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HISTORICAL EVENTS OF THE
CHEMICAL PROCESSING DEPARTMENT

By

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Special Studies & Reports
Finance and Services Operation
Chemical Processing Department

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The purpose of this report is to summarize and document the significant historical events pertinent to the operation of the Chemical Processing facilities at Hanford. The report covers, in chronological order, the major construction activities and historical events from 1944 to September, 1965. Also included are the production records achieved and a history of the department's unit cost performance.

HISTORICAL EVENTS OF THE CHEMICAL PROCESSING DEPARTMENT

<u>Date</u>	<u>Capital Cost (\$ in millions)</u>	<u>Remarks</u>
December, 1944	\$20.1	Hanford's first separations facility (T Plant) started operations. The purpose of the T-Plant was to isolate by the bismuth phosphate precipitation process (batch), plutonium-239 from the substantial quantities of other radioactive elements. The uranium, neptunium and fission products were discarded to underground waste storage tanks for retention and surveillance.
December, 1944	\$12.0	Construction was completed on sixty-four (64) waste storage tanks in T, B, U and C Tank farms. These tanks were the first of 149 to be constructed over the next 20 years for storing radioactive liquid waste generated from the chemical processing plants. By October, 1965, at a cost of \$40 million, this phase of the waste management program will have provided a tank storage capacity of over 94,000,000 gallons. During the 20 years of this program, leaks have been observed and corrective action taken in six tanks. Four more tanks are currently leakage suspects. Current estimates indicate tank life is approximately 20 years.
January, 1945	\$ 6.3	Final Pu product processing has gone through a series of developments. Initially the startup of a hydrogen peroxide process in 231 Isolation Building provided the capability to concentrate and purify the plutonium nitrate produced in the primary separations facilities. The plutonium nitrate was shipped from Hanford to other Manhattan Project sites for processing the nitrate solution to high purity metallic plutonium.
April, 1945	\$21.6	A second primary separations facility (B-Plant) was completed and activated. This new plant used the same precipitation process as the earlier T-Plant for the separation of plutonium from the irradiated uranium fuels.

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<u>Date</u>	<u>Capital Cost (\$ in millions)</u>	<u>Remarks</u>
July, 1949	\$ 24.2	The initial production of plutonium metal commenced with the RG Button line in the 234-5 Building. The functions of this building were to purify and concentrate plutonium-bearing feed solutions received from separations plants and produce plutonium metal. Later, the capability to fabricate the Pu metal into weapon components was added as well as the recovery of Pu from plutonium-bearing waste streams for recycling into the main process streams.
September, 1949*	\$10.7	Forty-two (42) waste storage tanks, located in the BX, BY, and TX Tank farms, were completed.
February, 1951	\$ 4.0	Twelve (12) waste storage tanks in S farm were completed.
May, 1951**	\$ 1.0	Evaporation of low level T and B Plants liquid wastes started in the waste evaporators (242 T and 242 B).
September, 1951	\$43.5	The earlier bismuth phosphate process (B and T Plants) which recovered only plutonium, was supplemented by the Redox process (Redox Plant). In Redox, a continuous solvent extraction process for the recovery of both uranium and plutonium was introduced.
January, 1952	\$ 2.3	Initial Hot Semiworks completed. The facilities were used as a pilot plant for the Redox process.
April, 1952	\$ 2.8	The startup of the UO ₃ UNH conversion facility allowed the current uranium product stream to be converted to oxide and shipped offsite as a second product.
April, 1952	\$ 1.8	The six (6) TY waste storage tanks were completed.
August, 1952		B Plant, the second separations plant to be built at Hanford, discontinued operations. T Plant continued to operate.
May, 1953	\$ 4.9	Expansion of 234-5 capacity by the installation of the RMA and RMB Remote Mechanical Button and Fabrication Lines.

* BX, TX, BY farms completed on 3/48, 7/49, and 9/49, respectively.

** T Plant and B Plant evaporators completed on 5/51, and 4/52, respectively.

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<u>Date</u>	<u>Capital Cost</u> <u>(\$ in millions)</u>	<u>Remarks</u>
May, 1953	\$35.3*	Prior to 1953, uranium from the T and B primary separations plants was retained in waste storage for ultimate reclamation. The completion of the uranium recovery facilities in the converted bismuth phosphate plant (U Plant) by solvent extraction (TBP), permitted the removal and recovery of this uranium from waste solutions stored in the underground tanks.
October, 1954	\$ 1.1	The conversion of Hot Semiworks to Purex Process providing facilities to obtain experimental data on existing and proposed separations processes and equipment. The facility is currently being used as a pilot plant for fission products recovery process demonstration and limited production.
1955		Initial fission product recovery work was begun at Hanford. The B Plant was scoped as a possible consolidated waste management and fission product fractionization facility.
April, 1955	\$ 1.7	Process facilities (Recuplex) were installed in the 234-5 Building, to recover plutonium from waste materials and process solutions from separations plants. Recuplex was originally a prototype experimental unit, but later converted to a production unit.
December, 1955	\$ 5.0	The six (6) waste storage tanks in A farm were completed.
January, 1956	\$77.1	Startup of Purex Separations Plant to process irradiated fuel elements. Purex employed a continuous solvent extraction process for the recovery of uranium and plutonium similar to Redox but with a different solvent (TBP) and much greater capacity. The facilities included metal dissolution, separation and decontamination of uranium and plutonium, waste handling, solvent recovery, acid recovery and chemical laboratory.
March, 1956		The startup of Purex gave enough additional capacity to permit shutdown of T-Plant even though added feed material was available from the new K-Reactors.

* Includes original U Plant project cost.

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<u>Date</u>	<u>Capital Cost</u> <u>(\$ in millions)</u>	<u>Remarks</u>
March, 1956	\$ 4.0	The fifteen (15) SX farm waste-storage tanks were completed.
October, 1956		Continuous calciners in UO ₃ Plant were put into production.
January, 1957		The operations in the 231 Isolation Building, started in 1945, were discontinued.
March, 1957	\$ 4.4	Additions and modifications to the UO ₃ Uranium Reduction Plant were completed to provide for segregated processing of low- and high-exposure uranium and to increase the metal conversion capacity.
March, 1957		Since all uranium in waste storage tanks had been recovered, TBP uranium recovery operations, started in 1953, were discontinued.
August, 1957	\$ 1.1	Continuous flow process for plutonium reduction started up in 234-5 Building, replacing batch-type operation.
August, 1958		The first plant waste-tank failure was detected in the 113SX Tank when the bottom liner bulged upward. The tank was emptied and removed from service after a test indicated potential leakage.
August, 1958		The recovery of a third product, neptunium, was initiated during plant shutdowns from the Purex Plant process.
July, 1959	\$ 2.6	Purex Plant converted to a 2-cycle operation in order to increase capacity.
August, 1959		The 106TY waste tank failed and was removed from service.
September, 1959		Hanford was assigned the lead for fission product recovery development.
November, 1959		The third tank failure occurred in 101U Waste Tank.
December, 1959		Recovery of neptunium was initiated during plant shutdowns in the Redox facility.

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<u>Date</u>	<u>Capital Cost</u> <u>(\$ in millions)</u>	<u>Remarks</u>
July, 1960*	\$ 1.8	Second remote mechanical RMC Button and fabrication lines were installed in 234-5 Building.
August, 1960		The first firm order for fission products was received by CPD. This order called for one million curies of strontium-90 to be used as a heat source for generating electrical energy. In addition, an order for development quantities of cesium-137 was received.
September, 1960 & February, 1961		Waste tank failures in 104U and 105TY tanks resulted in their removal from service.
April, 1961		First shipment of fission products was made from Hanford.
September, 1961	\$ 0.6	Initiated plutonium recovery from contaminated materials in the 234-5 Building. This is done by leaching plutonium from waste materials, burning combustible plutonium-bearing materials and transferring the resulting products to PR cans.
April, 1962		A criticality incident occurred on April 7 in the plutonium scrap recovery facility (Recuplex) within the 234-5 Building. The building, along with the entire 200 West Area, was shutdown and evacuated. By April 20, all personnel had returned to work but Recuplex was deactivated.
May, 1962	\$ 0.3	Redox installation of equipment for uninterrupted neptunium recovery.
September 1962	\$ 1.6	Installation of in-canyon and gallery facilities in Purex Plant for recovery and decontamination of neptunium as a nitrate salt in aqueous solution from the Purex Process streams.

* Fabrication line completed 6/59
Button " " 7/60

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<u>Date</u>	<u>Capital Cost (\$ in millions)</u>	<u>Remarks</u>
February, 1963	\$ 0.1	Facilities for one-step recovery and load-out of cesium from 241C Tank farm were completed.
July, 1963	\$ 1.4	<p>Completion of Phase I of the modification and reactivation of the B-Plant facilities for interim fission product recovery and waste management. The B Plant conversion to waste management was to be done in three phases:</p> <p>Phase I - In the first phase, tank activation provided for the stockpiling of strontium-90 and rare earths.</p> <p>Phase II - Scheduled for completion in May, 1966, will demonstrate loading, drying, closure welding and handling techniques for packaging of strontium and cesium.</p> <p>Phase III - This phase will provide B-Plant with the capability for fractionization of high-level wastes.</p>
November, 1963		Redox fire in anion exchange resin caused shutdown of continuous neptunium recovery equipment. Redox had to revert to the campaign during shutdowns for neptunium recovery. The damaged facilities were not reactivated.
June, 1964	\$ 3.2	A new facility, 236 Building, was completed at Z-Plant for reclamation of plutonium from both wet and dry process wastes.
February, 1965		Purex completed 25-day thorium process test. This test demonstrated that irradiated thorium fuel can be processed in the Purex Plant for the recovery of U-233 and thorium for recycle.
February, 1965	\$ 1.3	Completion of a 1700 foot long railroad tunnel at Purex for disposal of large pieces of failed equipment.
February, 1965	\$ 2.1	The four (4) waste storage tanks in the Ax farm were completed.
March, 1965		Waste tank 115SX leaked and was removed from service.
May, 1965	\$ 0.2	Facilities were added to permit recovery of americium in the Z-Plant complex.

<u>Date</u>	<u>Capital Cost</u> <u>(\$ in millions)</u>	<u>Remarks</u>
August, 1965	\$ 0.6	More than a million gallons in non-boiling waste storage space was recovered in the first 6 months of continuous operation of Hanford's first in-tank solidification unit, proving the feasibility of controlled evaporation of radiochemical wastes in the underground tanks. The evaporation leaves a salt cake in the underground tank, eliminating the potential safety hazards associated with a failure of a tank containing liquid waste.

REDOX AND PUREX
PRODUCTION RECORDS

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	<u>Date</u>	<u>Quantity</u>
Redox - Uranium	December, 1964	323.7 T
- Plutonium	December, 1964	189.9 Kg
Purex - Uranium	April, 1965	908.5 T
- Plutonium	December, 1960	508.6 Kg
Buttons	5-day week October, 1964	636.5 Kg(Gross)
	7-day week August, 1961	771.9 Kg(Gross)
UO ₃ - Normal and Enriched U Combined	April, 1965	1118.9 T

REDOX AND PUREX
PU SEPARATION PER GRAM

<u>FY</u>	<u>Plant*</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total U/C by Plant</u>	<u>Average Cost/gm.</u>
<u>1959</u>	R				
	P				
<u>1960</u>	R				
	P				
<u>1961</u>	R				
	P				
<u>1962</u>	R				
	P				
<u>1963</u>	R				
	P				
<u>1964</u>	R				
	P				
<u>1965</u>	R				
	P				

* R = Redox, P = Purex

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REDOX AND PUREX
DEPLETED URANIUM RECOVERY
COST PER POUND

<u>FY</u>	<u>Plant*</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total U/C by Plant</u>	<u>Average Cost/lb.</u>
<u>1959</u>	R				
	P				
<u>1960</u>	R				
	P				
<u>1961</u>	R				
	P				
<u>1962</u>	R**				
	P				
<u>1963</u>	R				
	P				
<u>1964</u>	R				
	P				
<u>1965</u>	R				
	P				

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* R = Redox, P = Purex

** Redox recovered no depleted uranium after FY 1961 (see page 12 for enriched uranium recovery)

REDOXENRICHED URANIUM RECOVERY
COST PER POUND**DECLASSIFIED**

<u>FY</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total Cost/lb.</u>
1959	\$1.703	\$1.071	\$2.774
1960	1.568	1.034	2.602
1961	1.097	.728	1.825
1962	1.036	.503	1.539
1963	1.119	.513	1.632
1964	.937	.443	1.380
1965	.698	.312	1.010

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UO₃ RECOVERY
COST PER POUND

<u>FY</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total Cost/lb.</u>
1959	\$.186	\$.058	\$.244
1960	.151	.053	.204
1961	.114	.044	.158
1962	.115	.051	.166
1963	.098	.035	.133
1964	.072	.039	.111
1965	.056	.029	.085

REDOX AND PUREX
NEPTUNIUM RECOVERY AND PURIFICATION
COST PER GRAM

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<u>FY</u>	<u>Plant*</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total U/C by Plant</u>	<u>Average Cost/gm</u>
<u>1959</u>	R	\$ --	\$ --	\$ --	<u>\$496.600</u>
	P	316.576	180.024	496.600	
<u>1960</u>	R	1 294.064	476.032	1 770.096	<u>\$371.759</u>
	P	207.084	100.384	307.468	
<u>1961</u>	R	275.299	107.663	382.962	<u>\$374.612</u>
	P	255.910	115.339	371.249	
<u>1962</u>	R	218.929	65.618	284.547	<u>\$225.798</u>
	P	150.474	60.122	210.596	
<u>1963</u>	R	120.816	71.255	192.071	<u>\$215.830</u>
	P	154.514	72.134	226.648	
<u>1964</u>	R	84.653	31.949	116.602	<u>\$135.950</u>
	P	93.909	48.287	142.196	
<u>1965</u>	R	80.027	24.974	105.001	<u>\$149.109</u>
	P	119.982	52.009	171.991	

* R = Redox, P = Purex

Note: Purex plant unit costs include all purification cost of neptunium for both plants.

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BUTTON COST PER GRAM

<u>FY</u>	<u>U/C Conversion</u>	<u>U/C Depreciation</u>	<u>Total Cost/gm</u>
1959			
1960			
1961			
1962			
1963			
1964			
1965			

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SIGNIFICANT CHEMICAL SEPARATIONS ASSOCIATED PROJECT WORK

<u>Project Number</u>	<u>Title</u>	<u>Construction Completion Date</u>
C-112	Additional Waste Tank Facility - 241-B, BX-Farm	3-15-48
C-163	Waste Storage Facilities - 200-W, TX-Farm	7-15-49
C-187 AB	Research & Development & Redox Program	12-31-48
C-187-C	Redox "R" Area	4-4-49
C-187- D-1	Redox "S" Area	9-1-51
C-187 D-11	Redox Production Facilities - Part II	5-31-55
C-187 D-111	Redox Production Facilities Part III-Waste Water Dis- posal Basin	12-31-54
C-187-E	Redox Analytical Plant Assistance Laboratory	10-31-52
C-198	234-5 Bldg. Program (MJ-2) Phases I, II & III	6-30-51
C-271	Additional Waste Storage Facilities 200-E, BY Farm	9-1-49
C-361	Metal Conversion Facility (UO_3)	4-15-52
C-362	Waste Metal Recovery Facilities (TBP)	5-29-53
C-369	Evaporation Facility for Waste Solutions, 200-W	5-17-51
C-413	Expansion of 234-5 Capacity	5-16-53
C-418	Additional Waste Storage Facility 200-E, TY Farm	9-26-52
C-423	Additional Waste Evaporation Facilities 200-E	4-30-52
C-496	Recuplex Installation, Bldg. 234-5	4-1-55
CA-513-A	Purex Facility	1-6-56
CA-513-B	Metal Conversion Facilities (Gas Fired Pots)	2-18-54
CA-513-C	Purex Prototype Facility	9-25-53

<u>Project Number</u>	<u>Title</u>	<u>Construction Completion Date</u>
CA-513-D	Conversion of Hot Semi Works	10-29-54
CA-513-E	Purex Plant Modifications	1-23-59
CA-535	Redox Capacity Increase, Phase II	4-29-55
CG-538	Redox Waste Line to 241-U Tank Farm	3-29-54
CA-539	Additional Waste Storage for Redox, SX Farm	3-30-56
CG-549	Activate Task I, RMA Line 234-5 Bldg.	5-2-55
CG-551	Expansion of Bldg. 234-5 Facilities, Task II & III	5-2-55
CG-603	Hanford 4X Program-Third Extraction Cycle - T Plant	12-30-55
CG-613	Hanford 4X Program-Metal Conversion Plant (UO ₃)	3-29-57
CG-647	Back-Up Radiiodine Removal Facility Purex	9-16-57
CG-648	Auxiliary Radiiodine Removal & Nitric Acid Recovery	9-13-57
CG-691	Improved Task I and Task II Facilities, 234-5 Bldg.	5-29-58
CG-719	Additional Facilities for Purex Tank Farm Vapor Wastes	10-15-59
CG-734	RMC Button Line 234-5 Bldg.	7-15-60
CG-745	RMC Fabrication Line 234-5 Bldg.	6-11-59
CGC-811	Additional Plutonium Fabrication Facilities 234-5 Bldg.	7-31-62
CGC-813	Plutonium Recovery From Contaminated Materials 234-5 Bldg.	9-29-61
CGC-821	Project Birch - Purex (Neptunium Recovery)	9-30-62
CAC-880	Plutonium Reclamation Facility - Z Plant	6-30-64
CAC-895	Reliability Improvements - Purex	9-28-62
CGC-897	Fission Product Concentrates Storage System - B Plant Phase I	6-31-63
CGC-912	Waste Treatment Facilities Z Plant	6-15-64
CAC-945	New Waste Storage Tanks - Purex AX Farm	2-18-65

END

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