RAS 13309

USEC's American Centrifuge Plant

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NRC Staff Testimony HTS-1

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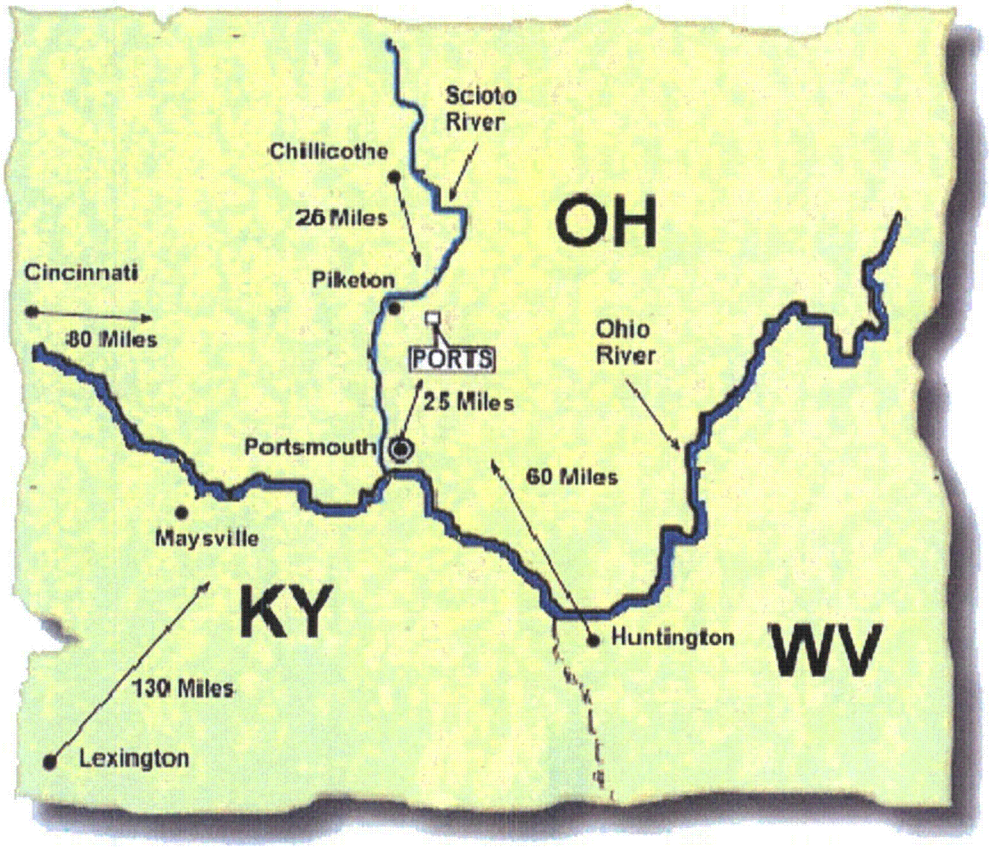
TEMPLATE = SECY-027

SECY-02

Map of Ohio

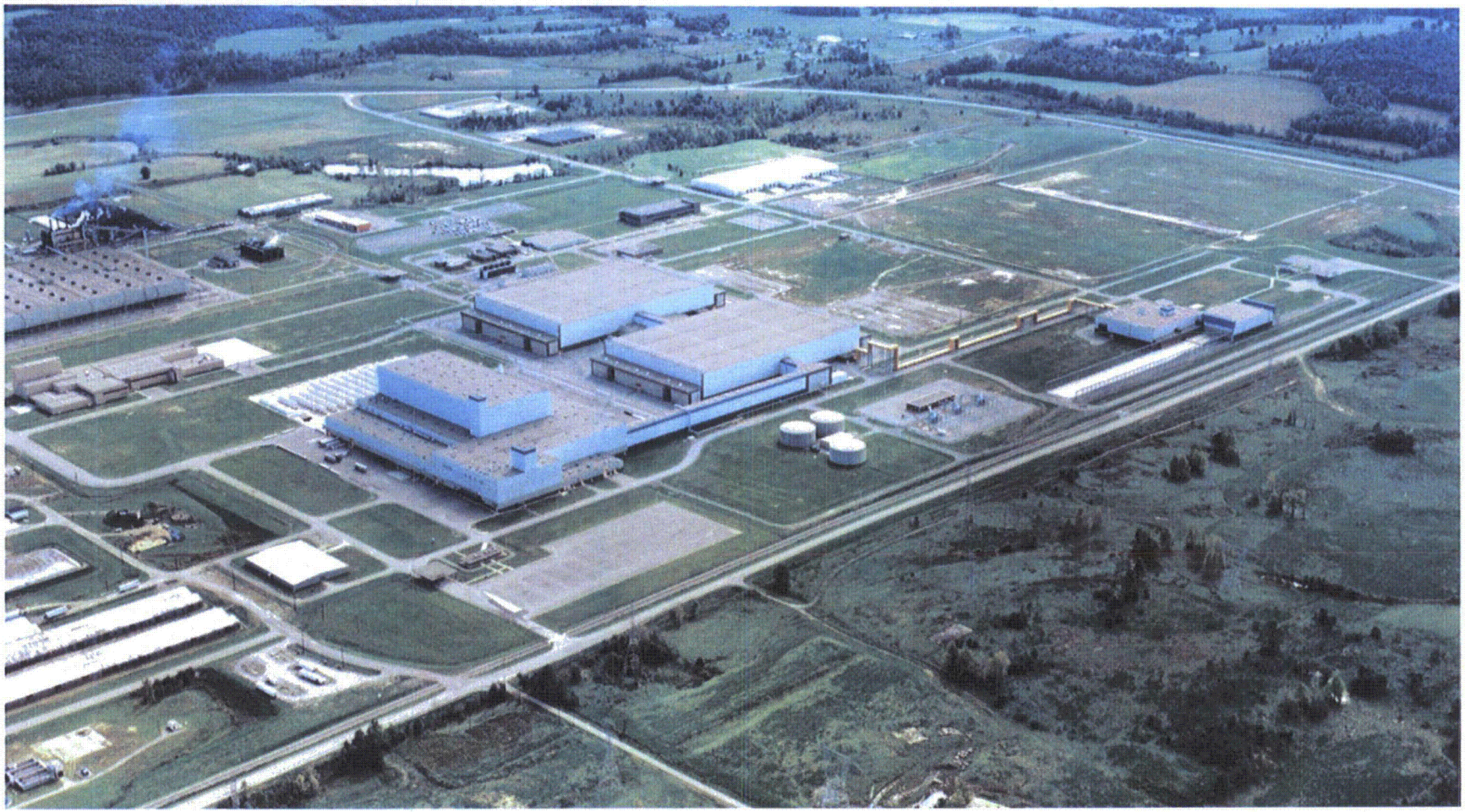

Scioto
River
Chillicothe
26 Miles
OH
Cincinnati
Piketon
80 Miles
PORTS
Ohio
River
25 Miles
Portsmouth
60 Miles
Maysville
KY
Huntington
WV
130 Miles
Lexington

Portsmouth Gaseous Diffusion Plant

View looking southwest

GCEP facilities in upper center of photo

GCEP (Future ACP)



GCEP (Future ACP)

Process Summary

- The USEC American Centrifuge Plant will enrich natural UF_6 feed to reactor grade material using gas centrifuges
- The plant will have a production capacity of about 3.5 million SWU per year
- The plant has been analyzed for processing up to 14,500 tons of natural UF_6 annually

Process Summary (cont'd)

- If approved, the ACP will be licensed to enrich UF_6 to a product assay of 10 weight percent ^{235}U
- Planned initial production will be limited to product assays of up to 4.95 weight percent ^{235}U
- The plant is expected to operate for 30 years

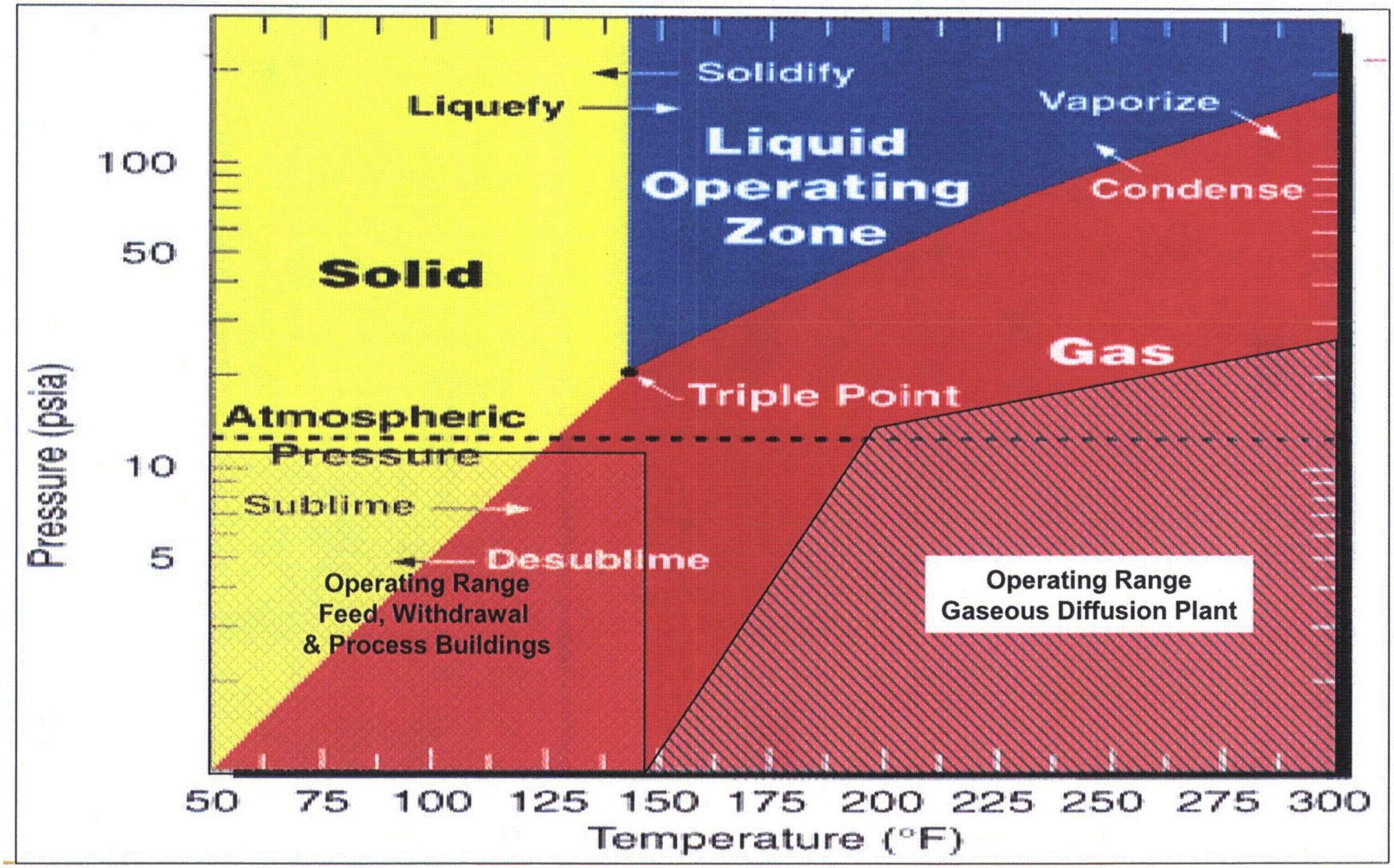
Process Material Characteristics

- The ACP will process uranium as uranium hexafluoride (UF_6)
- Throughout all processes the uranium will remain as UF_6 whose physical form may be solid, gas, or liquid
- UF_6 is a solid at room temperature

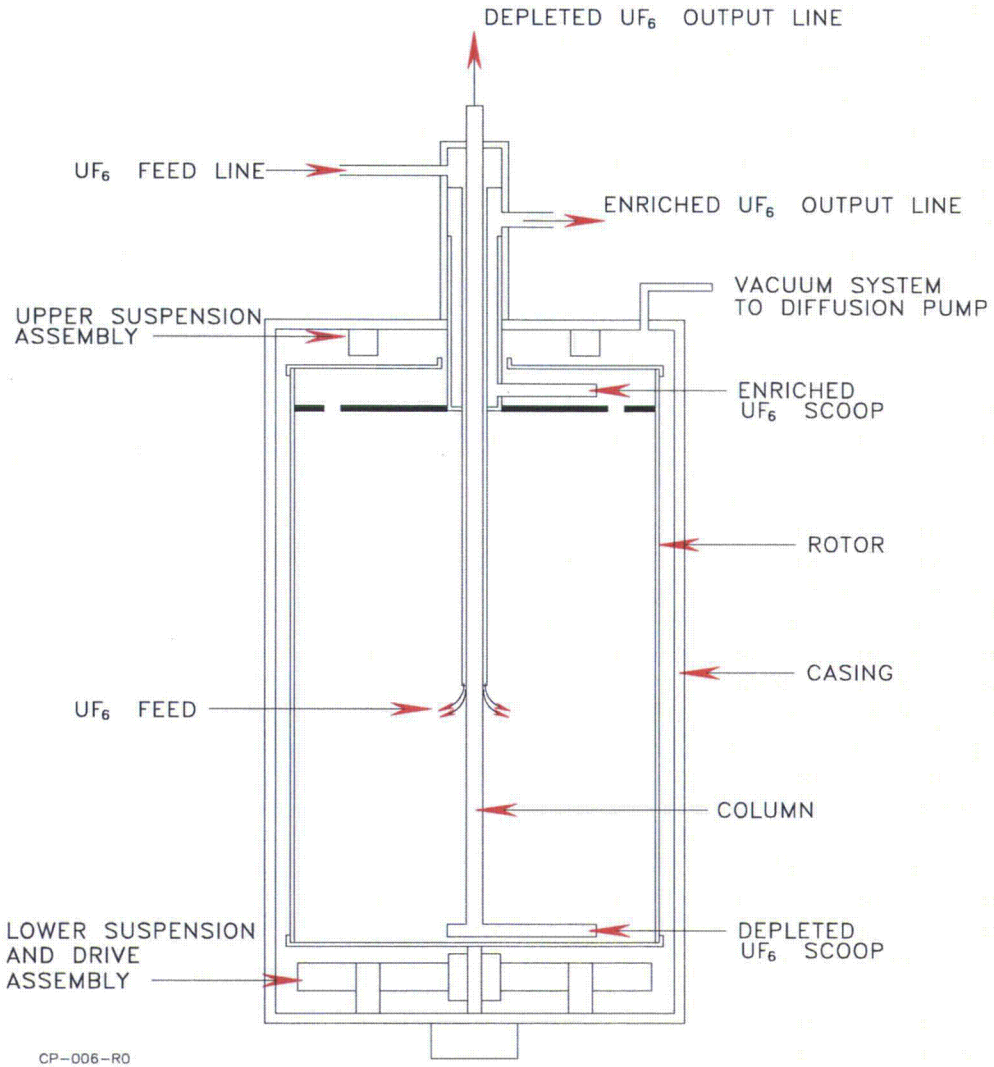
Process Material Characteristics (cont'd)

- UF_6 solid sublimes like dry ice if not kept in a closed system such as a cylinder
- UF_6 can be liquefied under the proper conditions:
  - Vapor pressure must be at least 22 psia and
  - Temperature must be above 147°F
- It will react with most materials

UF_6 Phase Diagram



Gas Centrifuge Schematic

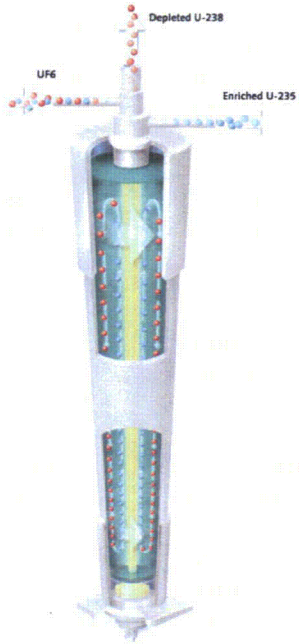


Note:

- Axial connections
- Rotor in casing (stator)
- Vacuum pull on stator

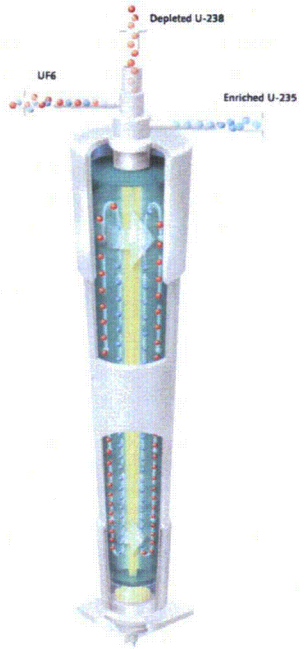
Basic Theory

- Slight density difference in $^{235}UF_6$ vs $^{238}UF_6$
- Centrifuge at subatmospheric pressure, almost vacuum
- Heavier isotope more abundant at edge than center



Basic Theory (cont'd)

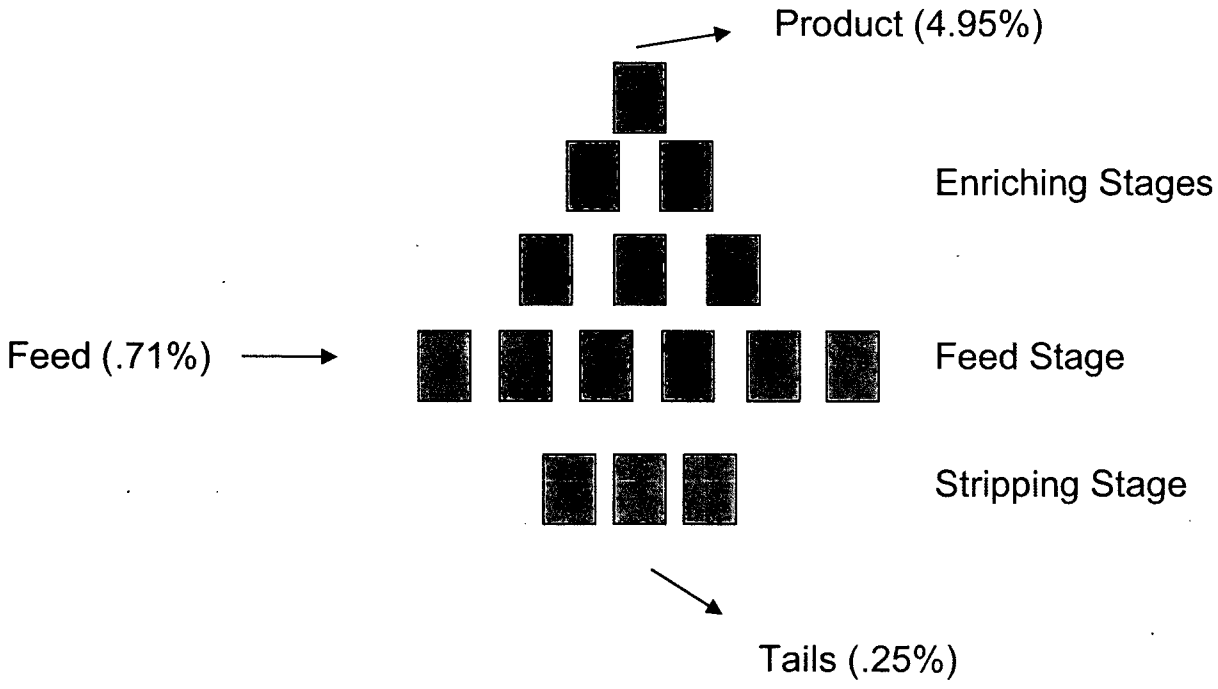
- improve separation with countercurrent flow
- improve separation with greater speeds
- improve separation and throughput with larger diameter and more height (DOE/USEC approach)



Enrichment Cascade Setup

- One or more centrifuges (in parallel) form a stage
- Several stages (in series) form a cascade
- Each cascade can provide the needed enrichment level (product)
- Several cascades (in parallel) provide the needed product flow rate

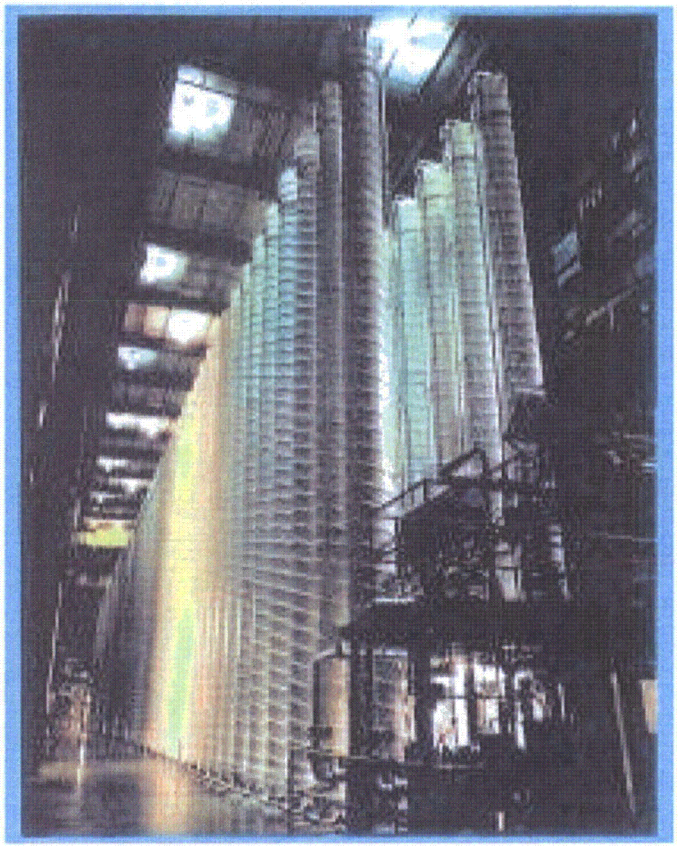
Example Cascade Configuration

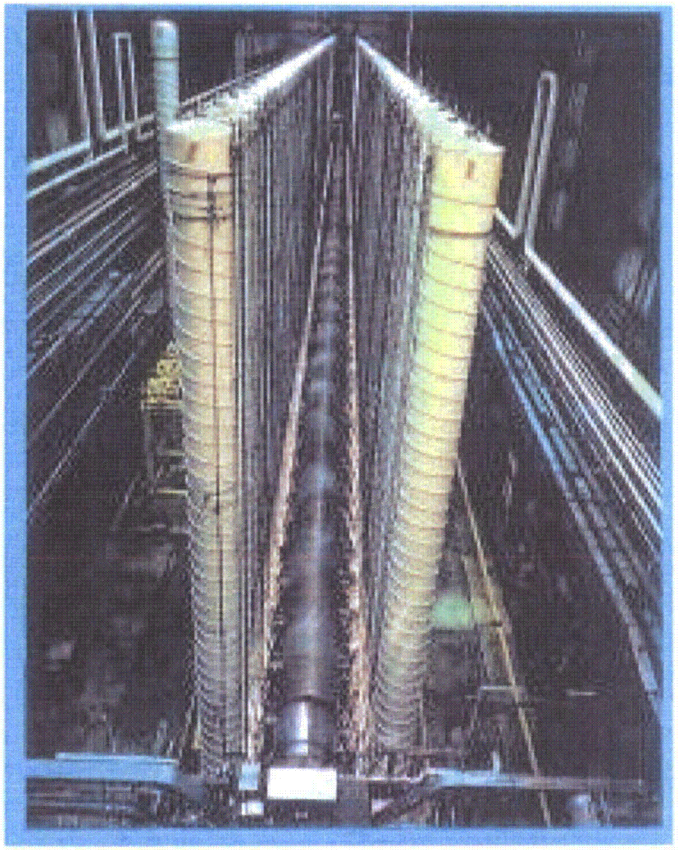


Gas Centrifuge vs Gaseous Diffusion

- Large enrichment effect per individual stage
- More compact design
- Better energy efficiencies
  - < 5% of GDP energy typically stated

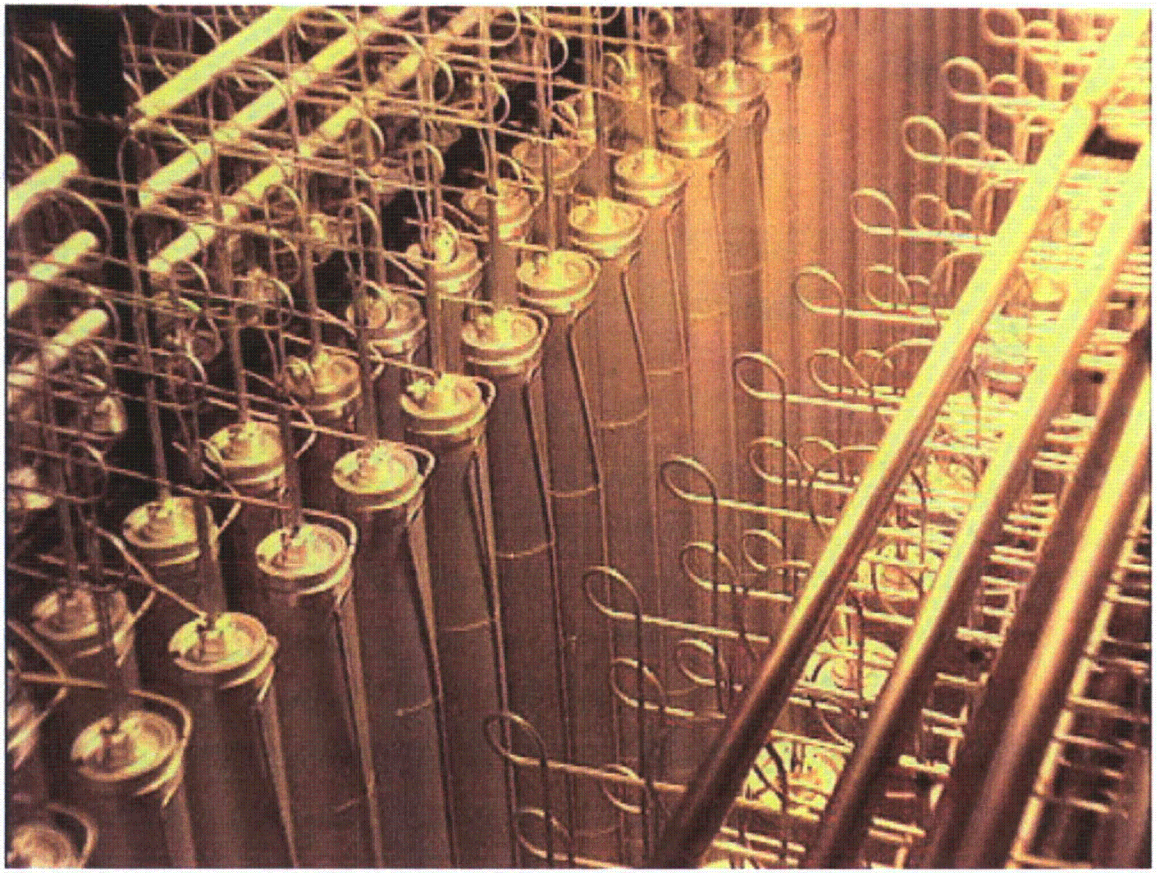
GCEP Centrifuges (1980s)





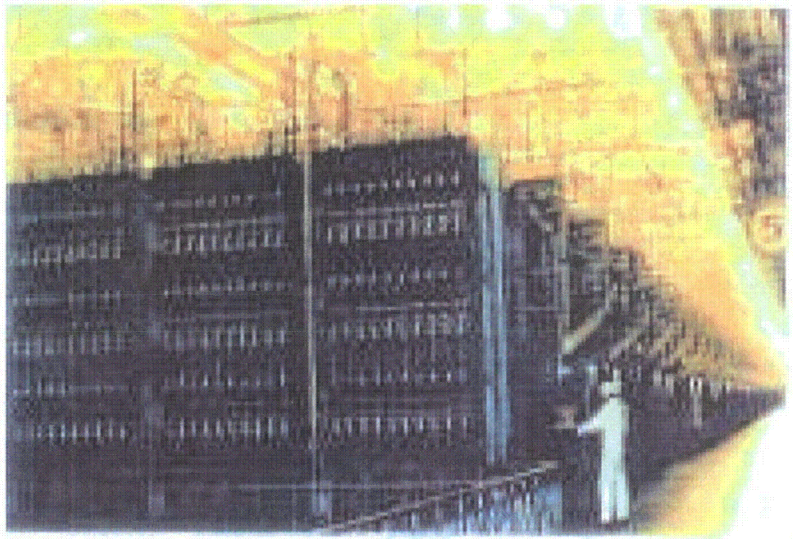
USEC's American Centrifuge is based on the U.S. Department of Energy's original centrifuges (pictured here), which operated in the 1980s at the Piketon facility.

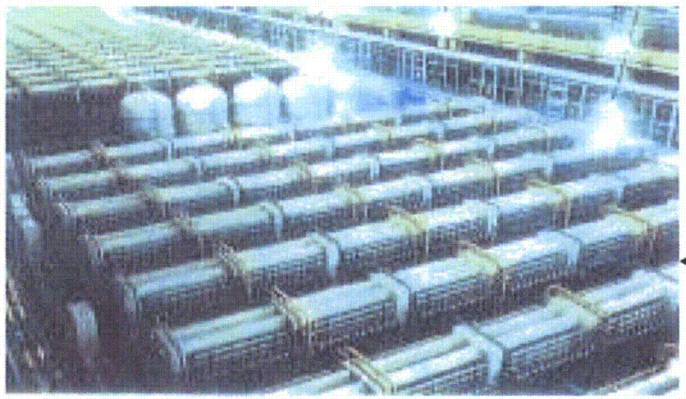
URENCO Centrifuges



Russian Centrifuges

floor view
GCs stacked→
vertically





← top view

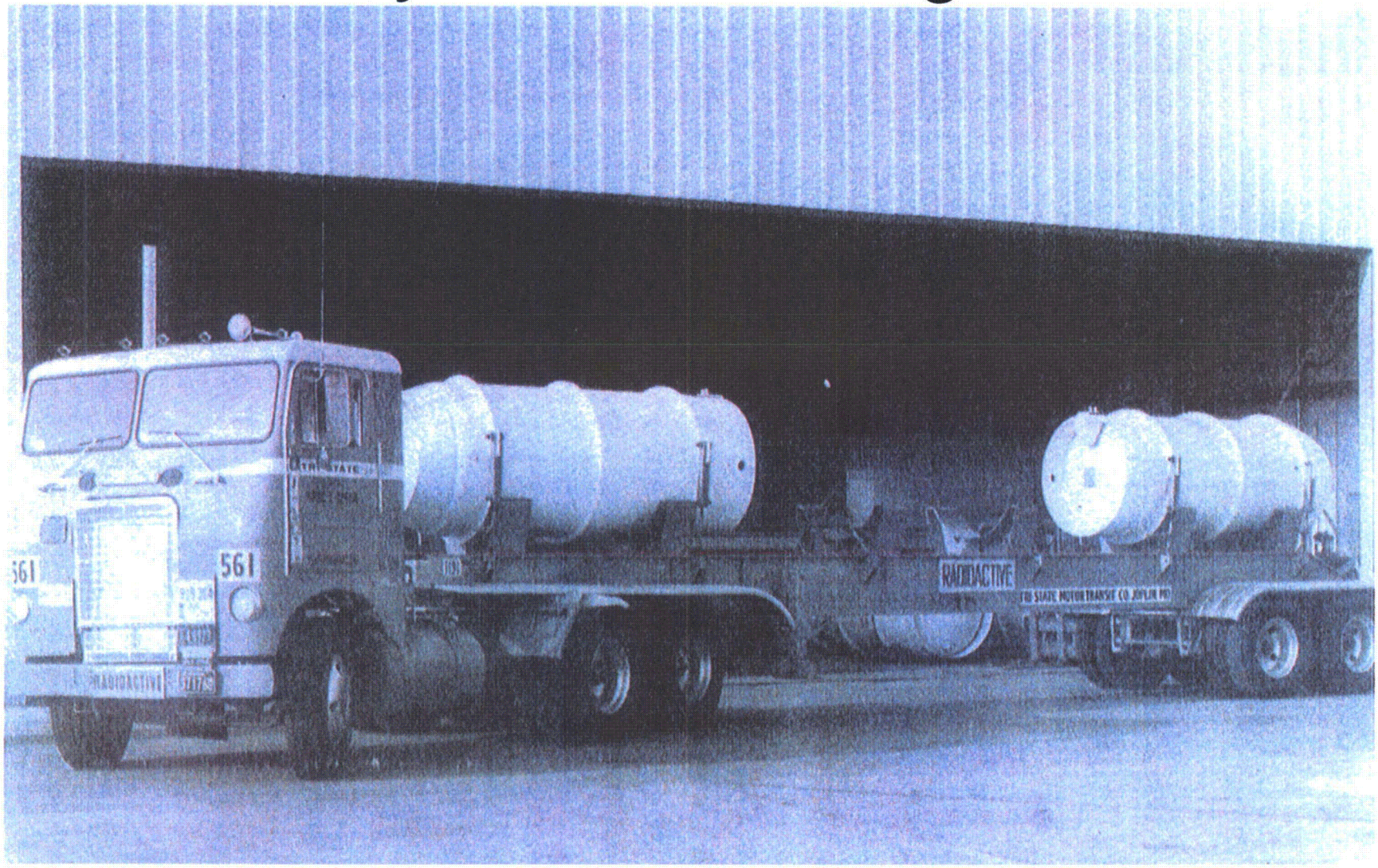
Eight Step ACP Process

1) Receipt and Storage of UF_6 Feed
2) Feed Operations
3) Enrichment Cascade
4) Tails Withdrawal
5) Tails Storage
6) Product Withdrawal
7) Transfer and Sampling of UF_6
8) Product Storage and Shipping

1. Receipt and Storage of UF_6 Feed

- Feed and Product Shipping and Receiving
- Cylinders containing solid UF_6 will likely arrive from Honeywell in Metropolis, Illinois, and Cameco in Port Hope, Canada via truck
- Normal feed (i.e., natural uranium) received in 10-ton and 14-ton cylinders
- Feed cylinders weighed

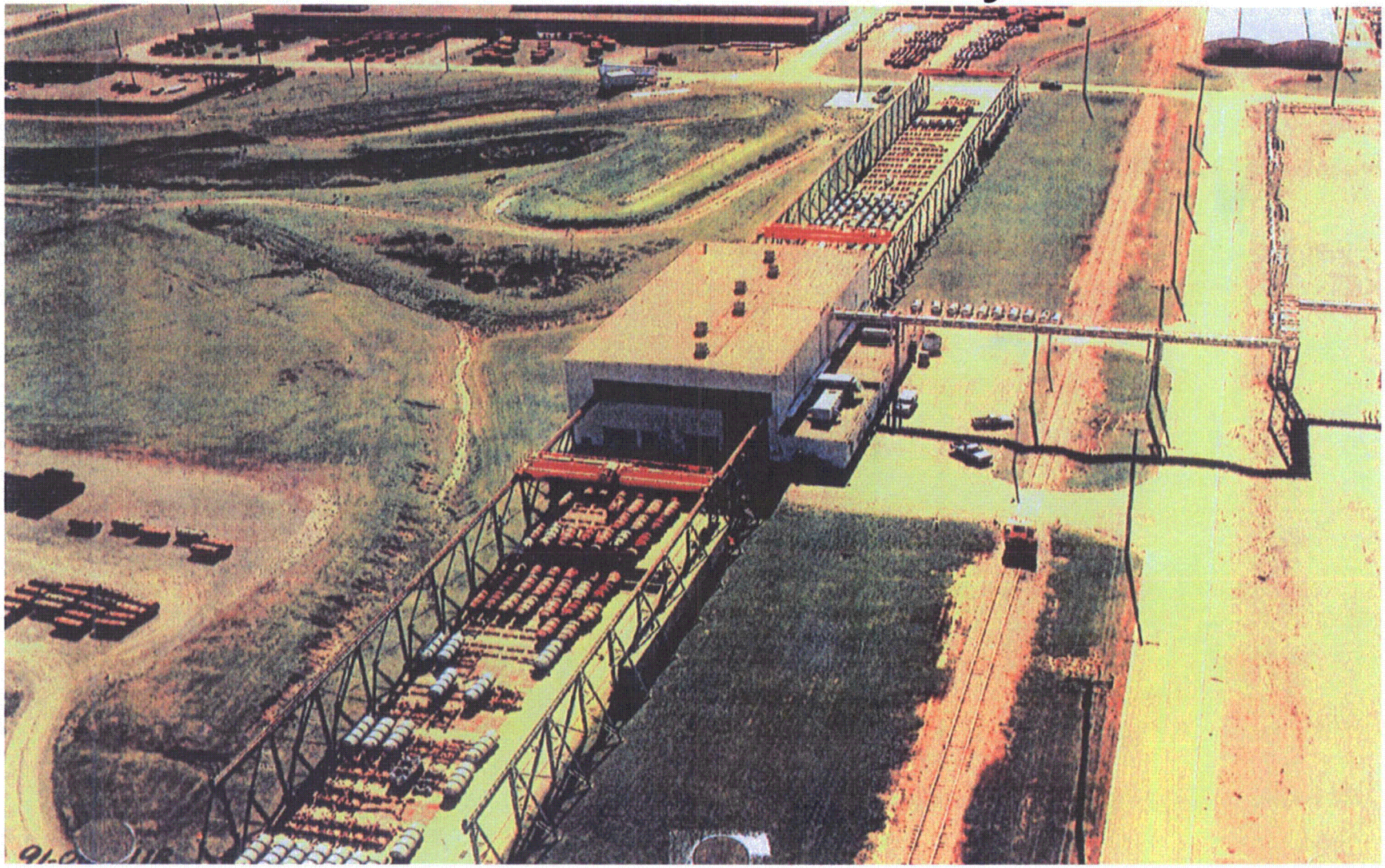
Feed Cylinders Arriving at GDP



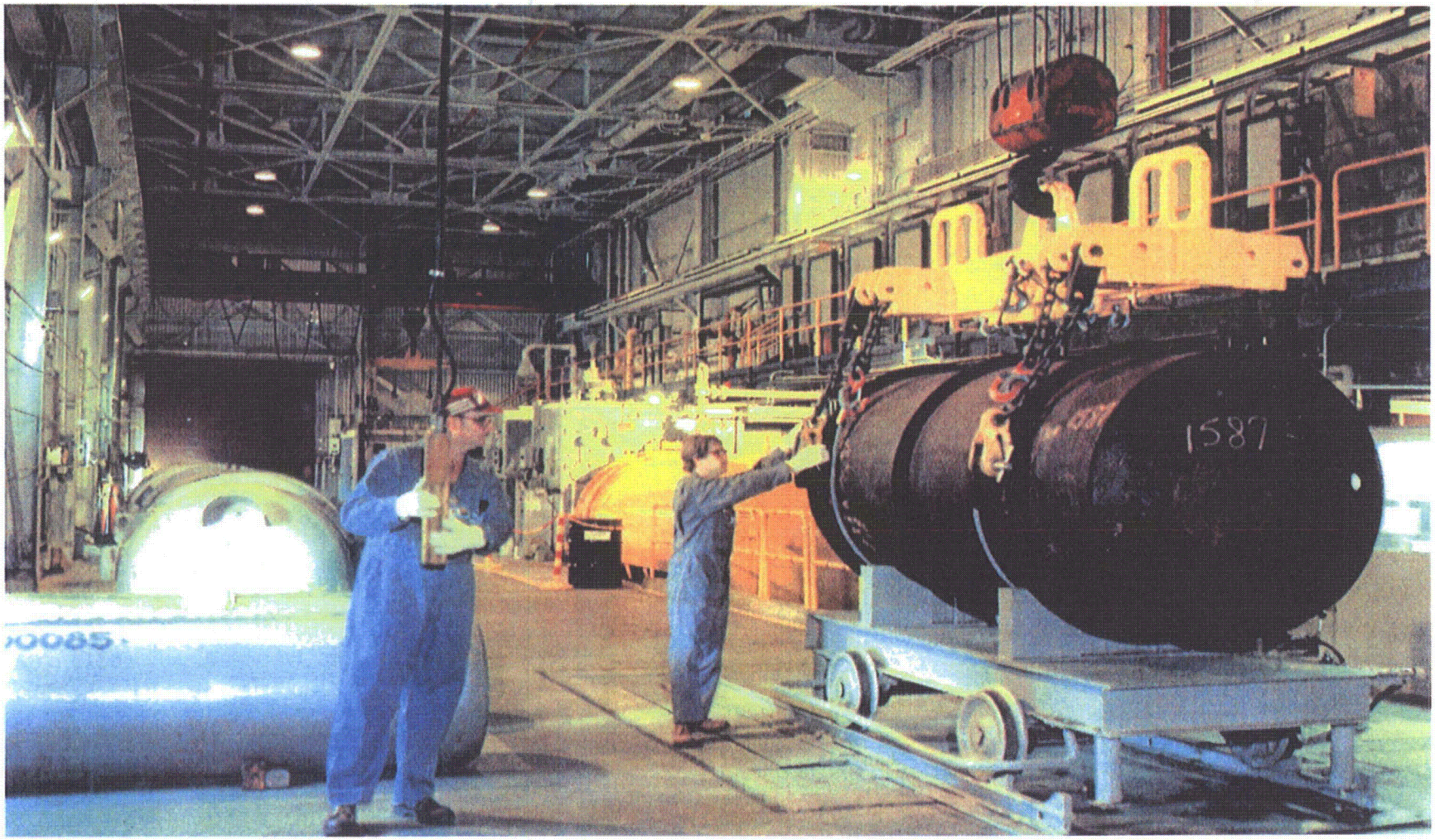
2. Feed Operations

- Feed operations conducted in the feed building
- Electrically heated ovens will be used
- From feed building, gaseous UF_6 will be piped to cascade buildings for enrichment

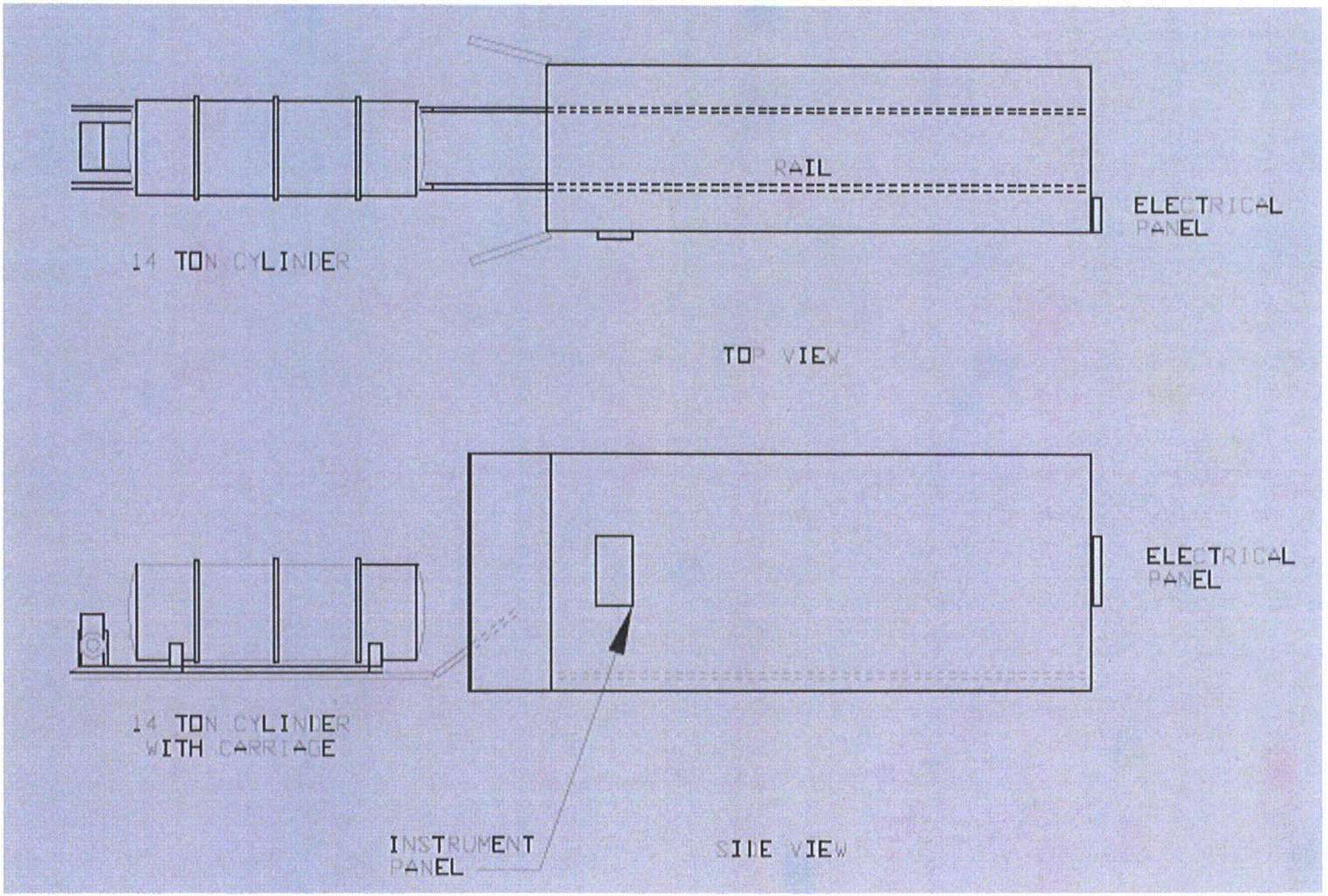
GDP Feed Facility



Lifting a Feed Cylinder (GDP)



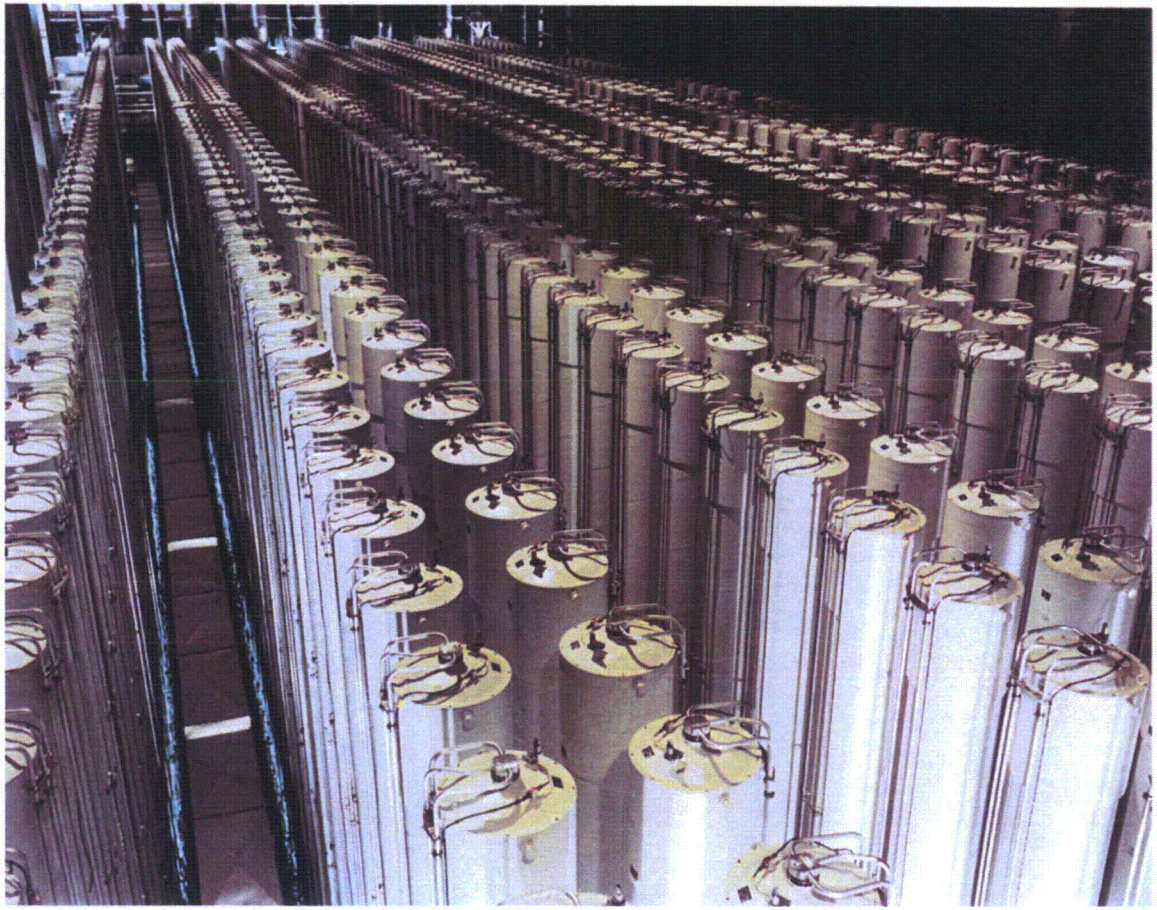
ACP Feed Oven



3. Enrichment Cascades

- Two process buildings contain the cascades
- All process pressures in the process buildings are sub-atmospheric
- Service modules route utilities and process gas to centrifuges

GCEP Centrifuges



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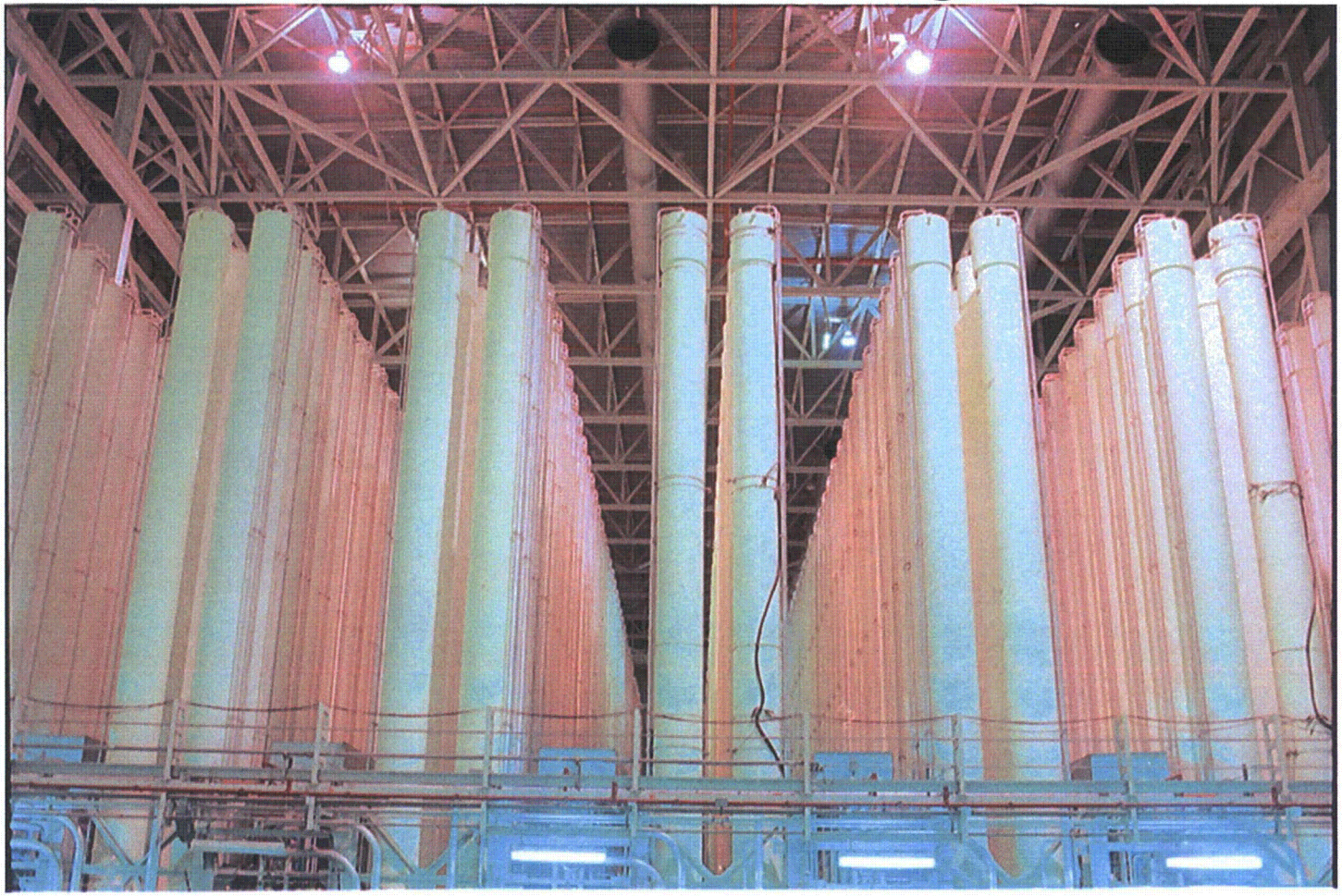
GCEP Centrifuges



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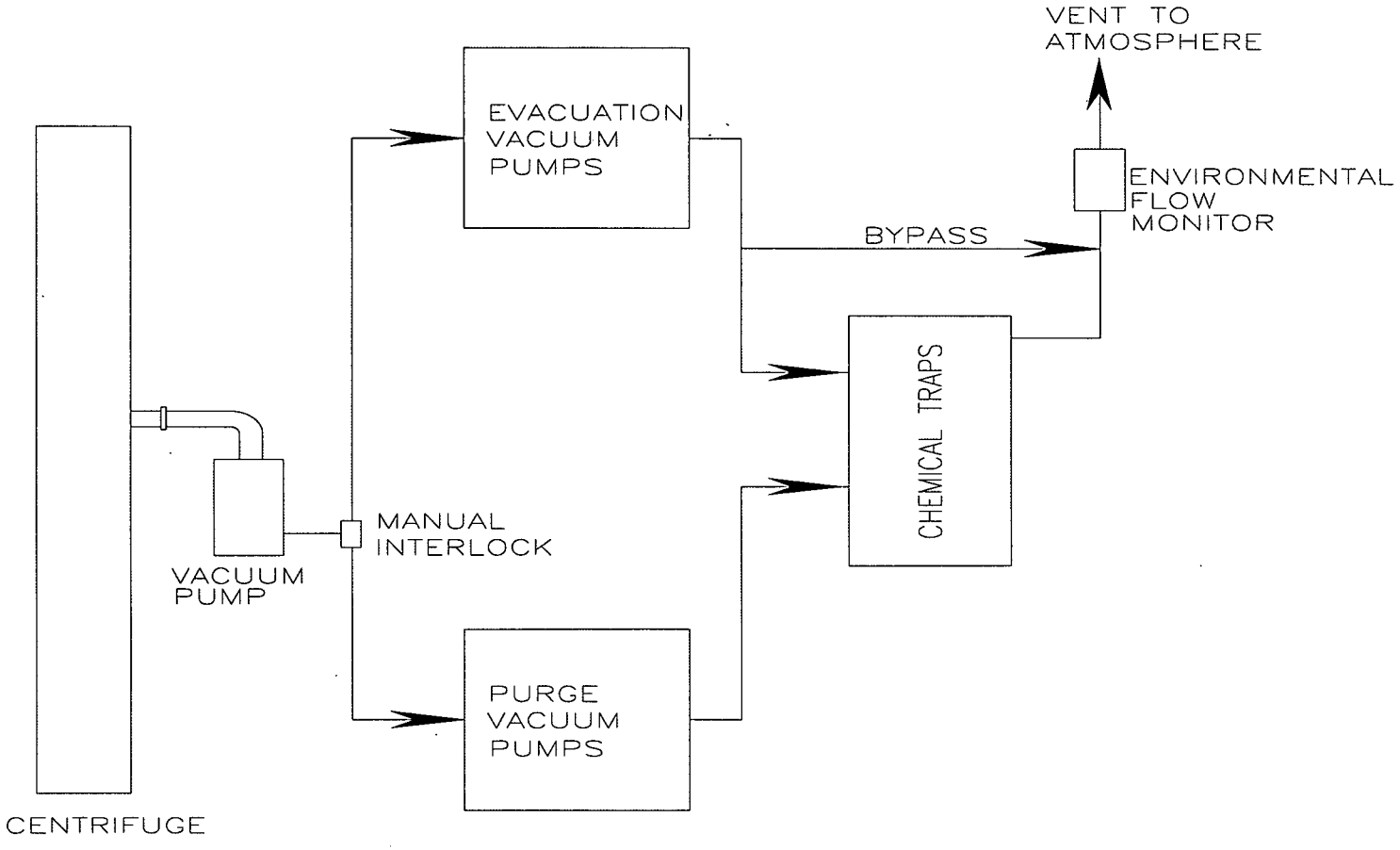
Purge and Evacuation Vacuum Systems

- Purge and Evacuation of centrifuges achieved via PV and EV systems
- Chemical traps used prior to gaseous discharge to atmosphere
- Two continuously monitored gaseous discharge points per process bldg

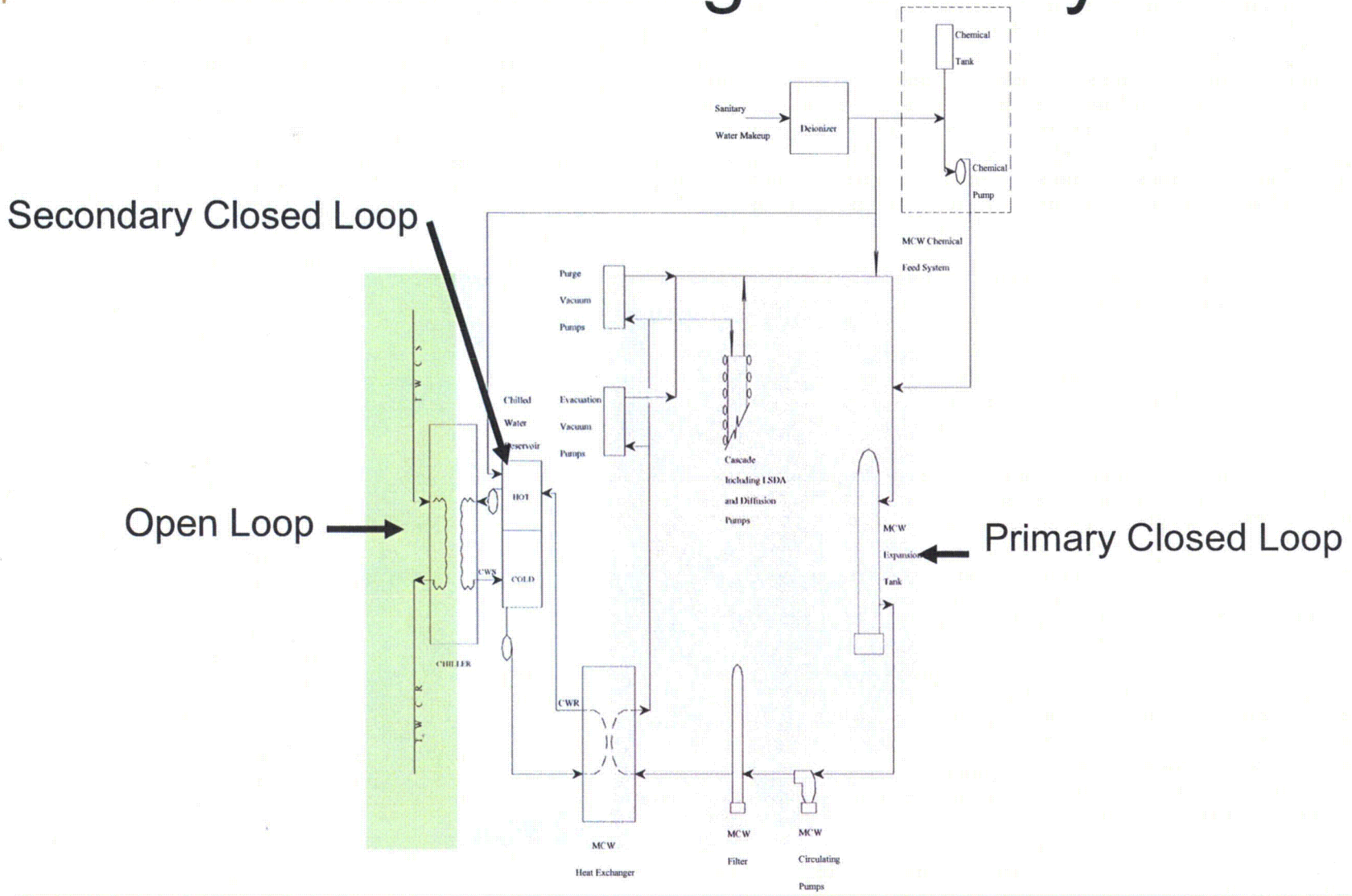
Purge and Evacuation System



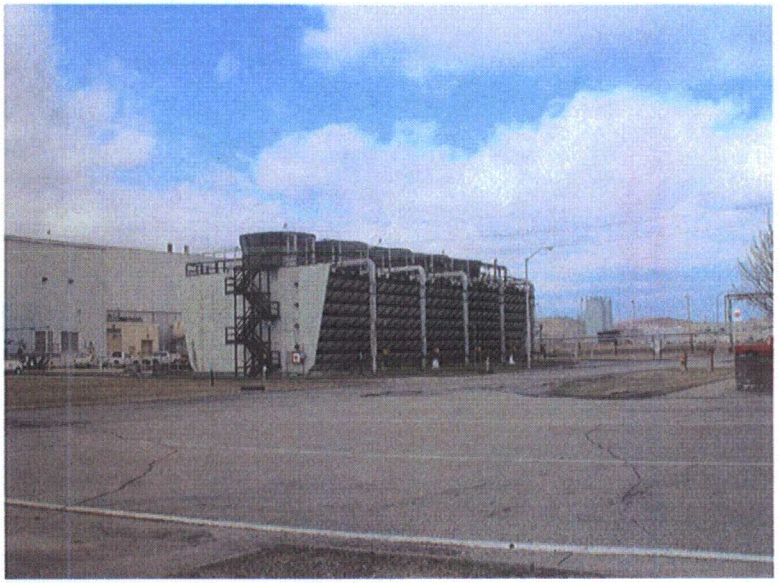
Machine Cooling Water System

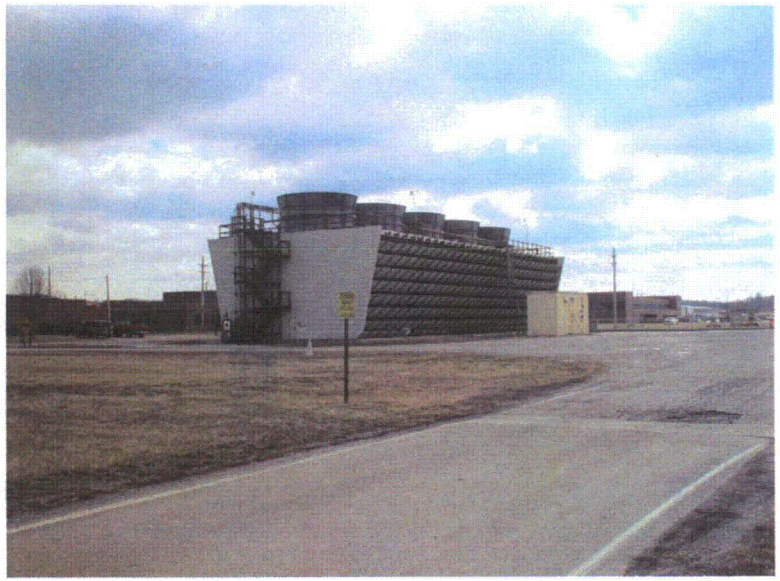
- Machine cooling water systems used to cool pumps, motors, etc.
- Closed loop system
- Ultimate heat rejection to cross-flow mechanical cooling tower

Machine Cooling Water System



Cooling Tower





4. Tails Withdrawal

- Conducted in the tails and product withdrawal building
- Empty tails cylinders are placed in cold boxes
- Cylinders are connected to process and chilled
- Compressors are used to fill tails cylinders
- Gaseous UF_6 is desublimed (solidified) in the tails cylinders

5. Tails Storage

- Tails cylinders will be stored in the tails storage yard onsite
- Concrete surface
- Cylinders stacked two high
- Large equipment used to move tails cylinders
- Tails cylinder integrity visual checks performed on a less than 5-year frequency

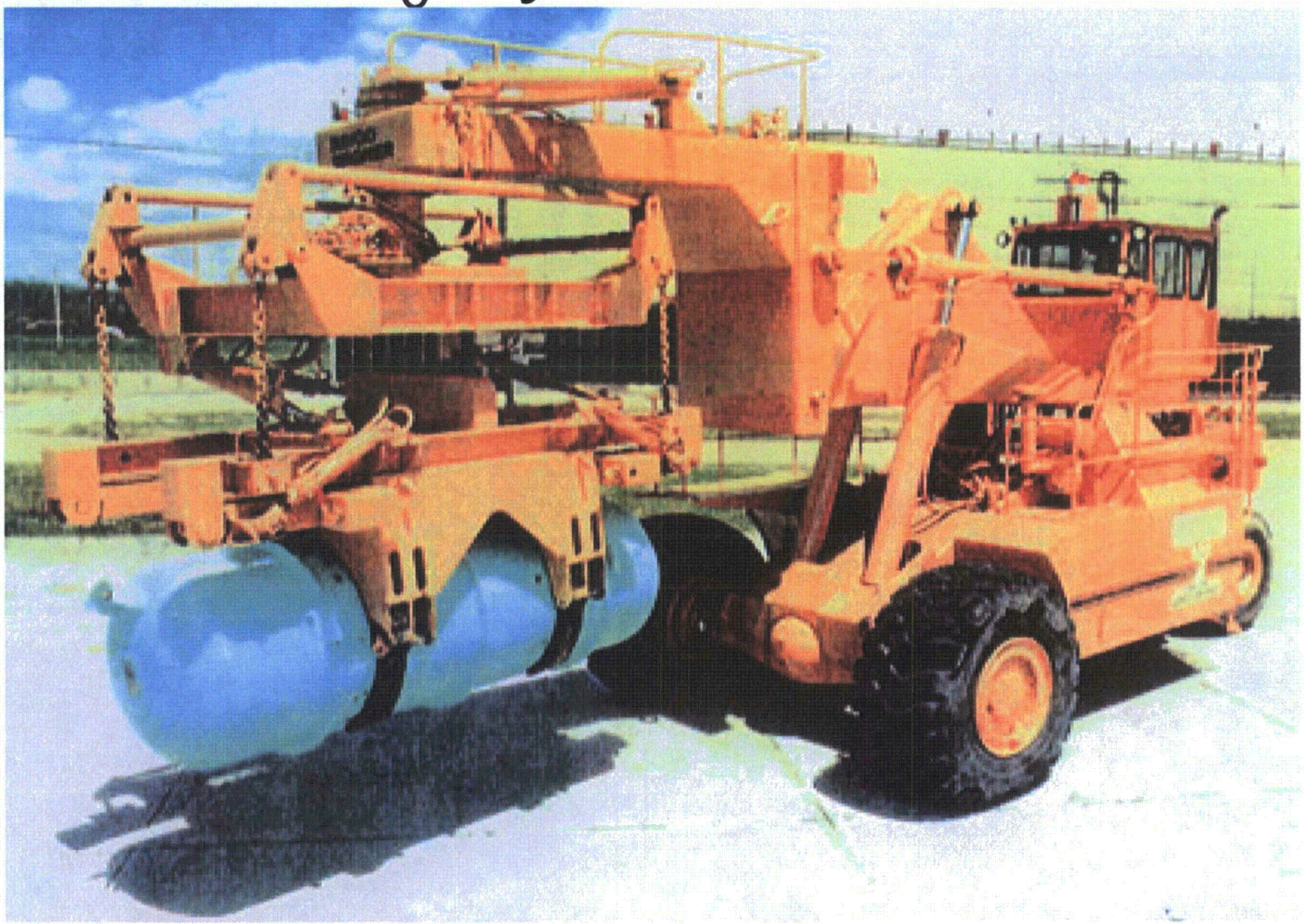
5. Tails Disposition

- DOE conversion operation to take about 18 years
- USEC may enter into an agreement with DOE to have its tails converted at the DUF_6 Conversion Facility in accordance with the USEC Privatization Act and other statutory authorizations
- The alternative would be to have the tails material shipped off-site for processing at some other location

Future DUF_6 Cylinder Storage Yard

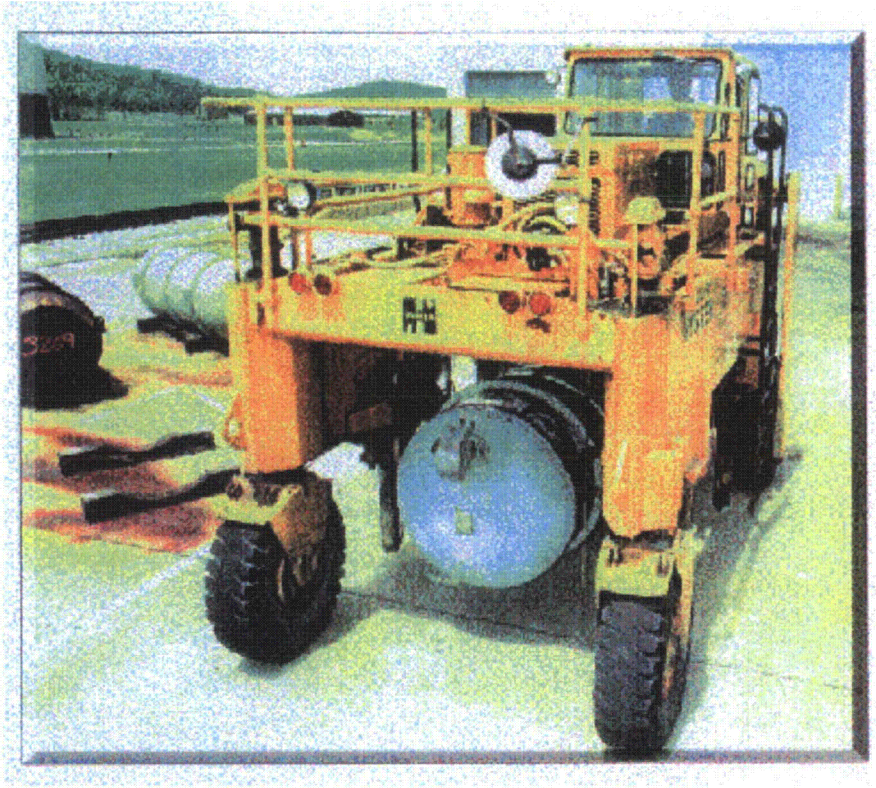
GDP Tails Cylinder Storage Yard

DUF_6 Cylinder Stacker



DUF6 Cylinder Movement in Storage Yards

Straddle Carrier



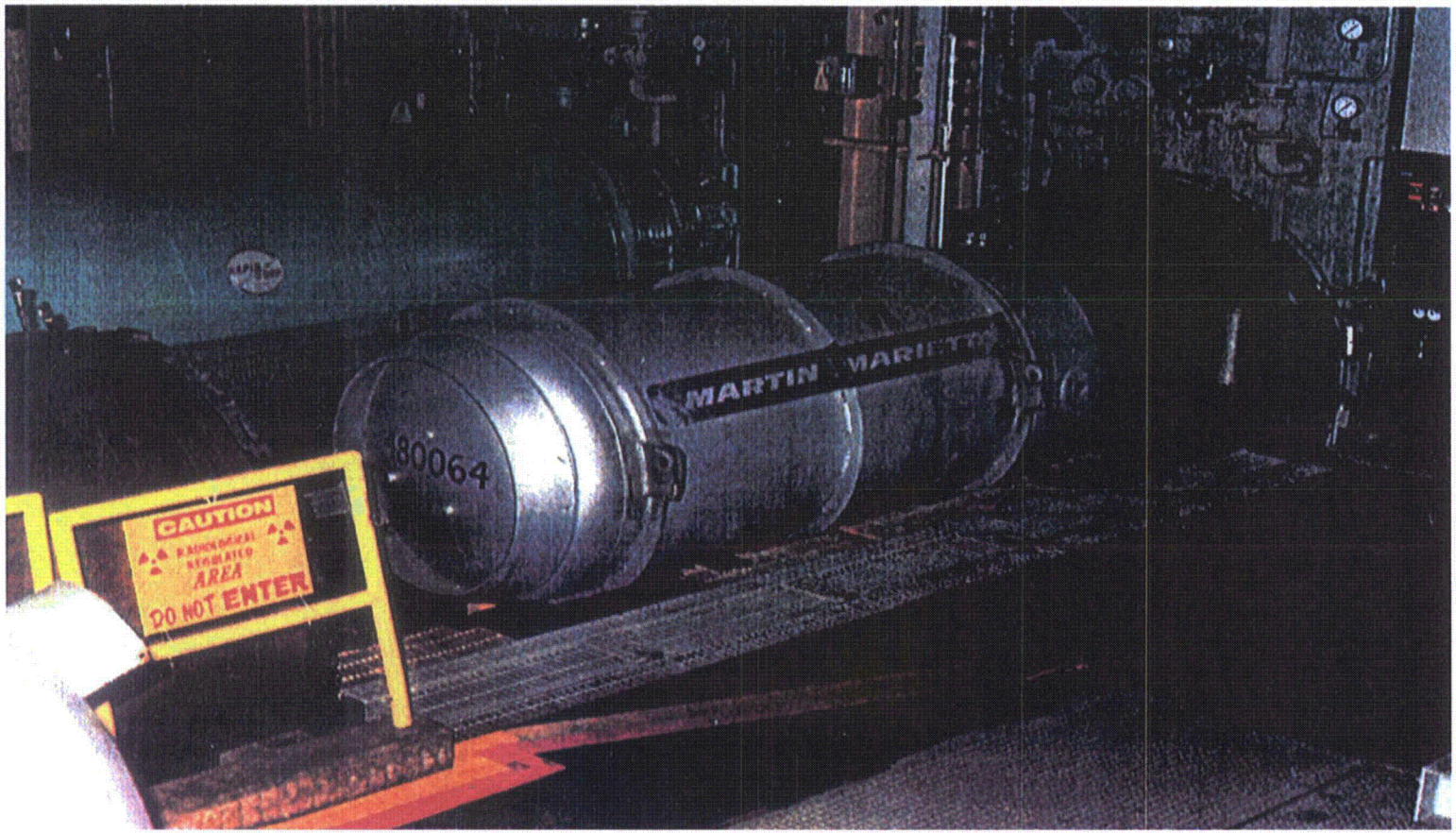
6. Product Withdrawal

- The tails and product withdrawal facility receives enriched UF_6 gas from the cascades
- Gaseous UF_6 desublimed in product cold traps
- Off gases pass through product cold traps to evacuation cold traps and chemical traps
- Product cold traps heated to sublime solid UF_6
- Product UF_6 is desublimed in 10-ton product cylinders in cold boxes

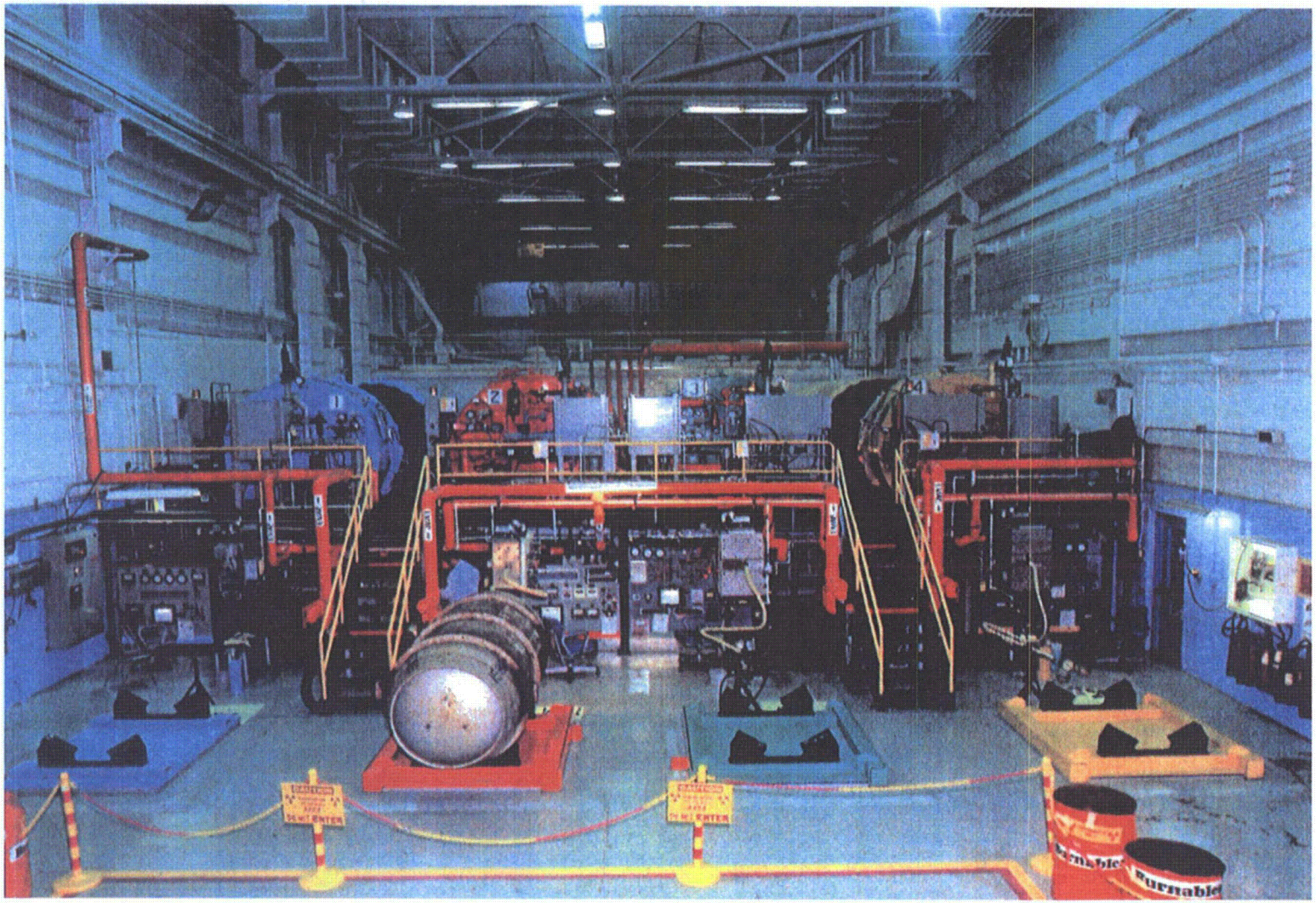
7. Transfer and Sampling of UF_6

- Customer Services Area/Sampling and Transfer Facility
- UF_6 liquefied in electrically heated autoclaves
- UF_6 is transferred from one cylinder to another such as from a 10-ton product cylinder to a 2.5-ton transportation cylinder
- Any sampling of UF_6 cylinders is also done in this facility

Cylinder in Open GDP Steam Autoclave



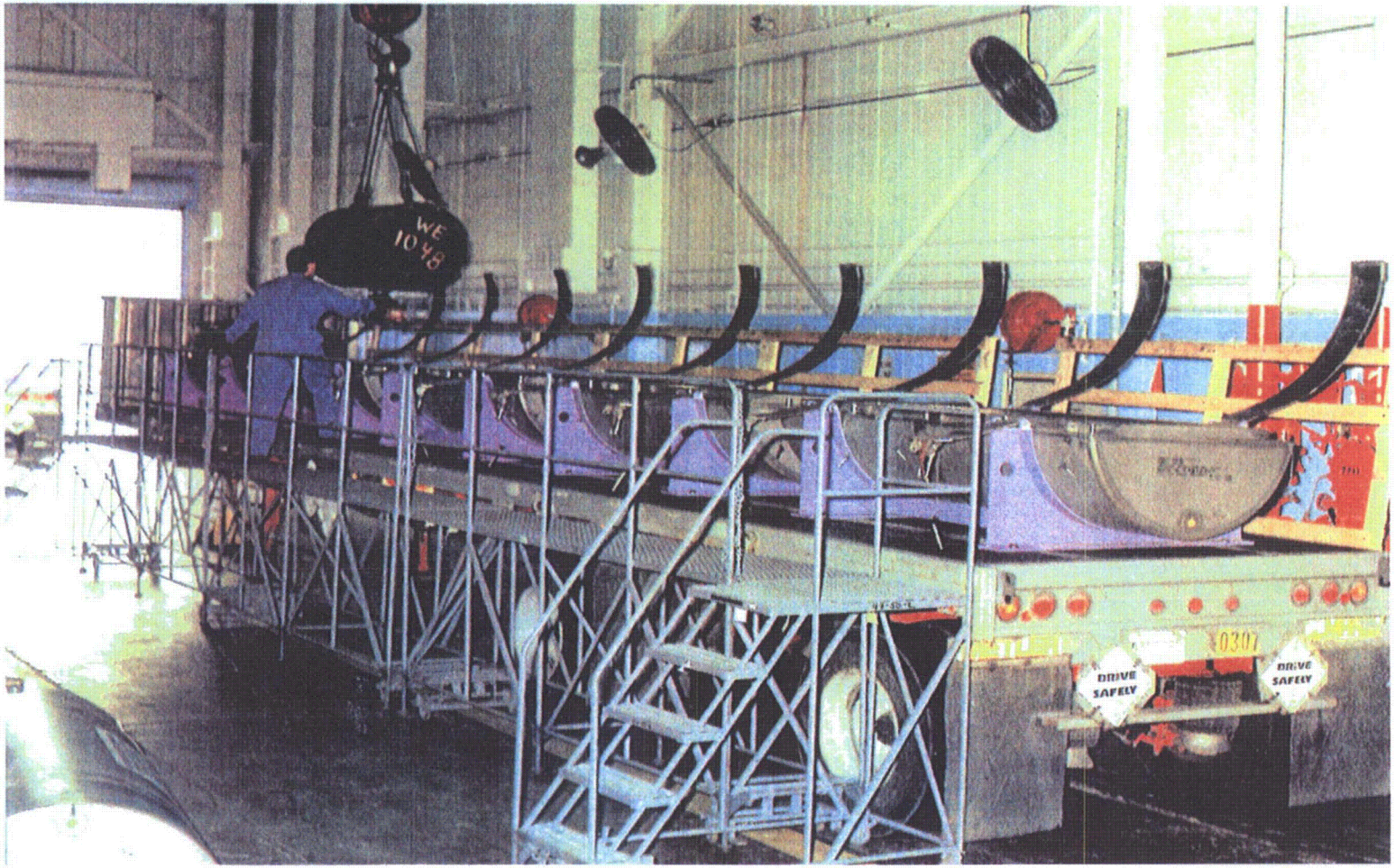
GDP Sampling/Transfer Facility



8. Product Storage and Shipping

- 2 ½ ton product cylinders are weighed and stored on an interim basis before being loaded into overpacks secured to trucks for shipment
- Product is shipped to customers via semi tractor-trailer truck

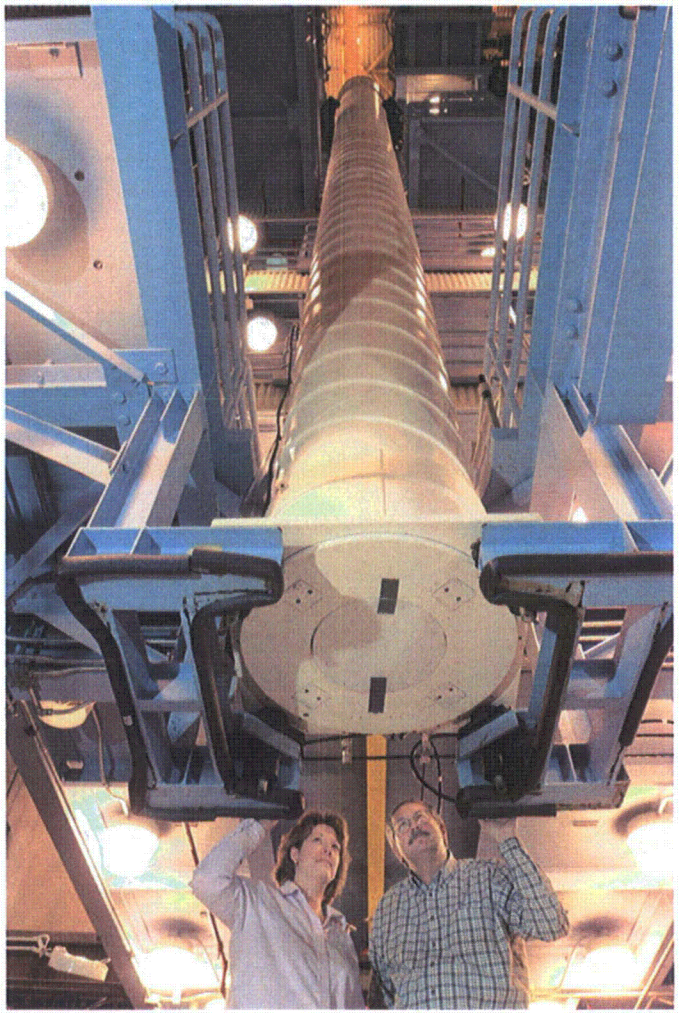
UF_6 Cylinder Overpack



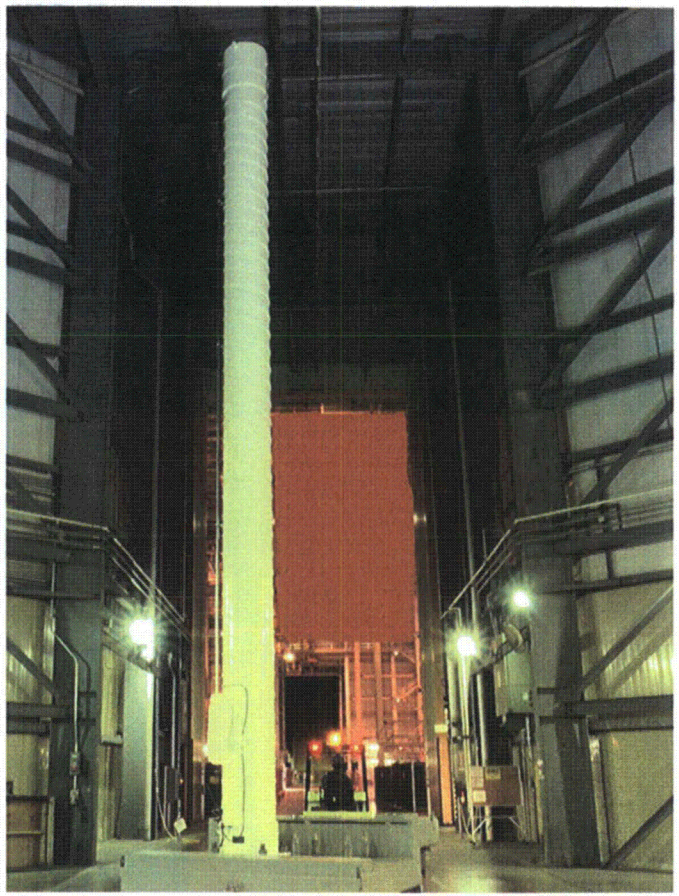
Centrifuge Assembly

- Centrifuges will be assembled on site in the centrifuge assembly building
- Completed centrifuges will be transferred to the process buildings using a special transporter unit

Centrifuge Assembly Stand



A Centrifuge Transporter



Potential for Criticality

- Potential for criticality accidents at gas centrifuge facility is very low
- Credible criticality hazards occur in process areas that handle large amounts of uranium enriched to above 1% ^{235}U in solid or liquid form
- Credible criticality accident sequences are required to be identified and made highly unlikely by applying IROFS

Potential for Criticality (cont'd)

- Double contingency applied to all criticality sequences
- A criticality cannot occur at the ACP without inadvertent introduction of moderator

Potential for UF_6 Releases

- Potential for large UF_6 releases at gas centrifuge facility is low
- Large UF_6 release hazard is controlled by IROFS and non-IROFS in process areas that handle large amounts of UF_6
- IROFS in place to ensure UF_6 sources are isolated upon system breach during feed, product withdrawal and tails withdrawal operations

Potential for UF_6 Releases (cont'd)

- IROFS in place to prevent fires and to ensure UF_6 containment is maintained if a fire occurs in process, and during transport and storage of UF_6 cylinders
- Non-IROFS used to protect against small UF_6 releases (wisps) as a result of upset conditions while
  - connecting/disconnecting UF_6 cylinders
  - changing chemical trap media

Schedule

- A recent USEC press release indicated that commercial operation is expected to begin in late 2009 and project completion in 2012