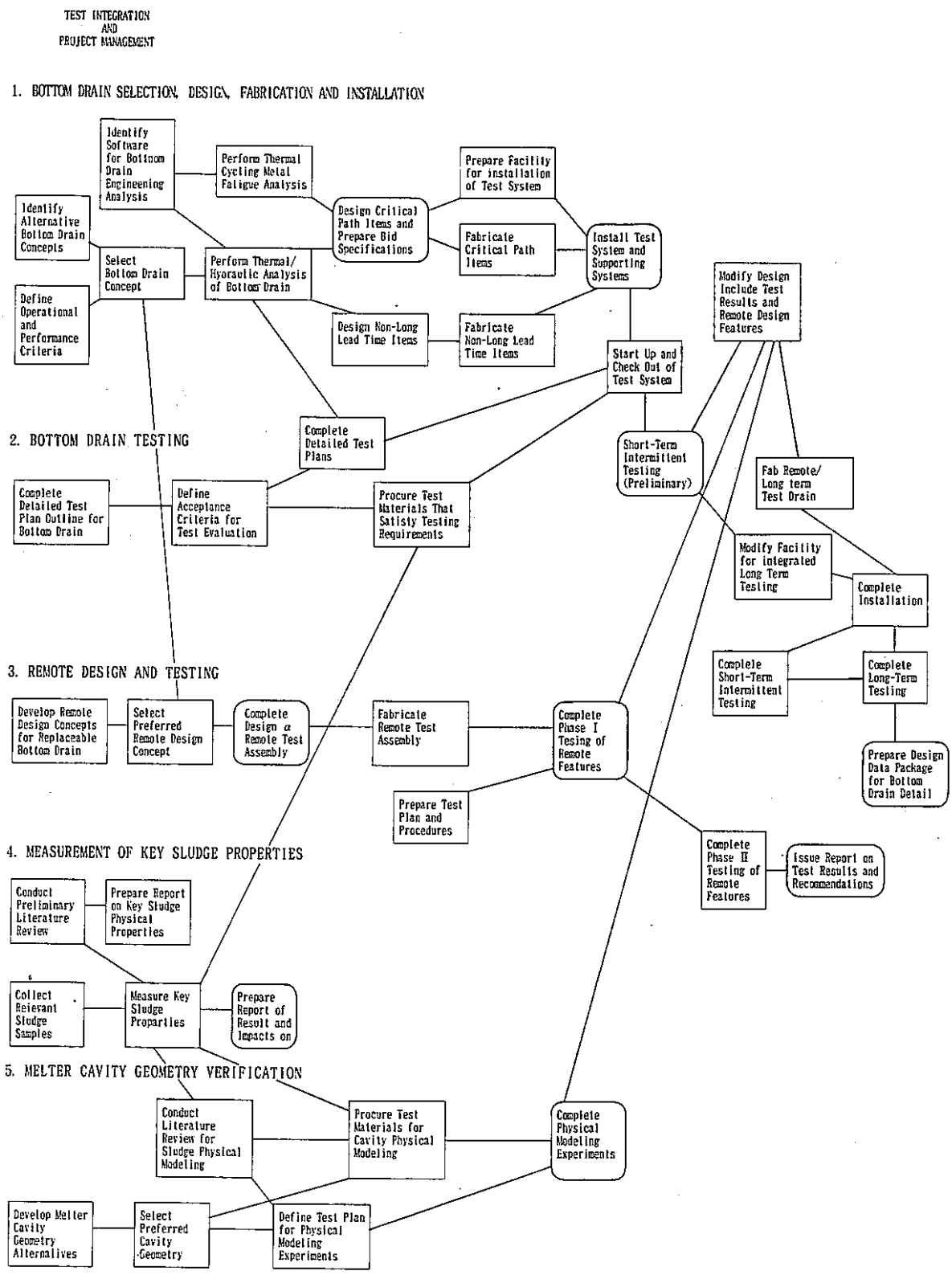


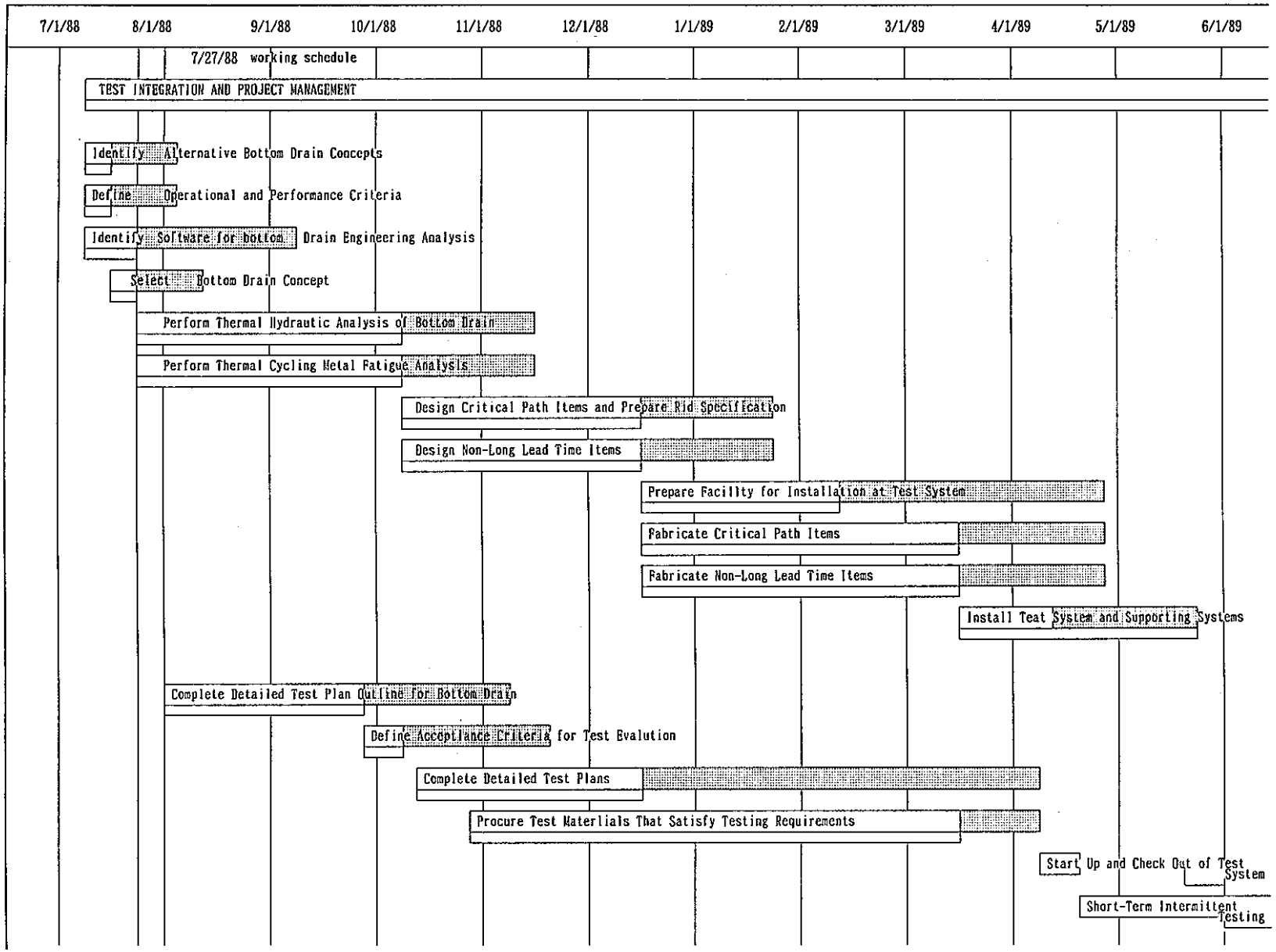
Appendix E

ＨＷＶＰにおける白金族スラッジ対策

研究開発計画及びスケジュール

９月１６日 C. C. Chapman より説明


TEST INTEGRATION AND PROJECT MANAGEMENT
1. BOTTOM DRAIN SELECTION, DESIGN, FABRICATION AND INSTALLATION
Identify Software for Bottom Drain Engineering Analysis
Perform Thermal Cycling Metal Fatigue Analysis
Prepare Facility for installation of Test System
Identify Alternative Bottom Drain Concepts
Design Critical Path Items and Prepare Bid Specifications
Fabricate Critical Path Items
Install Test System and Supporting Systems
Select Bottom Drain Concept
Perform Thermal/ Hyoraulic Analysis of Bottom Drain
Modify Design Include Test Results and Remote Design Features
Define Operational and Performance Criteria
Design Non-Long Lead Time Items
Fabricate Non-Long Lead Time Items
Start Up and Check Out of Test System
Complete Detailed Test Plans
2. BOTTOM DRAIN TESTING
Short-Term Intermittent Testing (Preliminary)
Fab Remote/ Long term Test Drain
Complete Detailed Test Plan Outline for Bottom Drain
Define Acceptance Criteria for Test Evaluation
Procure Test Materials That Satisfy Testing Requirements
Modify Facility for integrated Long Term Testing
Complete Installation
Complete Short-Term Intermittent Testing
Complete Long-Term Testing
3. REMOTE DESIGN AND TESTING
Develop Remote Design Concepts for Replaceable Bottom Drain
Select Preferred Remote Design Concept
Complete Design α Remote Test Assembly
Fabricate Remote Test Assembly
Complete Phase I Tesing of Remote Features
Prepare Design Data Package for Bottom Drain Detail
Prepare Test Plan and Procedures
Complete Phase II Testing of Remote Features
Issue Report on Test Results and Recommendations
4. MEASUREMENT OF KEY SLUDGE PROPERTIES
Conduct Preliminary Literature Review
Prepare Report on Key Sludge Physical Properties
Collect Relevant Sludge Samples
Measure Key Sludge Proparties
Prepare Report of Result and Impacts on
5. MELTER CAVITY GEOMETRY VERIFICATION
Conduct Literature Review for Sludge Physical Modeling
Procure Test Materials for Cavity Physical Modeling
Complete Physical Modeling Experiments
Develop Melter Cavity Geometry Alternalives
Select Preferred Cavity Geometry
Define Test Plan for Physical Modeling Experiments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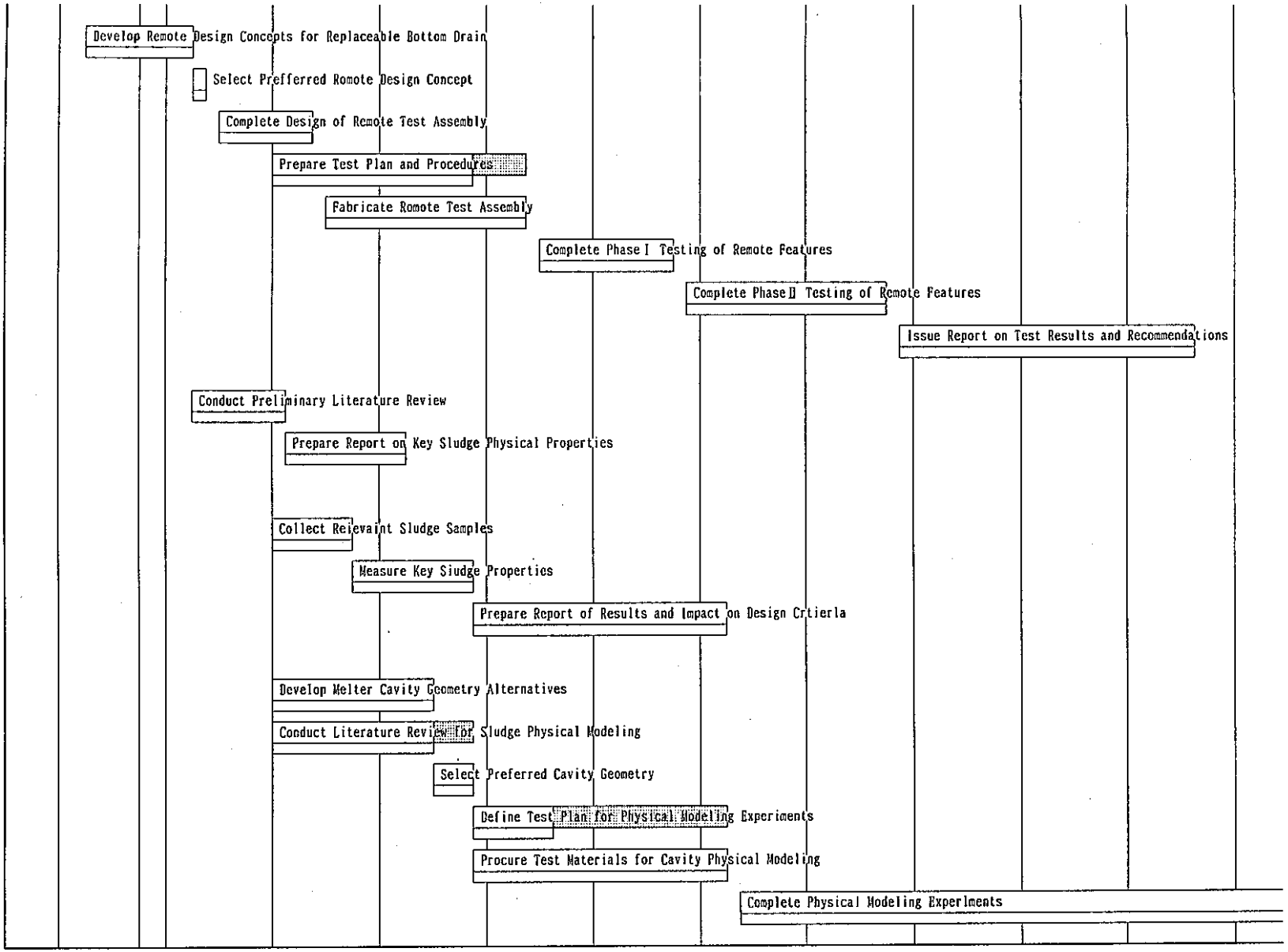
7/27/88 working schedule
TEST INTEGRATION AND PROJECT MANAGEMENT
Identify Alternative Bottom Drain Concepts
Define Operational and Performance Criteria
Identify Software for bottom Drain Engineering Analysis
Select Bottom Drain Concept
Perform Thermal Hydraulic Analysis of Bottom Drain
Perform Thermal Cycling Metal Fatigue Analysis
Design Critical Path Items and Prepare Rid Specification
Design Non-Long Lead Time Items
Prepare Facility for Installation at Test System
Fabricate Critical Path Items
Fabricate Non-Long Lead Time Items
Install Test System and Supporting Systems
Complete Detailed Test Plan Outline for Bottom Drain
Define Acceptance Criteria for Test Evalution
Complete Detailed Test Plans
Procure Test Materials That Satisfy Testing Requirements
Start Up and Check Out of Test System
Short-Term Intermittent Testing


Develop Remote Design Concepts for Replaceable Bottom Drain
Select Prefferred Romote Design Concept
Complete Design of Remote Test Assembly
Prepare Test Plan and Procedures
Fabricate Romote Test Assembly
Complete Phase I Testing of Remote Features
Complete Phase II Testing of Remote Features
Issue Report on Test Results and Recommendations
Conduct Preliminary Literature Review
Prepare Report on Key Sludge Physical Properties
Collect Relevaint Sludge Samples
Measure Key Siudge Properties
Prepare Report of Results and Impact on Design Crtierla
Develop Melter Cavity Geometry Alternatives
Conduct Literature Review for Sludge Physical Modeling
Select Preferred Cavity Geometry
Define Test Plan for Physical Modeling Experiments
Procure Test Materials for Cavity Physical Modeling
Complete Physical Modeling Experiments