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HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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DEFINITIVE SCOPE
OF A FACILITY FOR E-METAL PRODUCT SEGREGATION
AT THE UO₃ PLANT
PROJECT CG-767

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Process Design and Development
Facilities Engineering Operation
CHEMICAL PROCESSING DEPARTMENT

GENERAL ELECTRIC COMPANY
HANFORD ATOMIC PRODUCTS OPERATION

This document has been reviewed by appropriate members of the Process Design and Development Operation as a basis for detailed design of a facility for E-Metal product segregation at the UO₃ Plant.

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DEFINITIVE SCOPE
OF A FACILITY FOR E-METAL PRODUCT SEGREGATION
AT THE UO₃ PLANT
PROJECT CG-767

I. INTRODUCTION

E-Metal production is scheduled to start through the UO₃ Plant in July of 1958. E-Metal is defined in HW-46138 as uranium metal enriched with U-235 to a level selected to be always-safe for non-metallic uranium forms, i.e. for compounds encountered during solvent extraction or calcination. Currently E-Metal as selected contains 0.94% U-235 prior to irradiation. Planning of a segregation facility requires that the mixing of E-Metal with normal uranium be minimized, thereby preventing costly downgrading. Segregation of E-Metal through existing facilities would require extensive cleanout and flushing. Production scheduling with present demonstrated capacity would make this method impossible.

The Redox Plant will produce E-Metal on an intermittent basis. It is expected that normal operating production of E-Metal through the Redox Plant will be quantities of 100 to 200 tons. Production through the UO₃ Plant will follow on this same intermittent basis. During the first two quarters of FY '59 the UO₃ Plant production of E-Metal is forecast at not greater than 100 tons per quarter. Following this initial period the E-Metal production is forecast to run 135 to 200 tons per quarter for the next three to four years.

II. PURPOSE

It is the purpose of this document to establish a scope and design criteria for a facility providing segregation of E-Metal in the UO₃ Plant until the continuous calciners have demonstrated sufficient capacity to process all production.

III. SUMMARY

The E-Metal is to be shipped from the Redox Plant via the existing pipe line, and received at the UO₃ Plant in a new receiving and sampling tank, TK-X-36. An accountability transfer of this 60 per cent UNH solution is then made from TK-X-36 to another new tank TK-X-37.

From TK-X-37 a new line will route the E-Metal through pump PX-37 to the 100 per cent UNH Concentrators. Existing header piping permits separate processing of E-Metal through the 100 per cent Concentrators to TK-X-19. From TK-X-19 this segregated metal solution is pumped via the existing pot room feed loop header to the Luckey Pots. Following batch calcination the UO₃ powder is unloaded via the 224-U powder handling system.

The two new tanks required for this project may be obtained from excess vessels available on-site. Mechanical equipment is also available on-site. A 4,000 gallon 9 foot x 9 foot tank is to be used as TK-X-36. A 14,000 to 15,000 gallon tank is to be used as TK-X-37. In order to complete this facility by July, 1958, it will be required that existing on-site equipment and materials be adapted for all possible applications.

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IV. PRODUCT SPECIFICATIONS

E-Metal as UNH solution or UO_3 powder must meet all specifications currently required of normal depleted UNH solution or UO_3 powder other than U-235 enrichment level.

V. DISCUSSION

A. Process Description

E-Metal is received at the UO_3 Plant as 60 per cent UNH. The process involves concentrating to 100 per cent UNH followed by calcination to UO_3 powder. In this facility existing process equipment is used for both the concentration and calcination steps. There is no critical mass problem in the UO_3 Plant associated with E-Metal processing (reference HW-46138, "Processing E-Metal in the 200 Areas" by A. M. Platt and R. E. Tomlinson). New piping facilities are required for a separate feed supply of E-Metal to the 100 per cent concentrators. Prior to processing E-Metal, but not included in this project, the Finished Products Operation will assure that equipment pieces such as the Luckey Pots, X-3 and X-11 Bag Filters, X-6 Pulverizer, and X-7 Screw Conveyor are in good operating condition. A new continuous sampler is to be provided for sampling powder as it enters the 5 ton containers.

The Luckey Pots are used for the calcination step in this facility. The operating histories of the batch equipment verify excessive operating and maintenance costs as well as onerous working conditions for the production personnel. As such, it is expected that the continuous calciners will eventually be incorporated into the E-Metal Program; however, until the continuous calciners have proven to be of adequate capacity other facilities must be provided. The additional construction required to process E-Metal through the continuous calciners, would also make completion of a project of this nature unlikely before the required July, 1958 date. All construction proposed in this facility may be incorporated into a subsequent facility utilizing continuous calciners.

This facility consists of two new tanks with associated equipment, piping, and instrumentation. The first of these tanks, TK-X-36, is used as a receiving and sampling tank. E-Metal is received in TK-X-36 from the Redox to UO_3 pipe line. The overground pipe line is to be water flushed before and after each E-Metal transfer to prevent inadvertent degrading of E-Metal. This material is then sampled and an accountability transfer made to the second tank, TK-X-37. This second tank is used as a storage feed tank to the 100 per cent UNH concentrators. New piping from TK-X-37 is connected to the P-X-37 pump. This pump is then used to feed E-Metal to the 100 per cent concentrators via a connection to the existing spare feed header. No further modification is required beyond this point to permit E-Metal processing through the concentrators and Luckey Pots. Refer to flow diagram SK-2-17732.

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Operation through the 100 per cent UNH concentrators may be handled continuously or batchwise. One concentrator has adequate capacity to supply in one day enough feed for three days normal operation of the Luckey Pots. Limiting concentrator operation to a continuous rate of 6 tons per day will permit processing without intermittent concentrator shutdowns and startups.

Off gas from the Luckey Pots will normally be routed through the T-A-1 absorber tower. With existing piping, these off gases may also be routed to the T-A-3 absorber tower, if desired.

While processing E-Metal through the 100 per cent concentrator system, to TK-X-19, through the Luckey Pots, and through the 224-U powder handling system, extreme care must be exercised to prevent costly downgrading of E-Metal. Approximately 70 cents is lost for each pound of Normal uranium mixed with a much larger quantity of E-Metal or for each pound of E-Metal mixed with a much larger quantity of Normal uranium. The system must be thoroughly purged before and after E-Metal processing. Valving through the 100 per cent concentrator system must be closely supervised, and no remilling of normal UO_3 powder permitted through the 224-U powder handling system while processing E-Metal. Blanking and lock and tag procedures must be used to prevent inadvertent mixing of E-Metal and Normal uranium metal.

At a normal average monthly E-Metal processing rate of 50 tons the Luckey Pots will operate 8-1/3 days/month at a processing rate of 6 tons/day. Since it is expected that E-Metal will normally be handled in batches of greater than 100 tons, the operating periods will usually run in excess of 16 days with intervening shutdown periods of greater than six weeks. The facility has a maximum capacity of about 450 tons per quarter which is far above the existing E-Metal production forecasts.

B. Tanks, Agitators, and Pumps

1. Tanks

- (a) Tank TK-X-36. A 4,000 gallon, 9 foot x 9 foot, stainless steel, jacketed tank equipped with agitator. This tank is to be insulated, equipped with instrumentation, and installed as shown in Figure 1, Figure 3, and SK-2-17732. There is a tank of this type available as U-Plant spare equipment.

Example: TK-149 or similar tank.

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- (b) Tank TK-X-37. A 15,000 gallon, 14 foot x 14 foot, stainless steel tank equipped with steam-coil and agitator. This tank is to be insulated, equipped with instrumentation, and installed as shown in Figure 1, Figure 3, and SK-2-17732. A tank of this type is available as excess U-Plant equipment.

Example: 276-U tanks TK-382 or TK-387

Alternate: 10 foot x 16 foot x 14 foot tank available from excess U-Plant equipment

2. Agitators

- (a) Tank X-36 is to be equipped with an agitator similar to the 5 HP agitators now in use in 9 foot x 9 foot UO_3 Plant tanks.
- (b) Tank X-37 is to be equipped with a 7-1/2 HP agitator. This agitator is available with the excess 15,000 gallon U-Plant tank.

3. Pumps

- (a) P-X-37. This pump is to be used for feeding the 100 per cent concentrators from TK-X-37. It is an existing pump (P-X-3-1) which may be used without relocation. See Figure 6 and SK-2-17732.
- (b) P-X-36. This pump is to be used for transferring TK-X-36 contents to TK-X-37. It is an existing pump (P-B-4 also known as P-X-3-2) which may be used in its present location. New electrical switch gear is required for this pump. See Figure 6 and SK-2-17732.

C. Piping and Samplers

1. Piping is to be installed and relocated as shown on SK-2-17732 and Figure 6. New piping is to be so installed as to provide minimum possibilities for mixing of E-Metal and Normal uranium. Exposed UNH piping is to be steam traced and insulated.
2. (a) TK-X-36 is to be provided with a sampling outlet from the bottom of the tank as shown in Figure 4.
- (b) Continuous sampling of the UO_3 powder is required as it is loaded into the 5 ton shipping containers. A new design of sampler which may prove adequate for this installation is being developed and tested by Finished Products Operation (Figure 5). If the new design proves unsatisfactory it will be necessary to install a screw type continuous sampler as now used in the 224-UA unloading system.

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D. Architectural

The two new tanks are to be located in the 203-U enclosure. See Figure 3 for location. Support pads will be prepared in the south and west corners of the 203-U enclosure. Existing drains will be used for tank coil and jacket condensate. The pipe trench is to be extended to include the outlet piping from TK-X-37 to the P-X-37 pump.

E. Instrumentation

Instrumentation is to be provided as shown in Figure 1 and SK-2-17732. Spare and existing controls and instrumentation are to be used where possible.

1. Instrument Arrangement

All of the principal indicators and recorders will be located on a new panel, adjacent to the existing X-1 and X-2 instrument panel board in 224-U Building Operating Gallery. The operator will be able to observe instrument readings and control the pump motors from this location.

2. Instruments & Equipment Per Tank

(a) Tank X-36

1. Agitator
2. Pump (use existing pump with new controls)
3. Weight Factor and Specific Gravity Recorders
4. Temp. Indication (Remote)
5. Accountability Weight Factor Manometer
6. Control Valve (Stainless Steel) (DOV-X-36)
7. Manual Loading Station with Solenoid Valve for Automatic Closing of DOV-X-36
8. Weight Factor and Specific Gravity Transmitters
9. Pressure Switch with High Level Alarm
10. Temperature Control Valve

(b) Tank X-37

1. Agitator
2. Pump (use existing P-X-3-1)
3. Weight Factor and Specific Gravity Recorders
4. Temp. Indication (Remote)
5. Weight Factor and Specific Gravity Transmitters
6. Temperature Control Valve

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(c) Tubing

Purge lines shall be 1/2" stainless steel from rotometers to tank and transmitters. Tubing runs in tanks shall be 1/2" stainless steel. Tubing runs from transmitters to recorders shall be 1/4" dekoron covered plastic lines. All outside lines shall be protected to prevent freezing.

(d) Transmitters

Weight factor and specific gravity transmitters shall be located adjacent to tanks, preferably on the same elevation as the top of the tanks.

Adequate housing shall be provided around the transmitters to protect same from the elements.

F. Electrical

Electrical requirements are shown in Figure 2. The X-36 and X-37 agitators and pumps are to be controlled from the 224-U operating gallery control panel.

G. General Design Criteria

1. All piping shall conform to the appropriate sections of specification HWS-5500.
2. The use of tanks and agitators for this facility is dependent upon availability from excess equipment at the time of project approval. Tanks used are to be of stainless steel types 304-L, 347 or equivalent.
3. All structural concrete or steel is to be protected by painting with Amercoat or other equivalent protective covering.

H. Identification

Existing identification on the P-X-3-1 and P-B-4 (also known as P-X-3-2) pumps and controls is to be replaced with identification as P-X-37 and P-X-36. Any existing equipment, electrical controls, and instrument controls used in this facility are to be identified to show the new service. Reference identification showing the original service is to be included as an aid to maintenance.

L. D. Gustafson

Equipment Design & Development
Facilities Engineering Operation
CHEMICAL PROCESSING DEPARTMENT

LD Gustafson:vsc

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INSTRUMENTATION

PROPOSED CONDUIT RUN FOR TK-36 & TK-37 IGNITION MOTORS

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FIGURE 3.

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X-36 DRAIN TYPE SAMPLER

FIGURE 4.

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NOTE: DETAILS AND
DIMENSIONS TO BE
DETERMINED BY
EXPERIMENTAL DEVELOPMENT

CONTINUOUS UO₃ POWDER SAMPLER

FIGURE 5

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FIGURE 6

The diagram illustrates a process flow involving two storage tanks, A and B, and their connections to various piping systems.

Top Section:

- A horizontal line at the top is labeled "FROM RADON" on the left and "1014-22 P100" in the center.
- A vertical line descends from this horizontal line, passing through a "3 WAY VALVE" (indicated by a triangle symbol).
- Further down this vertical line is a "DOV 1-36" (indicated by a triangle symbol) and a circled number "1".

Left Section:

- A "MANOMETER" is connected to a vertical line with four pressure points labeled "RA", "UR", "SA", and "TK".
- A "15 PSI STEAM" line enters from the left, passing through a "1-1/2\" valve" and connecting to the side of Tank A.
- A "TO DRAIN" line exits from the bottom left, passing through a "C-143" valve and a "6135604" valve.
- A "6135604" valve is also located on the bottom left side of Tank A.
- A "6135601" valve is located on the bottom right side of Tank A.
- A "SPL" (Storage Point) is indicated below the bottom left valve.
- A "STE F16.3" and "NW-23366" label is at the bottom left.

Tank A:

- A rectangular tank labeled "A" with a dashed vertical line through its center.
- Below the tank is the label "TR X36" and "1000 GALLON".

Right Section:

- A vertical line labeled "C-143" connects the bottom of Tank A to the bottom of Tank B.
- A "TO DRAIN" line exits from the bottom left of Tank B, passing through a "6135604" valve and a "6135601" valve.
- A "6135604" valve is also located on the bottom left side of Tank B.
- A "6135601" valve is located on the bottom right side of Tank B.
- A "STE F16.3" and "NW-23366" label is at the bottom right.

Tank B:

- A rectangular tank labeled "B" with a dashed vertical line through its center.
- Below the tank is the label "TR X37" and "1000 GALLON".

Top Right Section:

- A horizontal line labeled "615P801" connects the top of Tank B to a pump.
- The pump is labeled "P-X-36 (EXISTING 2.0-6) LOC. IN B CELL" and has a triangle symbol below it.
- A vertical line labeled "C-143" connects the pump to the top of Tank A.
- A "615P801" label is also present on the line entering the pump.

Bottom Right Section:

- A vertical line with four pressure points labeled "UR", "SA", and "TK" is located on the right side of Tank B.
- A "1-1/2\" valve" is located on the line between the pressure points and Tank B.
- A circled number "2" is at the bottom right.

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100 PERCENT UNH CONCENTRATORS

NOTE A
 1. BLANK ALTERNATE CONCENTRATOR INLET & OUTLET PIPING TO PREVENT CROSS-CONTAMINATION OF E. METAL AND NORMAL URANIUM STREAMS
 2. NEW PIPING PER SPEC. NWS-5500

LEGEND

— EXISTING
 — NEW

SCOPE

APPROVED
 FOR DESIGN
 NOT FOR CONSTRUCTION

STREAM COMPONENTS	(1)	(2)	(3)	(4)	(5)	(6)
UNH	55311	25311	25311	25311	25311	25311
UN	19865	421	19865	785	19865	785
HNO ₃						
H ₂ O	16874	40	16874	40	147	147
VO ₂	14420	342	14420	342	14420	342
TOTAL HEIGHT	42185	42185	25311	25311	14567	14567
PHASE	LIQUID	LIQUID	LIQUID	LIQUID	SOLIDS	SOLIDS
SPECIFIC GRAVITY	1.63	1.63	2.5	2.5		
TEMPERATURE °F	150-200	150-200	260	212		
TIME 6 IN. DE CFM	15-25	200 AVG	0.833			
VOLUME GAL/DAY	3000	3000	1200	1900		
VOLUME GAL/BATCH	3000	7500	3000	400		

NOTE 1: (1) MAXIMUM AVAILABLE CAPACITY - 150 TONS/MONTH
 MAXIMUM REQUIRED CAPACITY - 100 TONS/MONTH
 NORMAL ANNUAL AVERAGE CAPACITY - 50 TONS/MONTH
 (2) PROCESS FLOW RATES CALCULATED AT 6 TON/DAY

NOTE 2:
 1. NO CALC AS FREE WATER
 2. CALCULATED ON NITRIC FREE BASIS SINCE REBOX FEED IS 0% Q. HNO₃

SK-2-17732 1000	
U. S. ATOMIC ENERGY COMMISSION HANFORD ATOMIC PRODUCTS OPERATION GENERAL ELECTRIC	
PROCESS & ENGINEERING FLOW DIAGRAM- UO ₂ PLANT PRODUCT SEGREGATION	
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