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K/EM-299

SANITIZED VERSION OF OUTLINE OF CASACE IMPROVEMENT (1945-1953)

(SANITIZED VERSION OF CRD DOCUMENT # KP-793)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

December 14, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
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This document has been approved for release to the public by: P. Fortman
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Technical Information Officer Date
Oak Ridge K-25 Site

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This document consists of 16 pages
No. 1 of 1 copies, Series A

K25RC
NOT TO BE LOANED FROM
PLANT RECORDS

PLANT RECORDS DEPT.
CENTRAL FILES
REC. R-51810
FILE
X-REF.
X-REF.

KP-793

File - Cascade Improvement Programs

OUTLINE OF CASCADE IMPROVEMENTS
1945 to 1953

I. IMPROVEMENT AS RESULT OF JULY '50 POWER FAILURE

II. IMPROVEMENTS AS RESULT OF EXPANSION PROGRAM

1. Special Hazards Requirements
2. Additional Operating Requirements

III. IMPROVEMENTS TO DECREASE OPERATING COST

IV. IMPROVEMENTS TO INCREASE PRODUCTION

KP 793 1 A
KP 793 1 A

~~Classification changed to C-RD (level and category)~~
~~By authority of: CG-PGD-4 (classification guide)~~
~~ADC or ADD signature (first reviewer) Date 1/27/94~~
~~Sam W. Wolfort ADD signature (final reviewer) Date 1/27/94~~

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IMPROVEMENTS FOLLOWING MAJOR POWER FAILURE, July, 1950

Subject	Brief Description	Cost
Emergency Power	Ten 300 kw diesel generators, as shown, to provide emergency power to motor operated valves, seal exhaust pumps, line recorders, control power, emergency lighting and the public address system.	$1,088,000
Dry Air Dependability	Utilization of existing centrifugal compressor for supplying 40# air to all cascade control instruments with emergency supply from 1500 kw diesel driven compressors and 100# system.	$176,170
Stand-By Purge Equipment	Seven mobile purge units, equipped with alumina traps and air ejectors.	$66,300
Alternate Power Supply to K-25 Power Station Auxiliaries	13.8 kv overhead line capable of carrying 20,000 KVA installed between the K-25 and K-27 plants for supplying K-25 steam station.	$47,520
Automatic Sprinklers in Switchyard	Automatic water spray fire protection on OCB's and transformers in the K-25, K-27, and K-31 switchyards.	$286,600
Seal Exhaust Revisions	Traps and pumps from K-302-1 through K-306-7 changed to "always-safe".	$48,300
Portable "Breather" Traps	Fifty "always-safe" alumina traps fabricated for emergency use. Traps will permit cell "breathing" during shutdowns with the cell at atmosphere.	$5,800
Total		$1,718,690
K-25 Switch Yard Breaker-and-a-Half Scheme	Design permits better oil circuit breaker inspection.	
Automatic Oscillographs	The oscillographs, initiated by system faults in operation at K-31, K-25 and Elza switchhouses. Record 154 and 13.8 kv system voltages and currents. Can evaluate protective relay action and power system behavior.	

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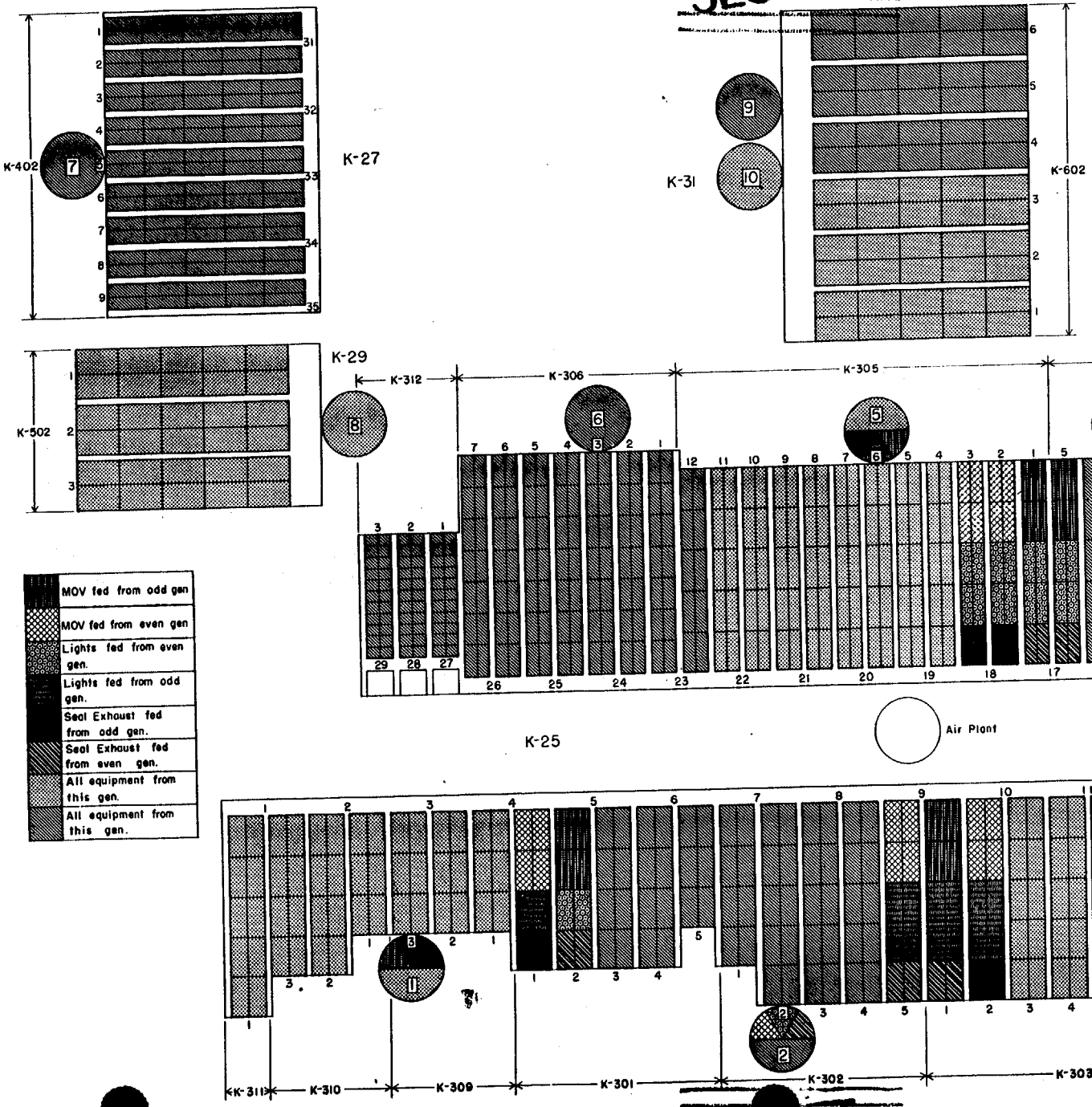

DIESEL SETS FURNISH POWER TO:

1. MOV's
2. Seal Exhaust Pump Motors
3. Emergency Lighting Circuits
4. Line Recorder Stations
5. Diesel Engine Auxiliaries
6. Battery Chargers
7. Control Power
8. Gamma Graphs

Location	Gen. No.	S.E. Load	Lights & Misc.
Area 2	1	40-60 kw	160 kw
Area 3	2	40-60 kw	160 kw
Area 3	3	40-60 kw	170 kw
Area 4	4	50-75 kw	125 kw
Area 4	5	40-60 kw	115 kw
Area 5	6	30-45 kw	220 kw
K-27	7	30-45 kw	210 kw
K-29	8	40 kw	40 kw
K-31	9	60 kw	40 kw
K-31	10	60 kw	40 kw

CHARACTERISTICS

RPM - 1200
BHP - 403
KW - 300
Stroke - 4
Cylinders - V-12
Fuel Used - 25 gal./hr. at 300 kw
Fuel comparable to domestic fuel oil

DIESEL GENERATOR PLOT PLAN OF CASCADE

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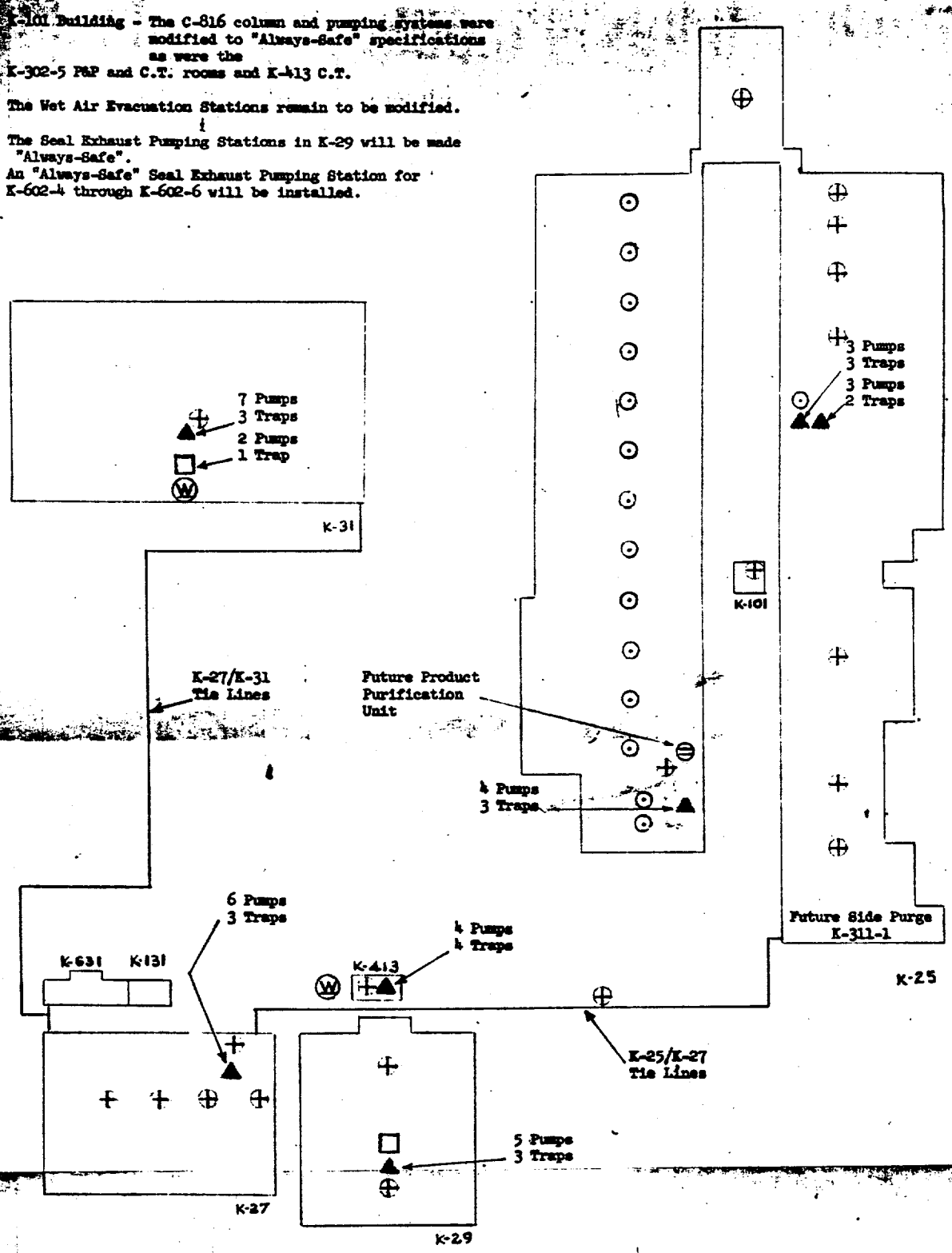
Seal Exhaust Pumping Stations in K-25 and K-27 have been made "Always-Safe" (alumina traps and oil reservoirs).

K-101 Building - The C-816 column and pumping systems were modified to "Always-Safe" specifications as were the
K-302-5 P&P and C.T. rooms and K-413 C.T.

The Wet Air Evacuation Stations remain to be modified.

The Seal Exhaust Pumping Stations in K-29 will be made "Always-Safe".
An "Always-Safe" Seal Exhaust Pumping Station for K-602-4 through K-602-6 will be installed.



⊙ Gammagraphs presently installed.

⊕ Gammagraphs to be installed.

▲ Cold Trap facility.

□ ClF_3 removal unit.

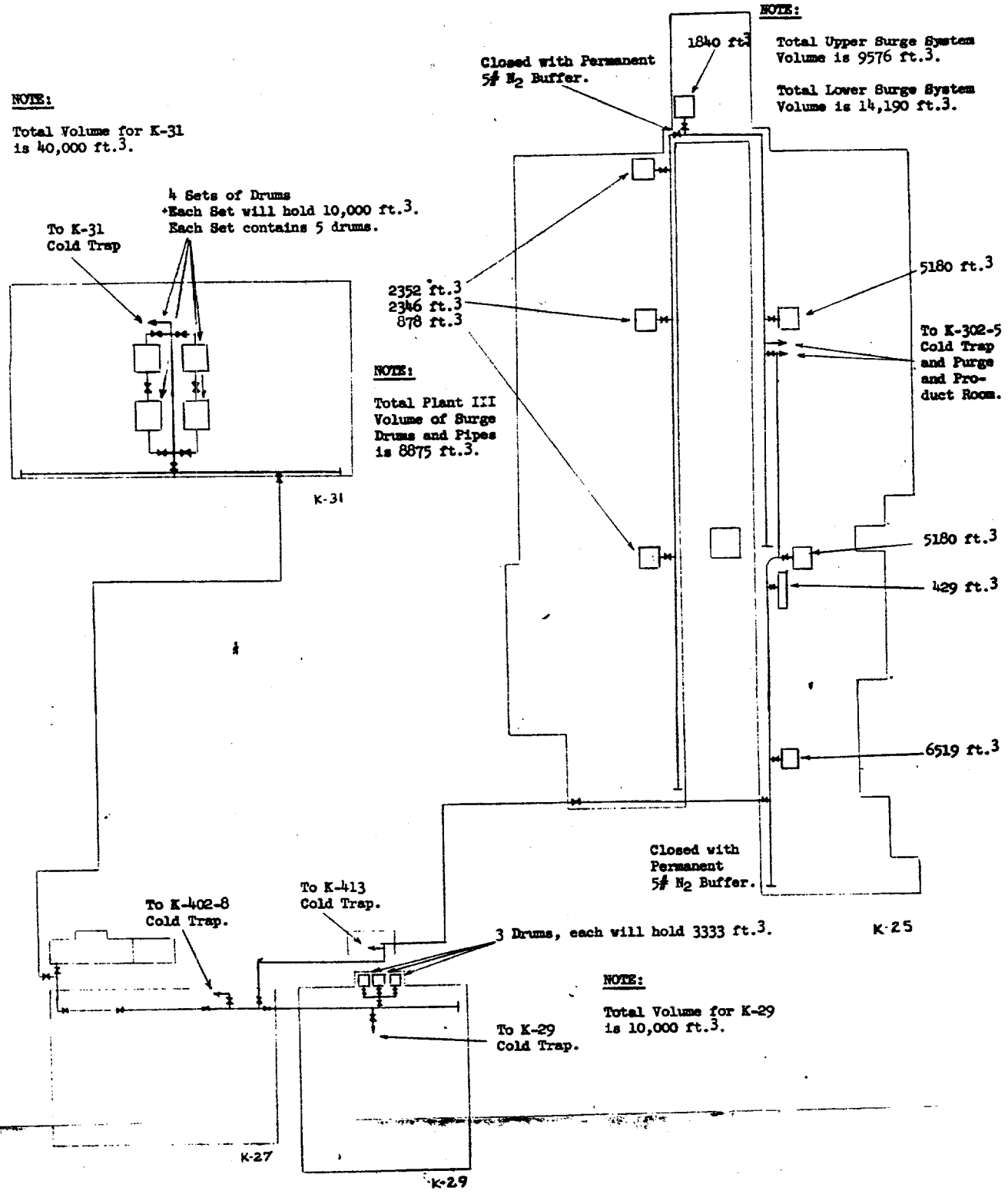
Ⓦ Wet air evacuation station.

PROCESSING COST REDUCTION PROGRAMS

Revision	Description	Initial Cost	Value
1945			
Improved equipment evacuation techniques	Surplus installed equipment utilized for removal of toxic gases prior to repairs - eliminate expensive cold trapping operations.	Nil	$2,000,000/yr.
1947			
K-600 Section shutdown	Surge system established utilizing K-311-1 compressors and K-309-3 drums and surplus lines.	-	$44,000/yr.
Carbon seals in K-312 Purge Buildings	Decreased maintenance costs by installing carbon shaft seals, replacing bellows on reciprocating pumps	-	$18,000/yr.
Line recorder shutdowns	The spare mass spectrometers in each unit at K-25 (total of 60) shut down	Nil	$273,000/yr.
Ambient air system change	Dry air bleed-off from instruments utilized to maintain equipment housings in dry atmosphere	Nil	$18,000/yr.
1948			
Pairing of cell cooling system	Coolant systems of adjoining cells interconnected to eliminate 50% of pumps for recirculation	$60,000	$160,000/yr. + $2,000,000 of inventories
Line recorder improvements	Metal spectrometer tubes substituted for glass tubes and mechanical refrigeration installed to replace manual cooling.	$140,000	$730,000/yr.
Seal exhaust vacuum pump lubrication	Use of lube oil from building systems substituted for more expensive vacuum pump oil.	Nil	$2,100/yr.
[redacted]	Oil system of vacuum pumps connected to building system	$5,800	$6,000/yr.

Revision	Description	Initial Cost	Value
1948 (Cont.)			
Lube oil temperature increase	Lube oil for stage pump bearings raised in temperature to 130° F resulted in lowered friction losses and lowered power requirements.	-	$30,000/yr.
Lubrication schedule	Operating experience showed that frequency of lubrication could be lowered - process lubricants standardized	-	$60,000/yr.
1951			
Ten-ton tails cylinders	The design, purchase, and use of cylinders of ten-ton capacity for tails material withdrawal and storing eliminated purchase of smaller chlorine-type units.	-	$85,000 during FY 1952 alone - additional amounts later
Power frequency reduction	Power frequency to K-303, K 305, K-310, and K-311 sections lowered from 65 to 60 cycles. Incremental production with this power exceeded the cost of the power.	-	$228,000/yr.

Surge for Purge Systems



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PLANT PRODUCTION INCREASE PROGRAMS

Revision	Description	Cost	Value
1946			
Power frequency to K-309, K-301 A motors raised from 60 to 65 cycles	Increased output by changing load to A pumps and relieved B network.	Power	$177,000/yr.
Power frequency to K-304 section increased from 60 to 65 cycles	Barrier performance and interstage flow increased.	Power	$12,000/yr.
Surge-for-purge system and stage control changes	Surge capacity provided for contaminant storage and stage control system revised to permit contaminant bubbles to pass through plant without significant inventory shifts.	-	$300,000/yr.
1947			
Stage pressures revised from section to building basis	Tails pressures from Unit K-302-1 through Unit K-306-7 optimized on a unit-by-unit basis.	-	$352,700/yr.
Stage pressures in K 402 1 on cell-wise taper	Permitted better stage pressure taper from previous building.	-	
K-27 B-motor ducts in escape alley	Permitted higher stage pressures by cooling B motors.	-	$340,000/yr.
Increased power frequency	Power frequency increased from 60 to 65 cycles - increased barrier separation factor and interstage flow - K-302, K-303, K 305, K-310, and K-311 sections.	$425,000/yr.	$795,000/yr.
K-301, K-309 B-motor power frequency	Frequency lowered from 60 to 55 cycles, shifted load to A motors, permitting stage pressure increase.	$40,000/yr.	$385,000/yr.

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Revision	Description	Cost	Value
1947 (Cont.)			
Installed improved barrier in K-27 for test	Better barrier raised separation factor in 90 stages.	-	$40,000/yr.
Installed improved barrier in K-25	New barrier in 10 buildings of K-25.	-	$1,200,000/yr.
K-101 adapted for use in removal of coolant from cascade	Cascade gas stream inventory of C-816 lowered - raise in output.		$177,000/yr.
Cascade fluorine bleed	Productivity increased by lowering consumption.	-	-
1948			
Series operation of K-25, K-27	New interplant lines installed to change from overlap to series operation of the two plants.		$1,338,000/yr.
Improved barrier in K-25		$4,225,000	$3,400,000/yr.
Cooling duct installation on B motors - K-25	Air ducts installed on B motors of K-310, K-311, K-301, and K-309 sections to maintain stage pressures at high level.	-	$327,000/yr.
K-309, K-301 motor voltage increase	Motor voltage increased 5% to enable stage pressure increase	$66,000/yr.	$112,000/yr.
1949			
Capacitor installation in K-301, K 309	The installation of capacitors in the electrical system of the K-301, K-309 sections permitted a stage pressure increase in all stages.	$40,000 + $50,000/yr.	$250,000/yr.

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Revision	Description [redacted]	Cost	Value
1950			
Relocation of K-310 section operation	The operation of the K-310 section was moved from between the K-309 and K-402 sections to a point between the K-301 and K 302 sections. Sufficient piping and valves were installed to facilitate the operation. This section was under-sized for the former location in the cascade.	$45,000	$350,000/yr.
Unplugging and uranium recovery with chlorine trifluoride	Although difficult to evaluate on a production basis, the treatment of cascade equipment with chlorine trifluoride has resulted in very large savings in maintenance costs and very substantial gains in production due to barrier unplugging and reduced equipment offstream. The use of chlorine trifluoride after the power failure in mid-1950 returned large quantities of deposited uranium to the gas streams, enabling a rapid return to normal plant production.	-	-
K-311-1 improvement	Cells 2, 6, and 10 fitted with larger motors - Cells 4, 8, and 9 shut down to make power available for improved cells.	$54,000	$25,000/yr.
1952			
Ten-ton cylinder feed facility	The feeding of K-25 depleted material to the K-25 cascade from ten-ton cylinders increased production significantly prior to the startup of the Paducah facilities.	$24,000	$600,000 during 1952 only
K-31 Pressure increase	K-31 stage pressures were raised an average of in order to raise the K-31 total load from	$1,760,000/yr.	$7,700,000/yr.

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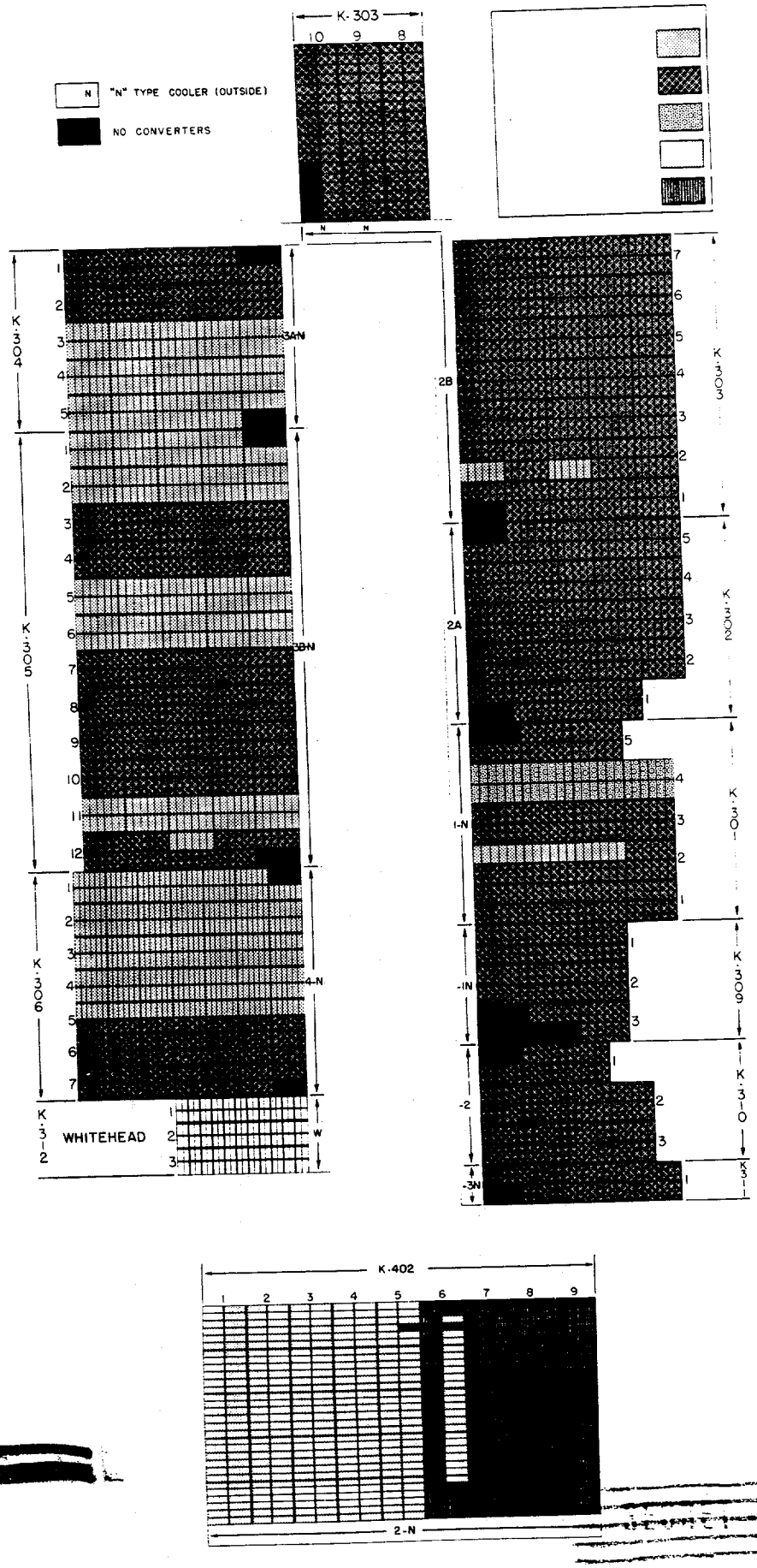
PROCESS ENGINEERING

ORIGINAL BARRIER LOCATIONS



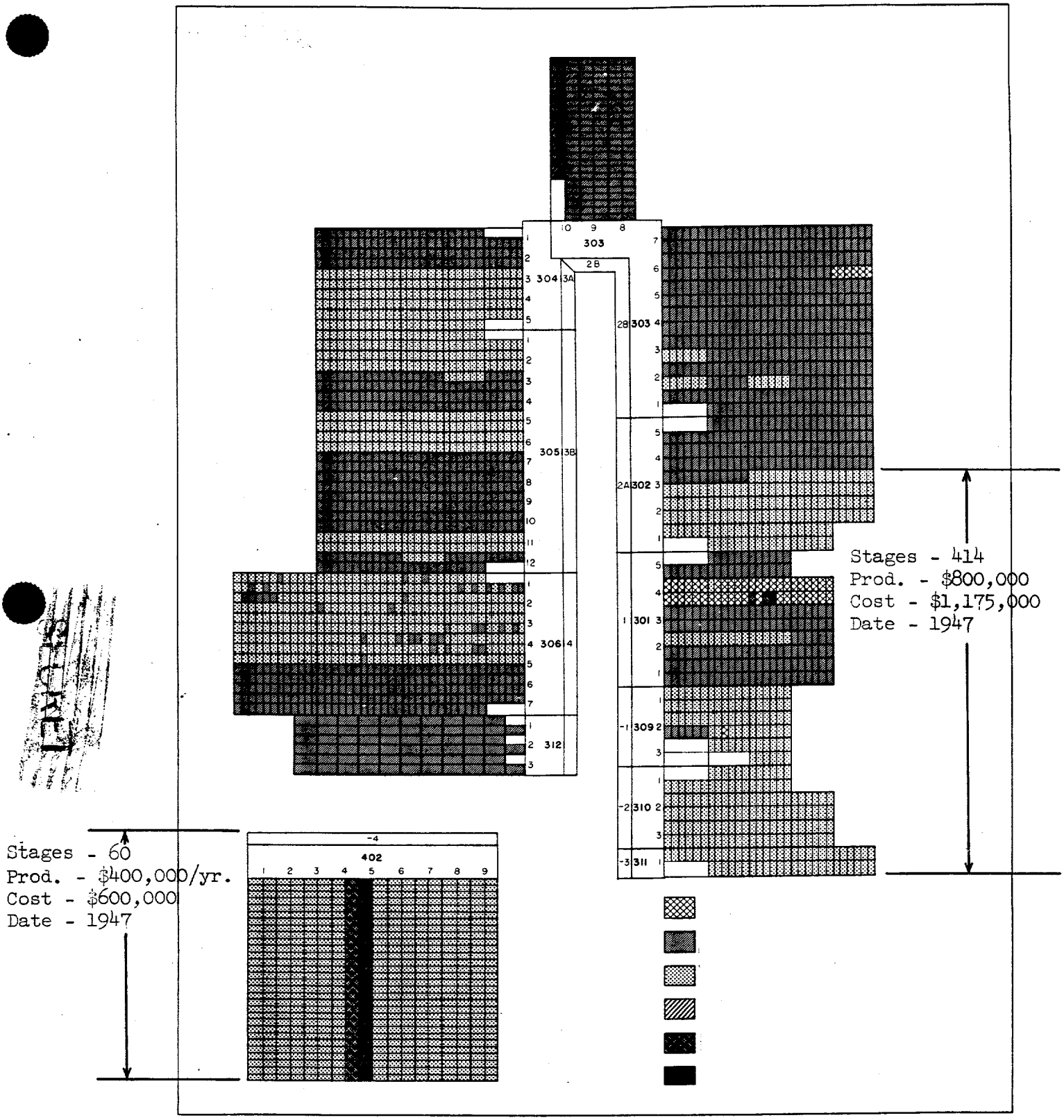


FIGURE C-2

BARRIER LOCATION - JANUARY 1, 1948

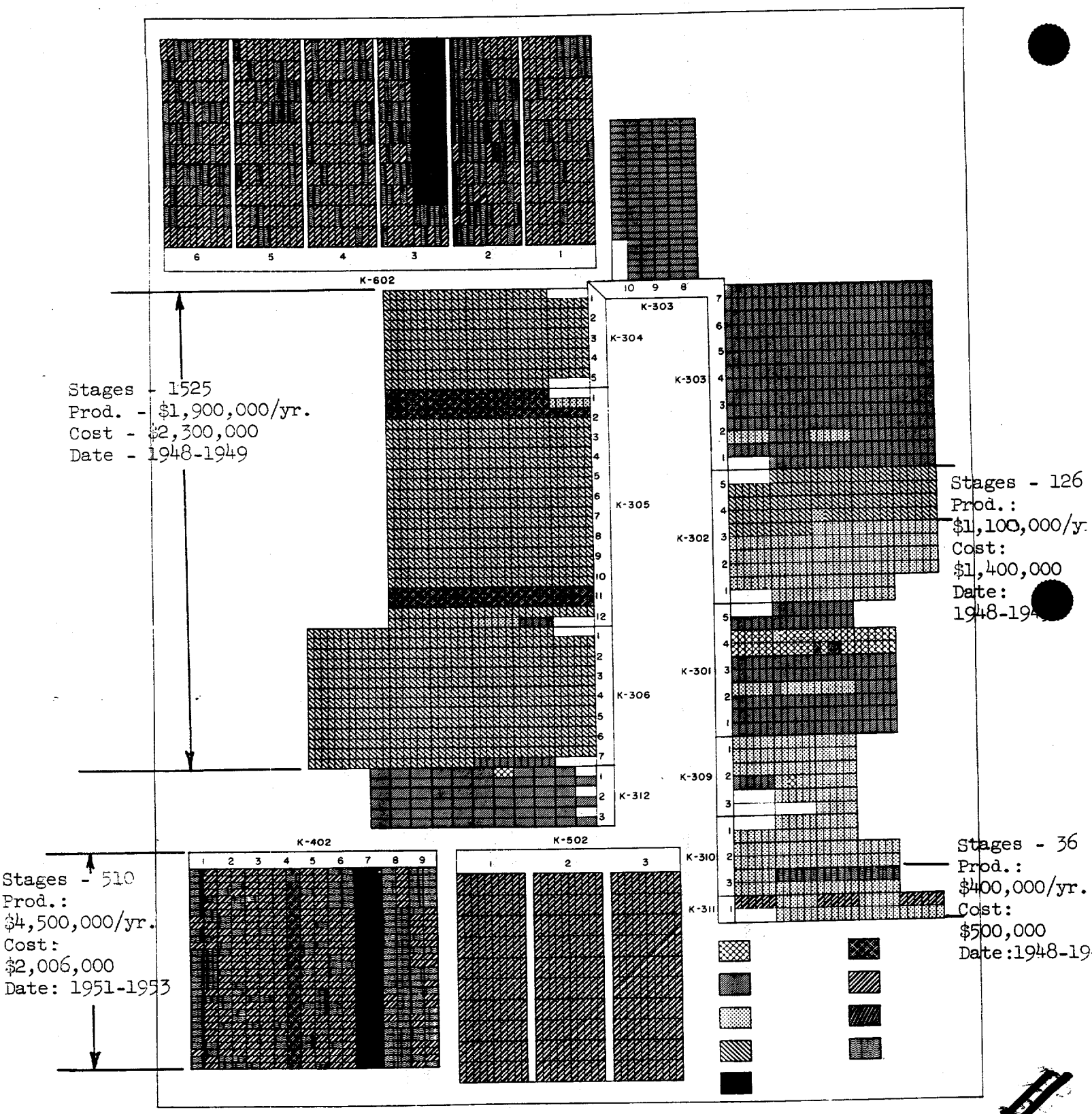


FIGURE C-2

CURRENT BARRIER LOCATION

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K-27 STAGE IMPROVEMENT PROGRAM

MODIFICATION	REASON	TOTAL COST	PRODUCTION GAIN, Dollars per year
Installation of improved barrier	Increase separation qualities	$2,006,006	$4,500,000
Cut-down B pump impellers from 29.5" to 22.0" diameter (install 5 re-enforcing pins between shrouds)	Shift load to A compressors; decrease B pump compression ratio, thereby reducing the pressure drop across the control valve and increasing the pressure differential across the barrier	194,563	
Electrical alterations Installation of new A motors Installation of bus bars and cables between transformers and motors	Higher HP rating to accommodate increased interstage flow Higher loads	359,462	
540 new motors (100, 150, 200 HP)	Replace lower rated motors - higher loads	817,680	4,000,000
Install dual seal feed and seal exhaust systems	Reduce inleakage to cascade by allowing different pressure settings to be made at A and B pump seals	473,000	
Separate cell coolant systems and reverse coolant flow	Increase heat transfer capacity for higher cell pressure operation and provide cooler coolant at the pump to reduce coolant losses through evaporation	30,856	
Instrumentation	Provide adequate control of stage pressures and measure interstage flows	456,638	
	Grand Totals	$4,338,205	$8,500,000

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~~SECRET - WORK SHEET~~

[redacted]

[redacted]

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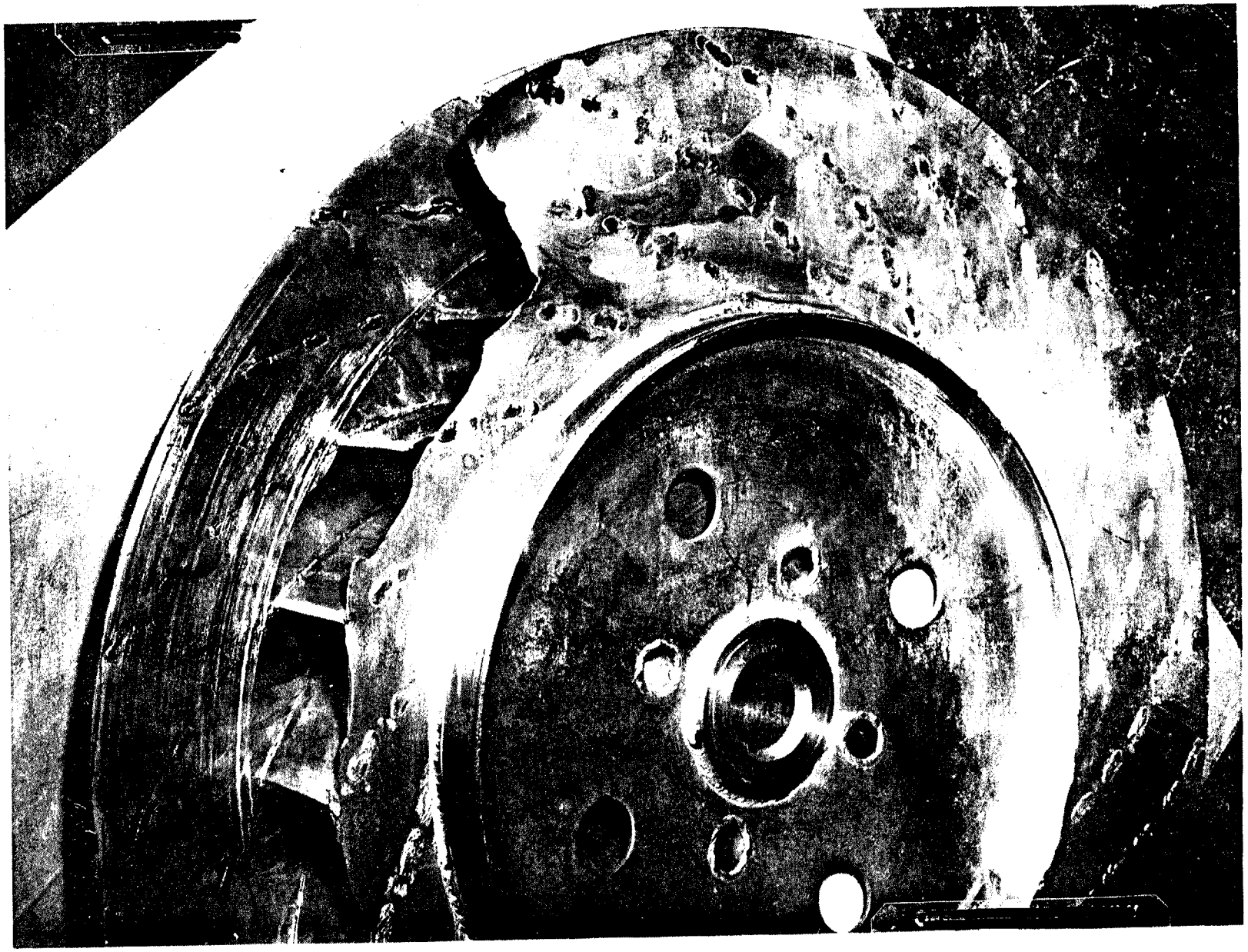

FIGURE 1

IMPELLER - DRIVE SIDE, PUMP NUMBER C1AS-1065

A section of the hub disc was torn from the impeller. The drive side seal ring was badly worn. This impeller was removed from K-402-2 Cell 6 1B position on 2-22-52.

[redacted]

DISTRIBUTION

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