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Title: Recovery of Pu-238 by Molten Salt Oxidation Processing of Pu-238 Contaminated Combustibles

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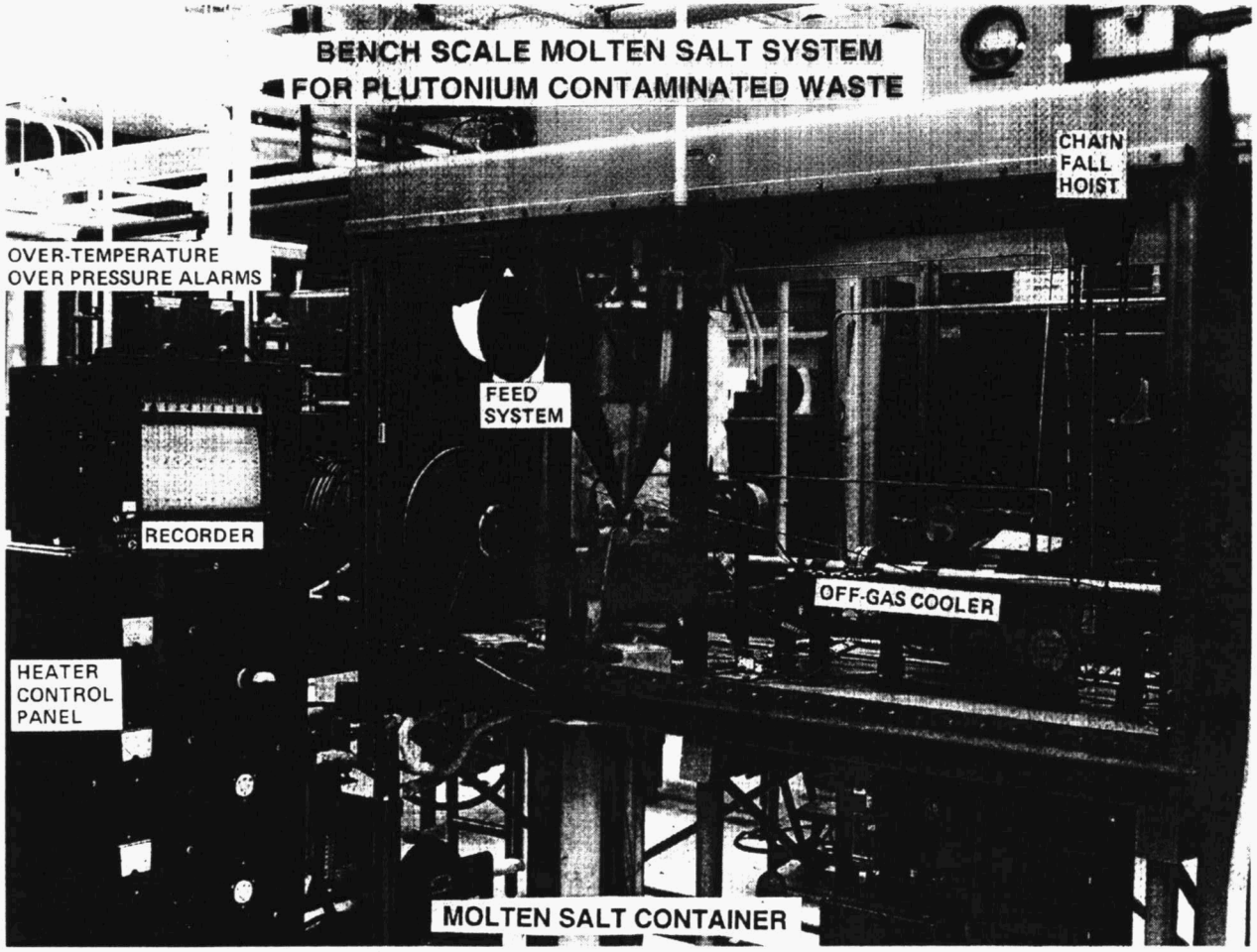
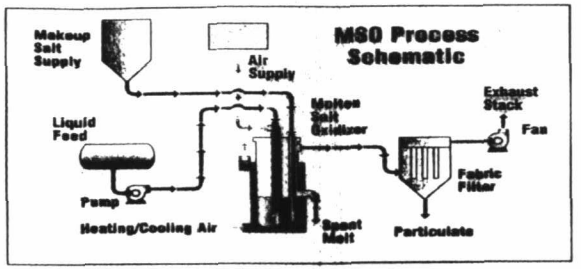
Los Alamos
NATIONAL LABORATORY

Bench-scale unit from Rockwell



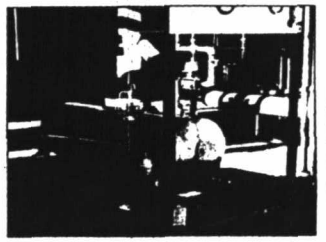
Commercial MSO Unit

Energy Technology Engineering Center (ETEC)



MSO Vessel

Fabric filter subsystem for hazardous service



Liquid feed subsystem

ETEC's Molten Salt Test Facility (MSTF)

The MSTF is an existing, permitted facility of commercial scale that is now available for test operations. The MSTF, described in this brochure, is ideally suited to support the deployment of the Molten Salt Oxidation (MSO) process for destruction applications, such as chlorinated hydrocarbons, oils, and alkali metals.

Test programs can be conducted to address a variety of technical issues, such as destruction removal efficiency, off-gas characterization, and safety and ease of operation. Additionally, studies can be performed to optimize operating conditions, validate full-scale component and subsystem design, and assess material performance.

The immediate availability of the MSTF can provide near-term data to minimize technical and permitting risks associated with the implementation of MSO at Department of Energy sites.

Specifications:

Vessel size:	33-in. dia x 17-ft 9-in. high
Melt depth:	73-in. expanded bed
Vessel material:	nickel alloy
Throughput:	50 - 200 lb/hr, maximum
Operating temperature:	900°C, nominal

Design features:

- Top-entry feed
- External forced-air cooling and heating
- Continuous salt makeup and melt discharge
- Passive off-gas cooling
- Capability for oxygen-enriched air

Exhaust subsystem designed for performance monitoring

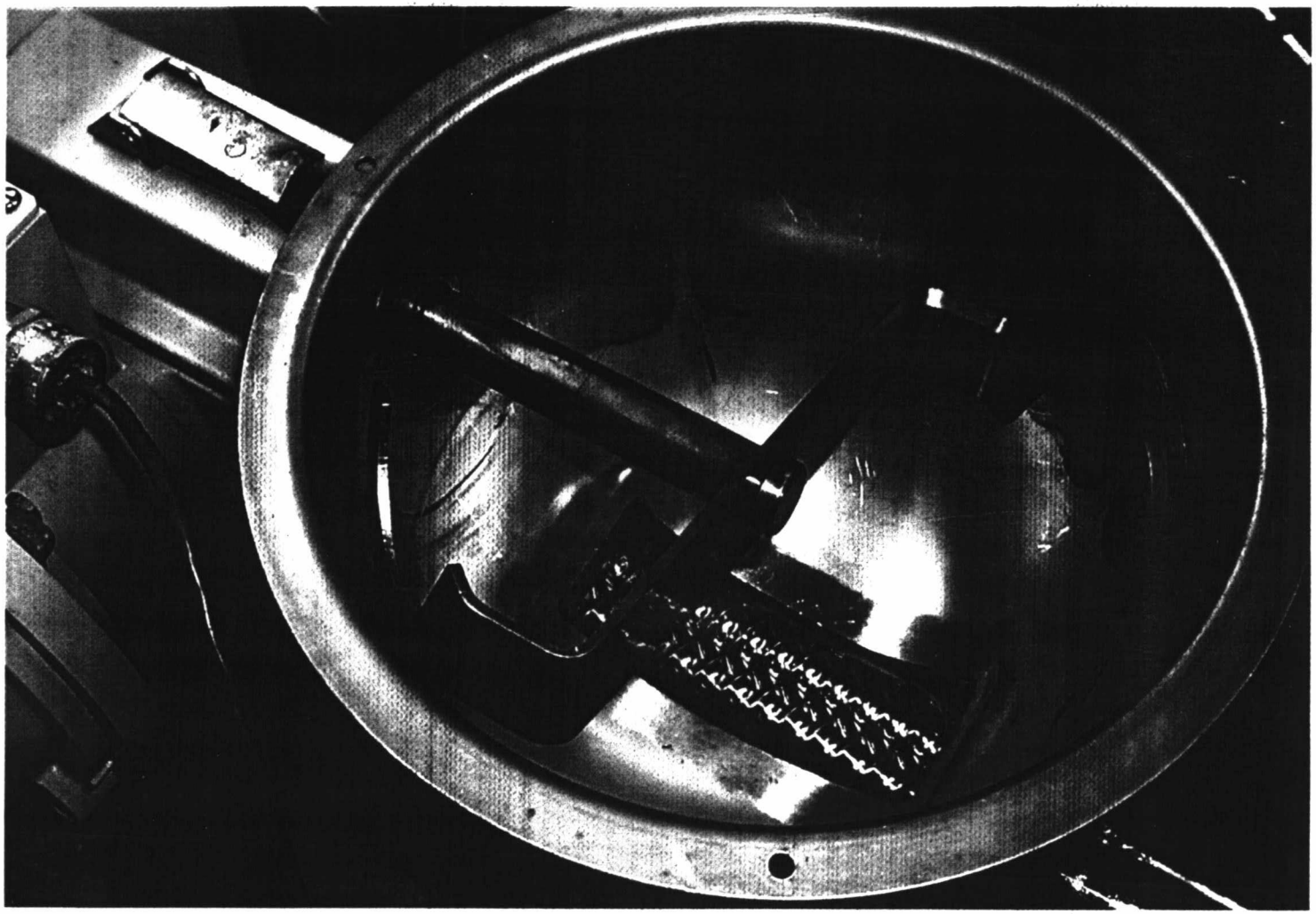
Rockwell Aerospace

Rocketdyne

For more information, contact:
Energy Technology Engineering Center
Office of Research and Technology Applications
P.O. Box 7930
Canoga Park, CA 91309
(818) 586-5040

Pub. no 571-Z-002 New 12/94

K-Tron Screwfeeder Agitator and Screws



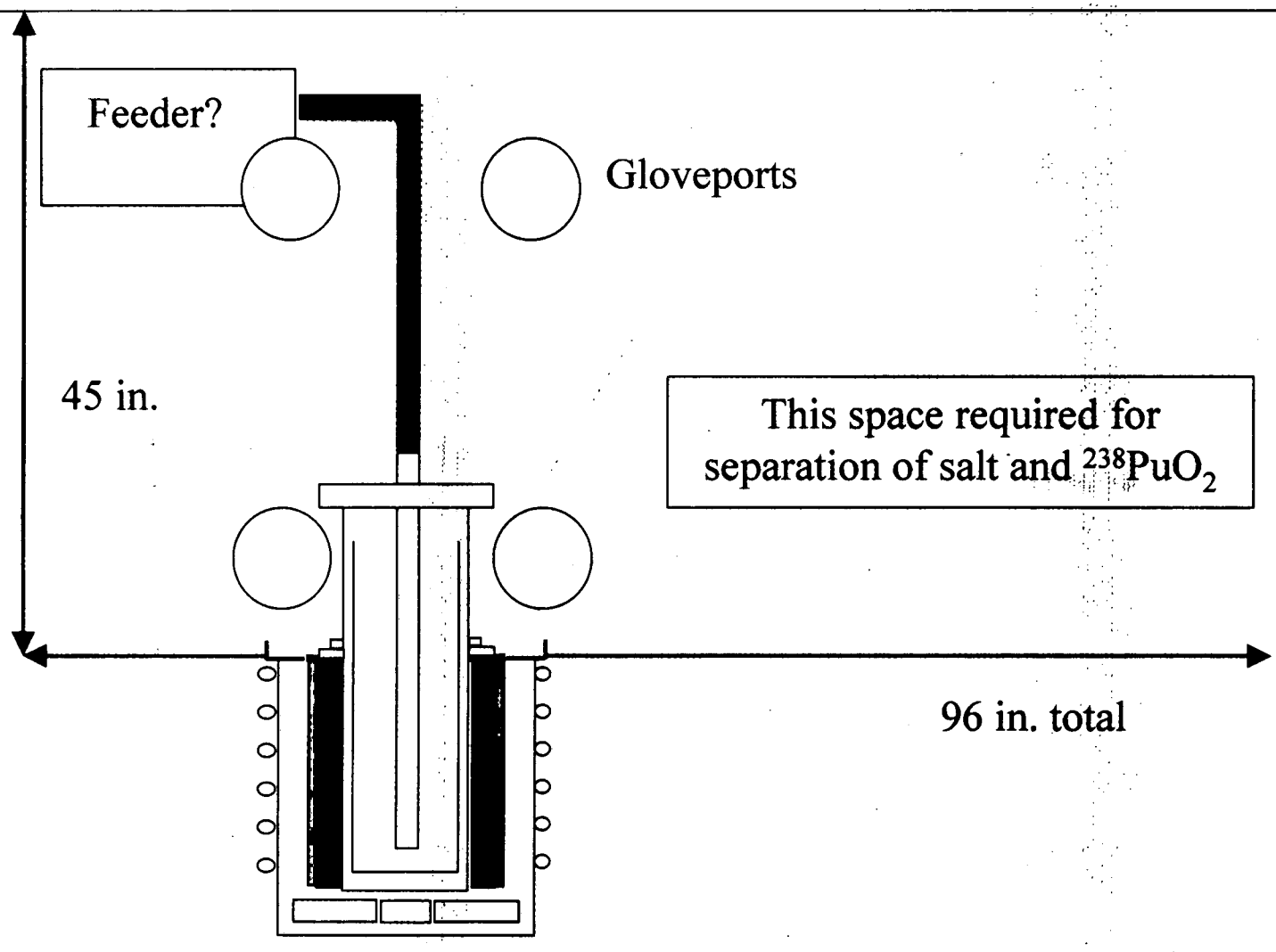
K-Tron Screwfeeder

Proposal

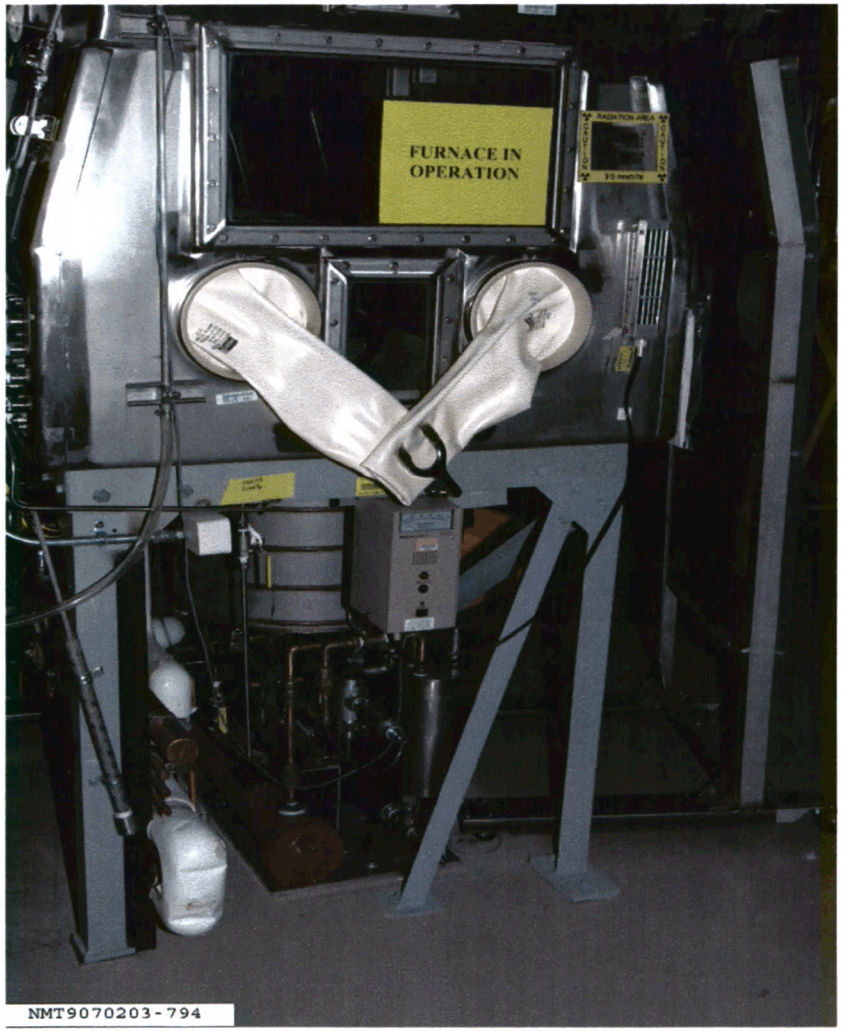
- More robust salt containment
  - ✓Procure & test crucibles from identified materials
- Implement continuous feed system
  - ✓Procure & fully test continous feed system
  - ✓Particularly the screwfeeder
- Ancillary systems integrated and installed in PF-4

Salt Plug from 1st MSO Run in GB

Stringent Space Requirements Exist for Installation

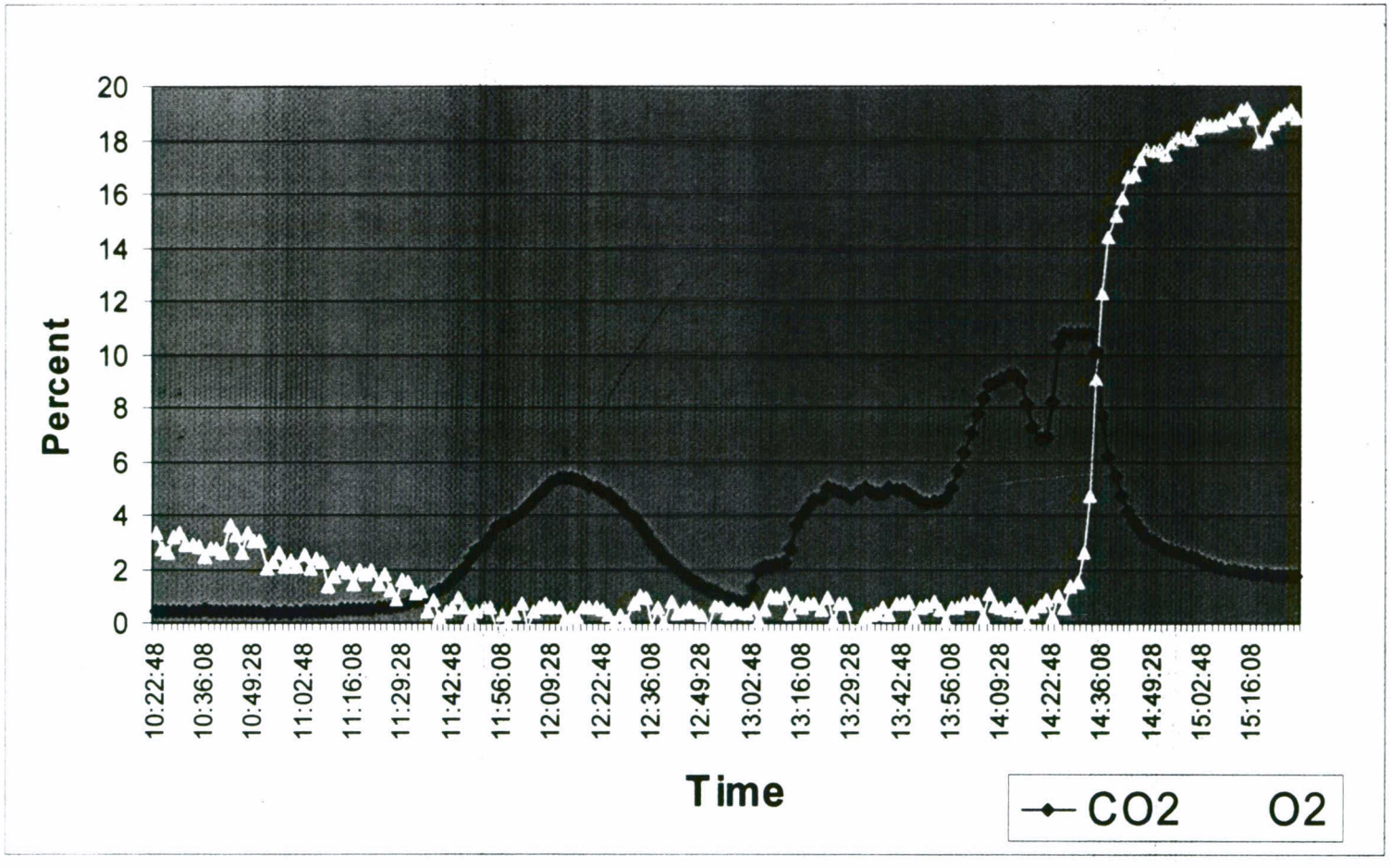


Glovebox with Furnace Well

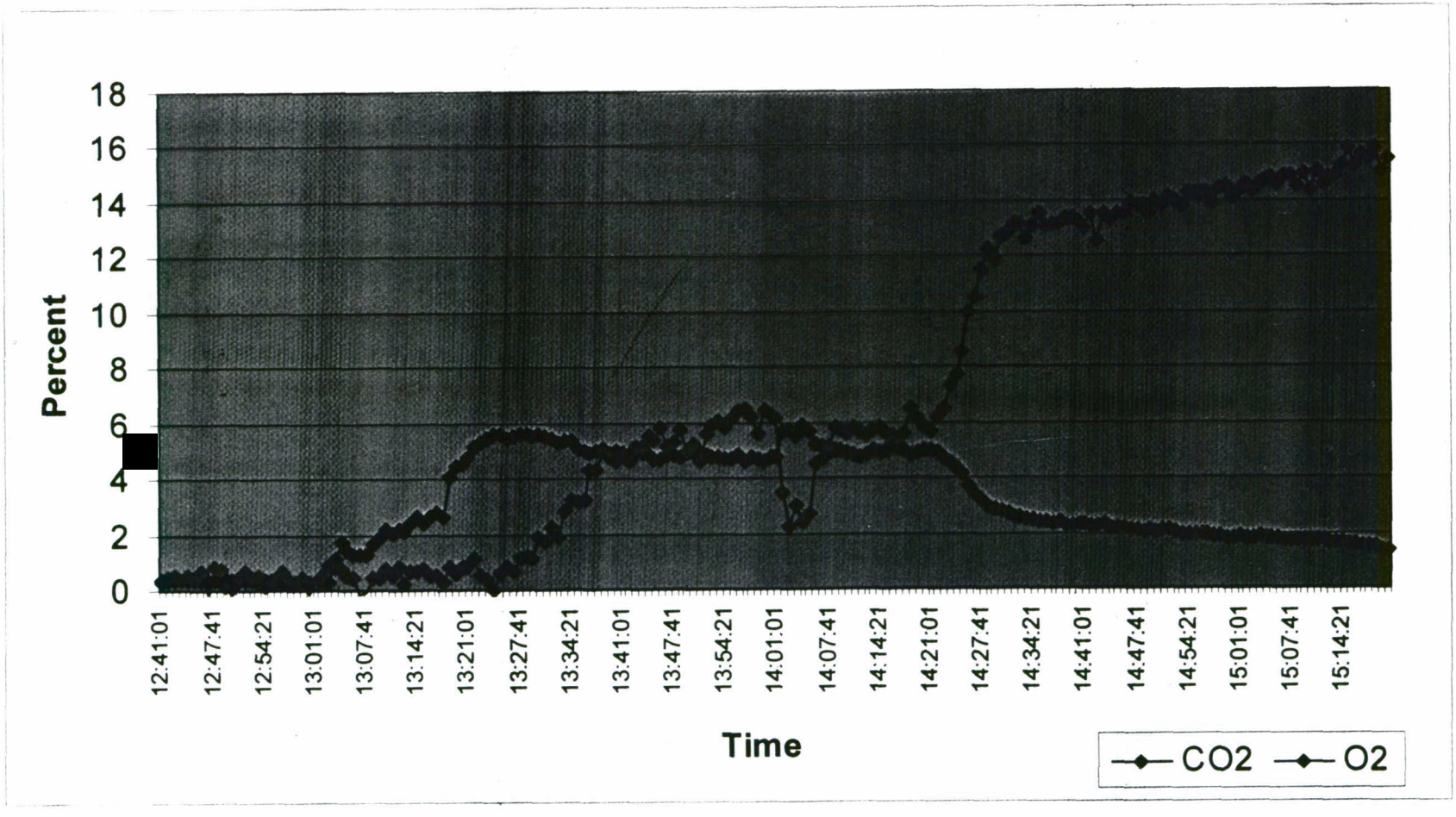


Batch Mode MSO Data

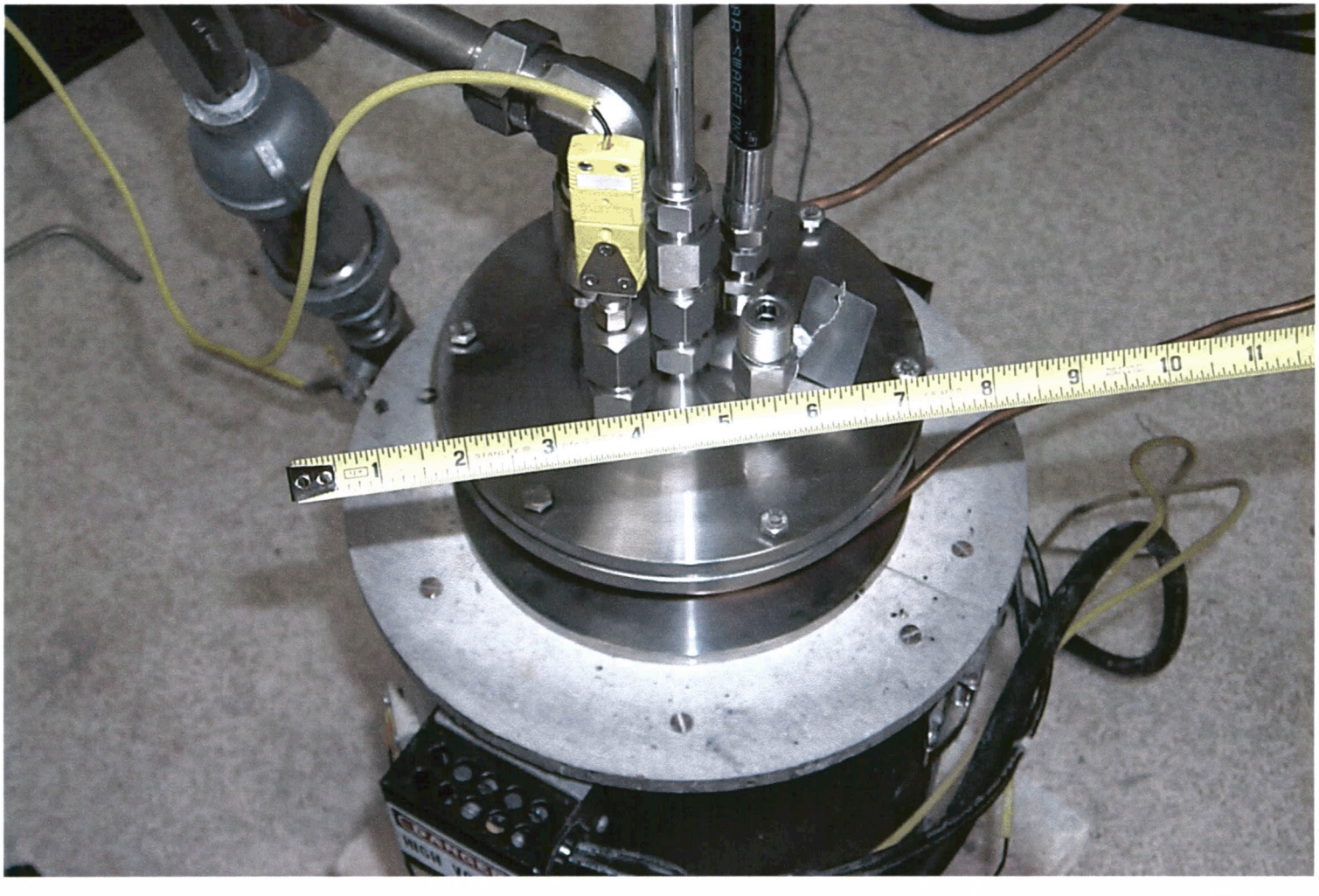
Catalyst added



Batch Mode MSO Data



Bird's eye of Batch Unit



Two-pronged Approach

- Install batch mode unit in PF-4
  - ✓ Small unit operating under existing AB
  - ✓ Real experience with glovebox and plutonium
- Continue to develop continuous mode unit
  - ✓ Much higher feed rate
  - ✓ More varied feed stock

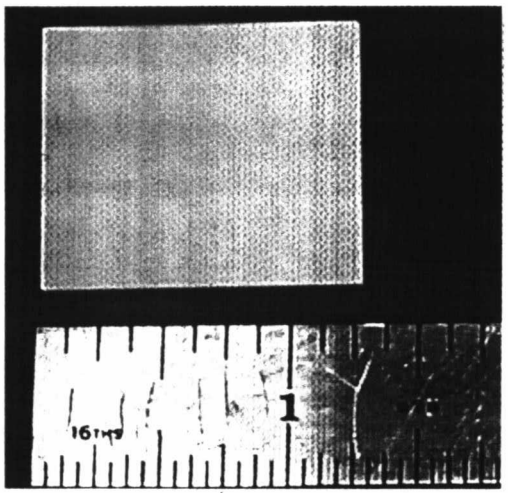
Ancillary Systems

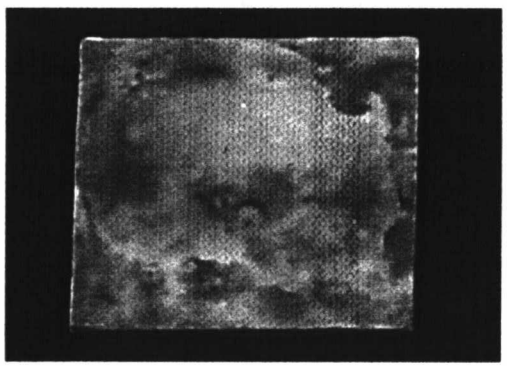
- Analytical system
  - ✓ Upgrade of CO and CO_2 ranges
- Furnace & Controller
  - ✓ New controller fabbed by our shop
  - ✓ Furnace needs "refurbishing"
- Screwfeeder
  - ✓ Working with vendor on custom order (loaner)
  - ✓ Improvising hopper agitation system
  - ✓ "Mocking" glovebox space to place feeder

Progress

- AB – PrHA to be submitted mid-Feb
- MSO Unit
  - ✓"Retrofit" of vessel to shorter height
  - ✓ Procured custom inner liners of Inconel 600
  - ✓"Flanged" lid and Inconel 600 downcomer
  - ✓ Procured alumina crucibles to test
  - ✓ Ordered aluminum nitride crucibles

Corrosion Test with AlN

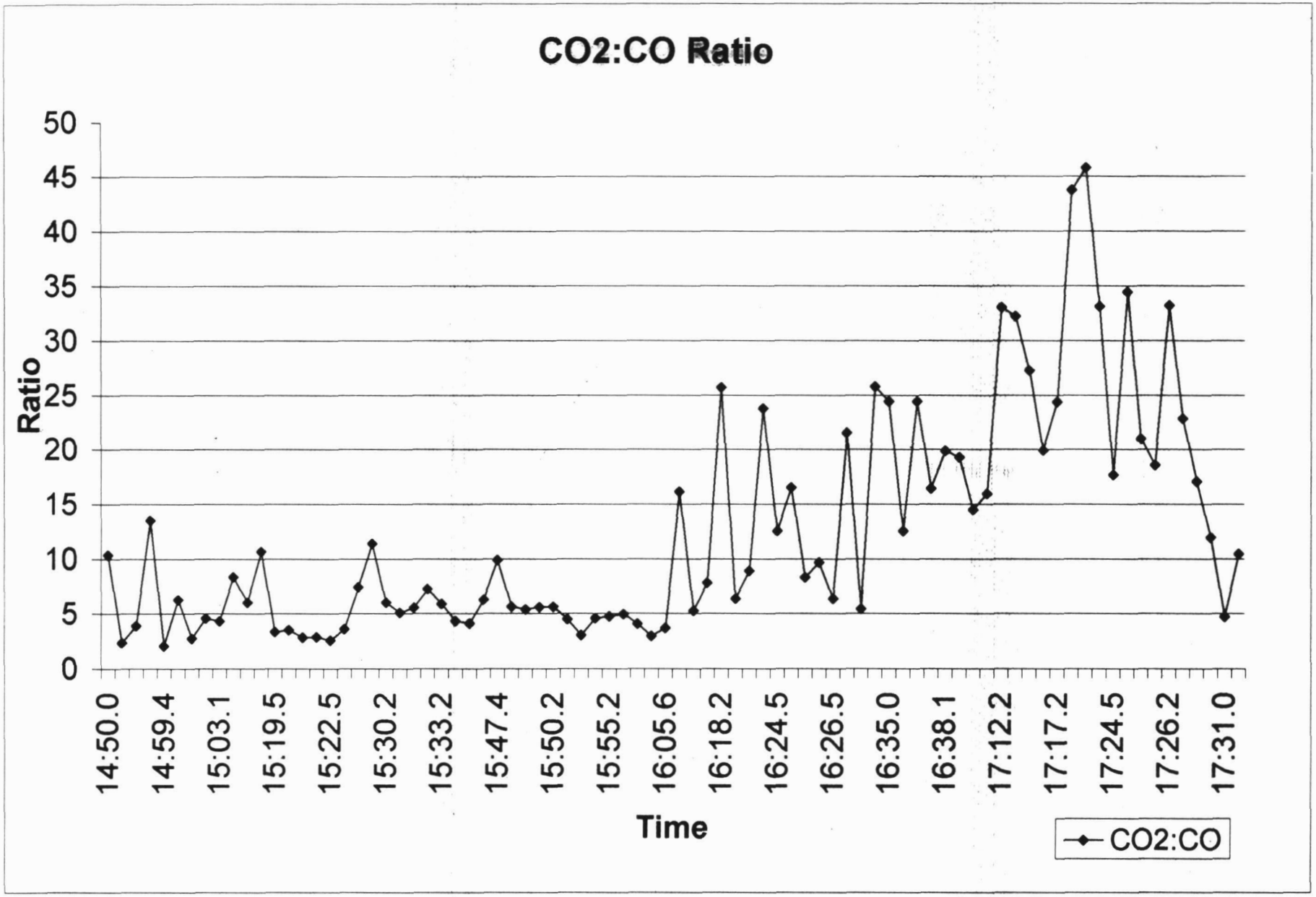




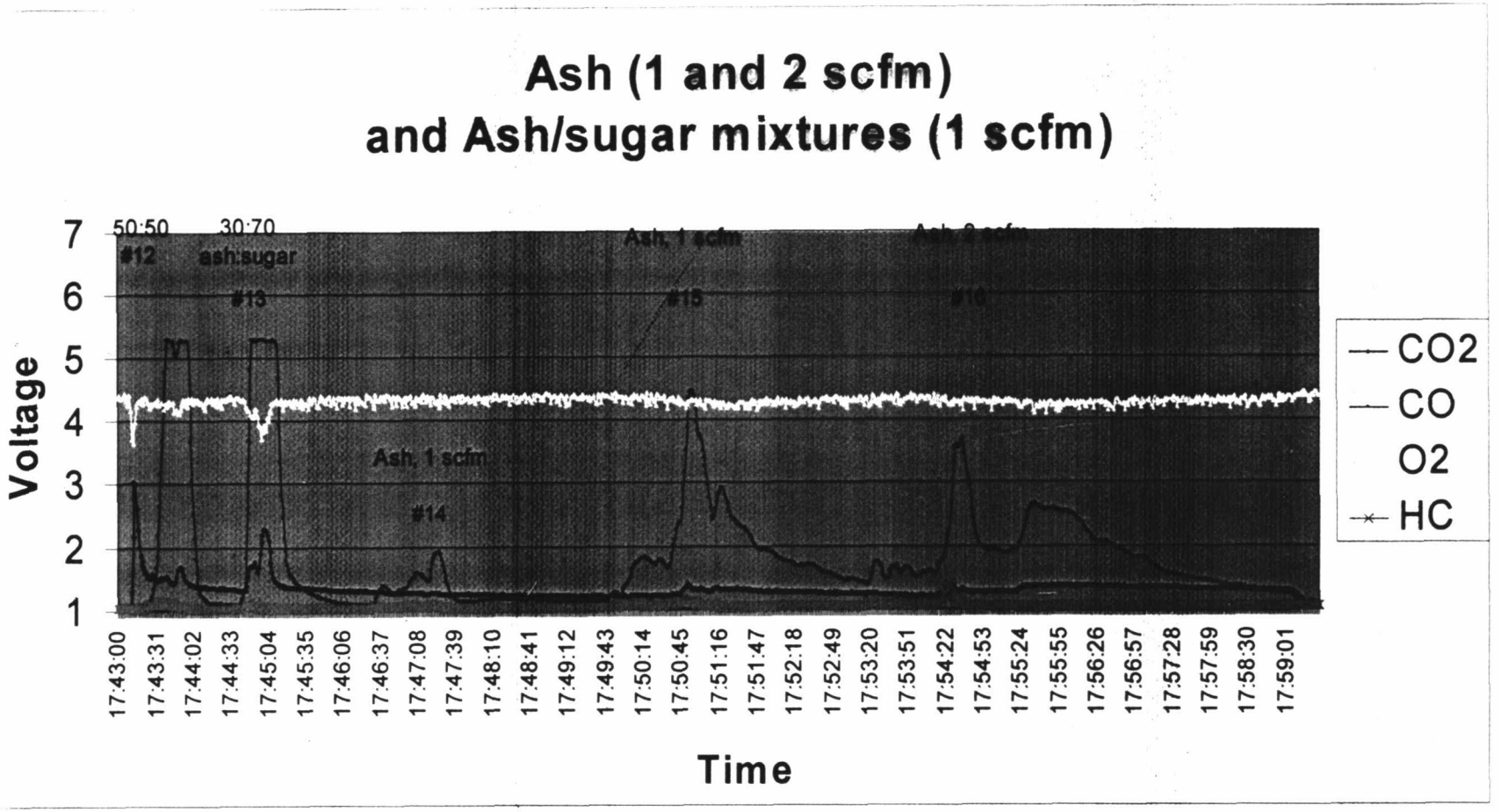
Aluminum Nitride

Aluminum Nitride vs Alumina

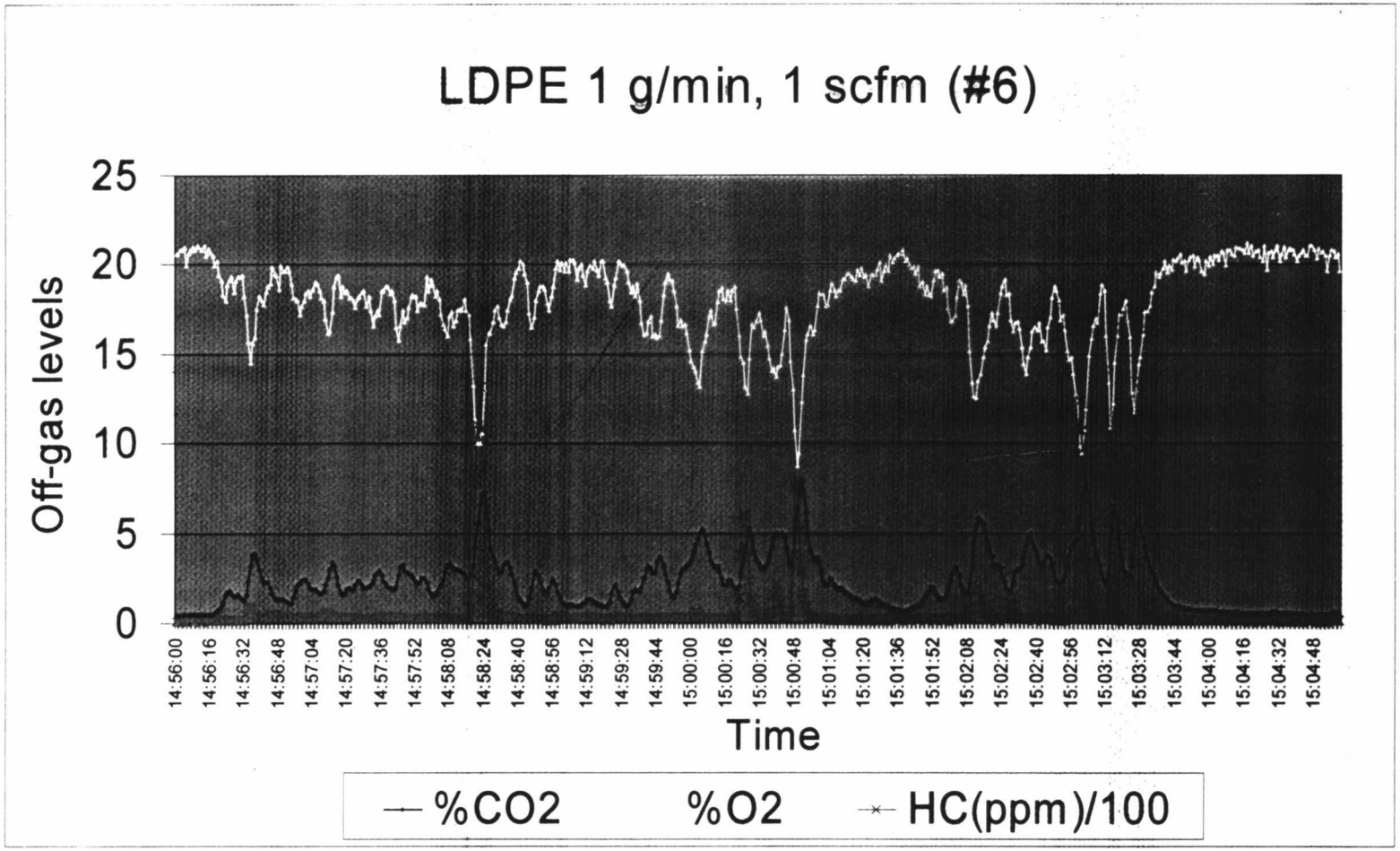
Thermal conductivity (high)	175 vs 25
Thermal expansion (low)	3.6 vs 8.1


CO2:CO Ratio
Ratio
50
45
40
35
30
25
20
15
10
5
0
14:50.0
14:59.4
15:03.1
15:19.5
15:22.5
15:30.2
15:33.2
15:47.4
15:50.2
15:55.2
16:05.6
16:18.2
16:24.5
16:26.5
16:35.0
16:38.1
17:12.2
17:17.2
17:24.5
17:26.2
17:31.0
Time
CO2:CO

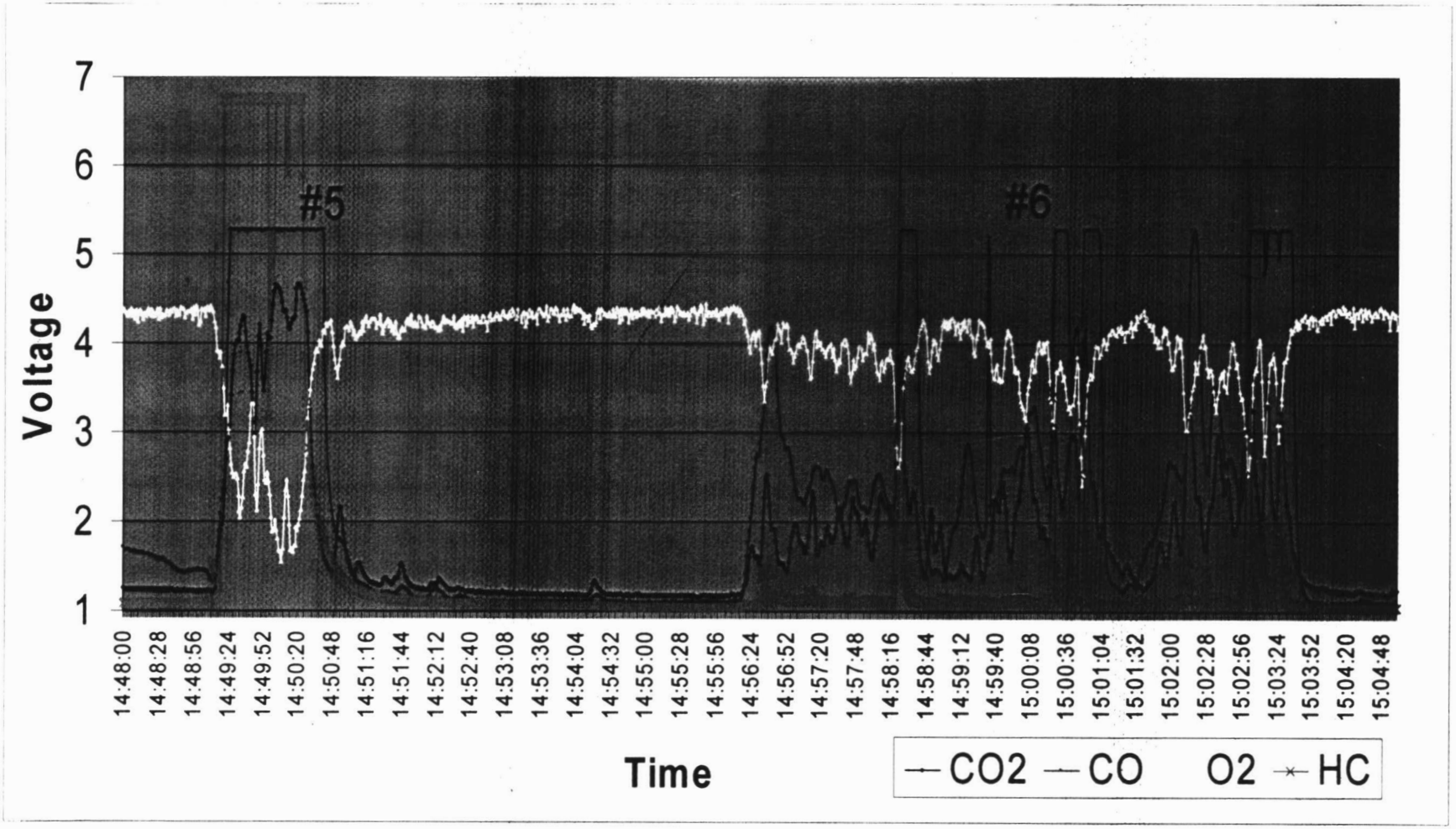
Ash Feedstock



"Human metered" Feed System

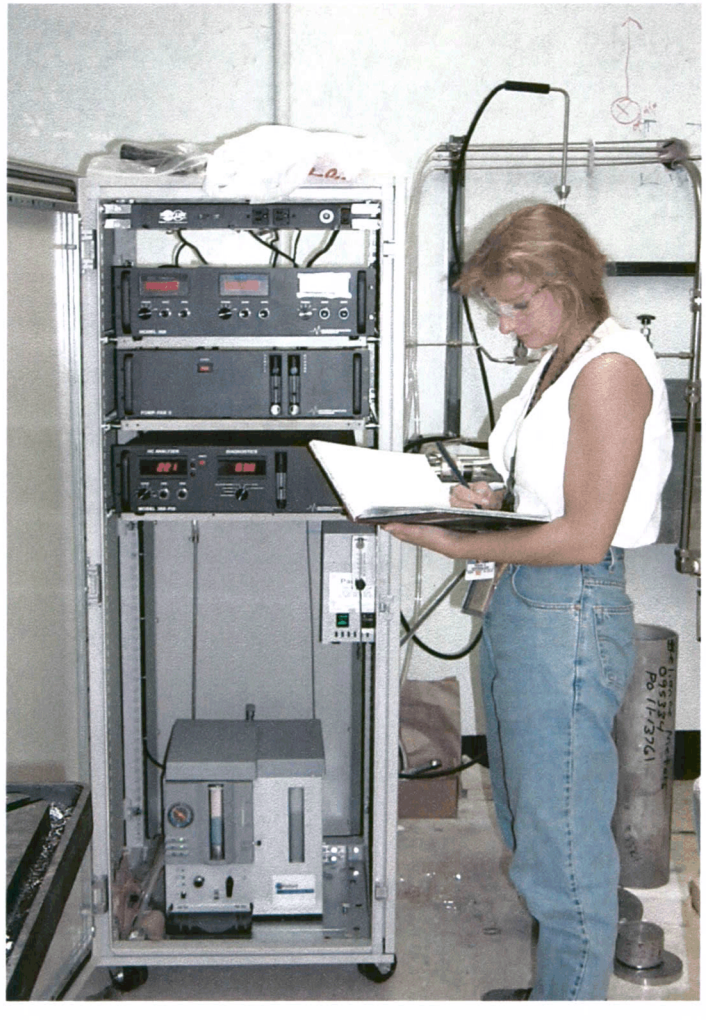


LDPE at 5 g/min (#5) and 1 g/min (#6)

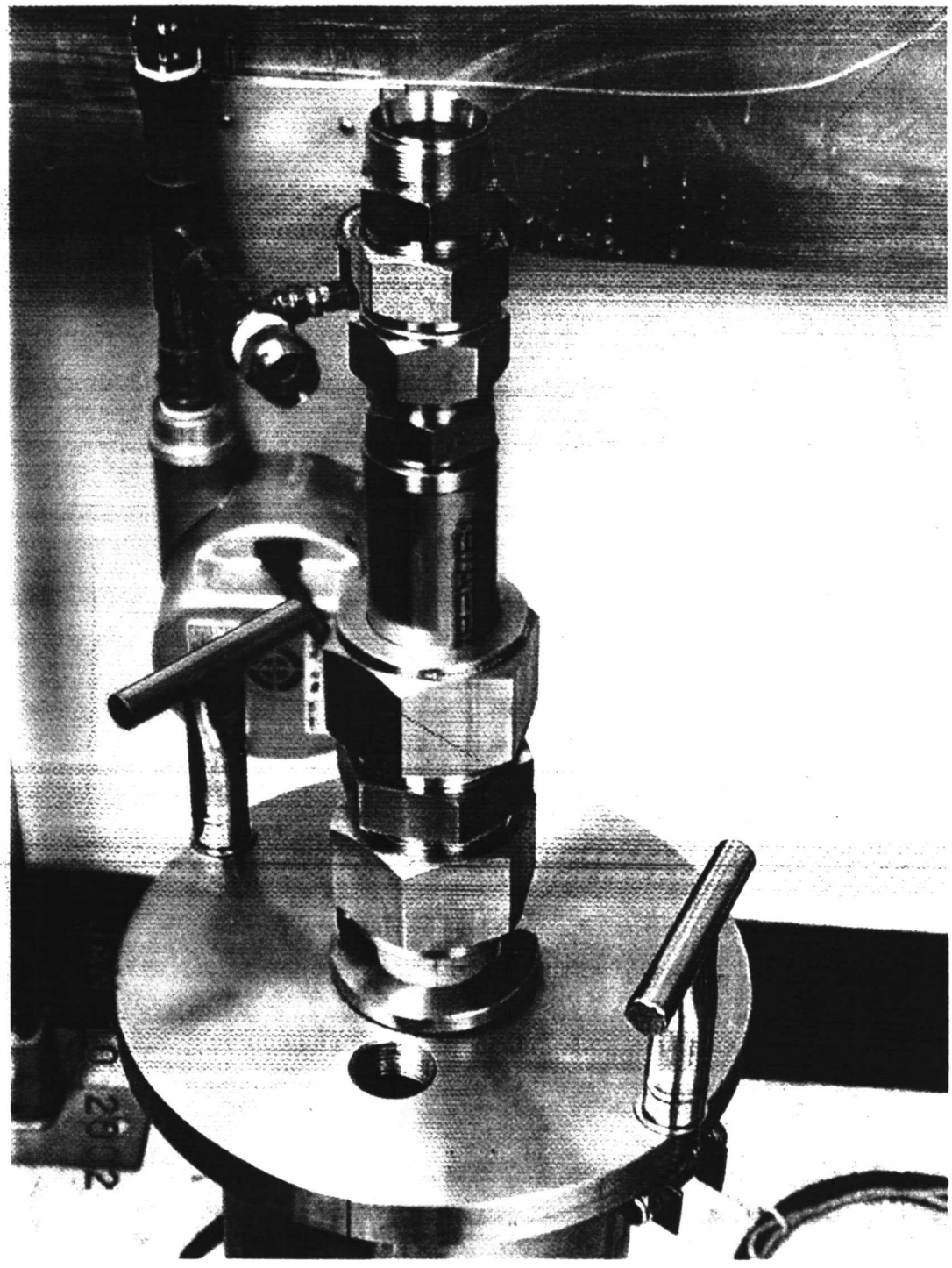


Continuous Feed Unit 2002

Analytical Instruments

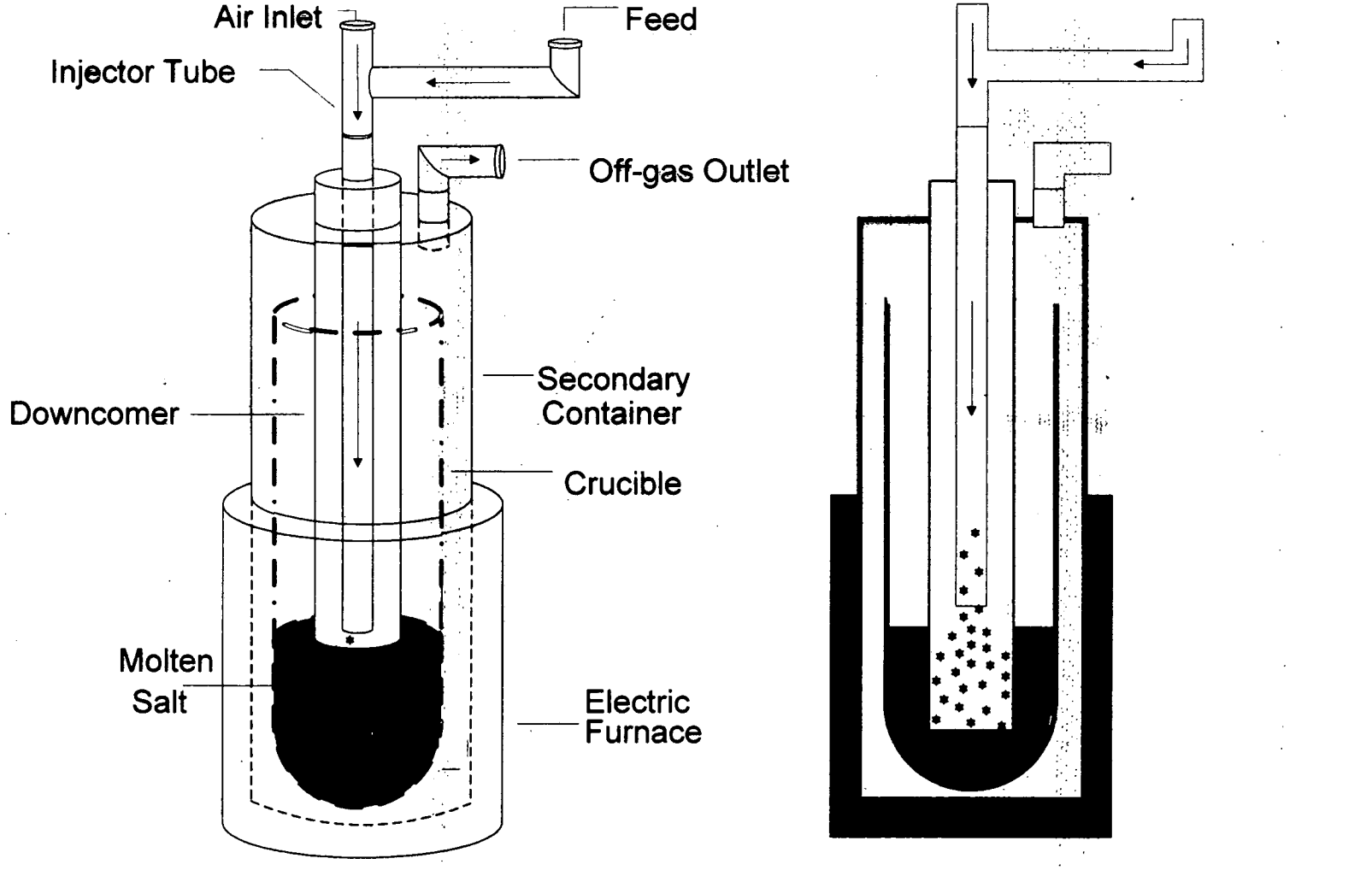


MSO II



Inside the Vessel

Schematic of MSO Unit



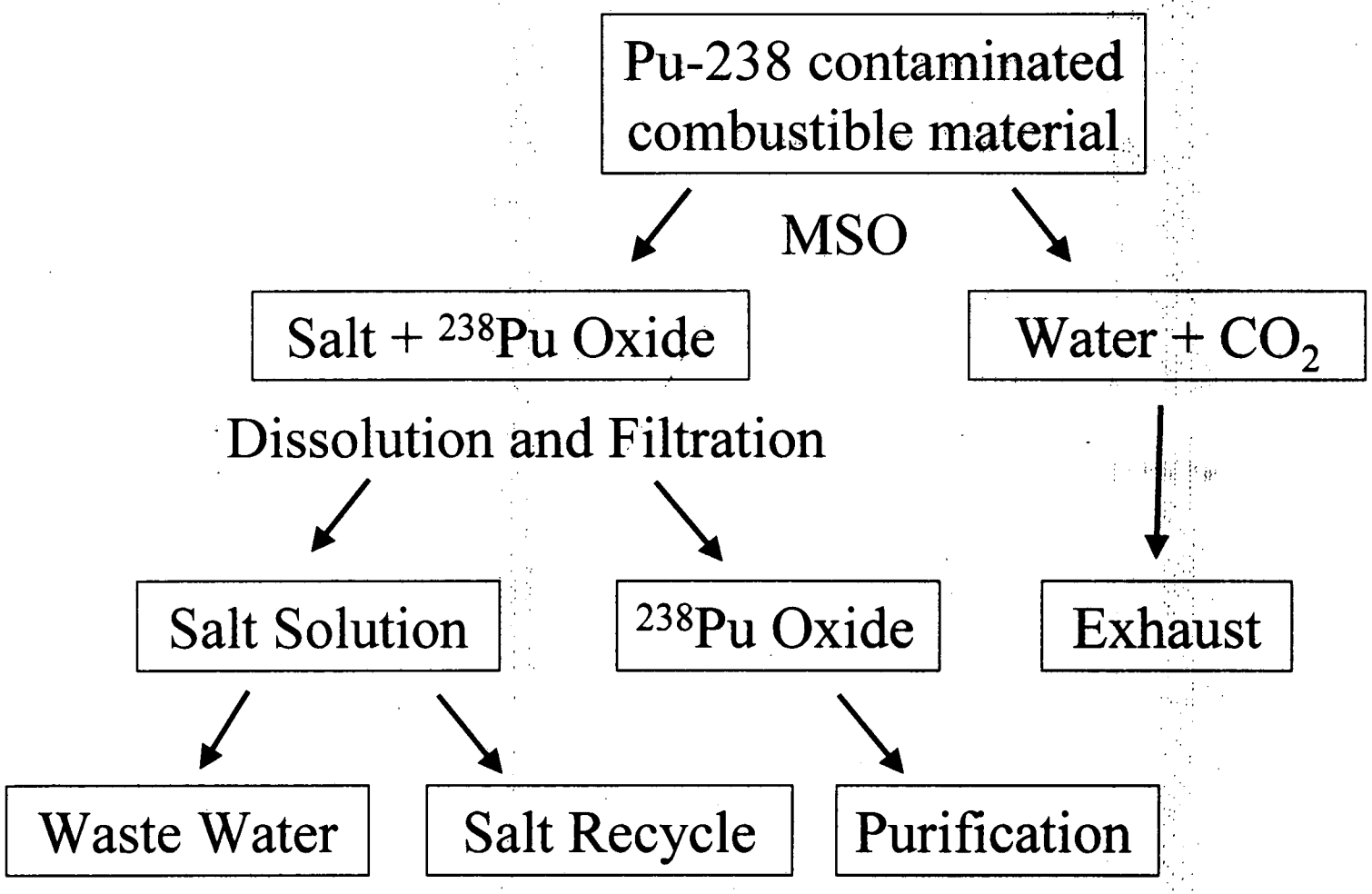
MSO Material Corrosion Tests

- Alumina has the best anti-corrosion characteristics, and has been used in other MSO operations but has thermal shock sensitivity, especially as the crucibles get larger. (Configuration plays an important role.)

- Looking for combination of maximum corrosion and thermal shock resistances. Corrosion testing yielded two materials which may work as crucible material.

- Aluminum nitride showed very good corrosion resistance after testing at 900 C for two weeks, and 950 C for three more weeks. It has exceptional thermal shock resistance.

Flow Chart of MSO Process



MSO Technology

- **Flameless** alternative to incineration
- Uses bed of molten salt as matrix for **complete oxidation** of hydrocarbon material
- Plutonium remains in the salt as insoluble oxide and **can be recovered**

A Few Facts about Pu-238 Oxide

- Crucial heat source material for deep space missions. Pluto, Mars, etc. (Rover "RUs")
- Increasingly important material for national security applications
- Currently no domestic production

A Few Facts about Pu-238 Waste

- Pu-238 currently classified as having no-path-forward
- DOT limits for Pu-238 combustible waste are currently less than a few grams per drum
- Significant amount of oxide in the combustible material

Vision

- Present: Partner with IH-NSWC on continuous feed project
  - ✓Some money allocated on this project (efficient)
  - ✓Present experts on MSO (engineers)
- Future: Scale up
  - ✓Proven technology from Rockwell and IH-NSWC
  - ✓Natural progression with willing partners
  - ✓Success succeeds