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HDC-2524
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RECORD CENTER FILE

DESIGN SECTION

This document consists of
9 parts, No. 1

Classification Cancelled and Changed To

Process Engineering Unit

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By Authority of D. S. Lewis
CG-NMP-1, 6-27-94
By J. E. Savely 7-1-94
Verified By J. E. Savely,
7-28-94

Design Specification

BASIC DESIGN SPECIFICATION FOR "X" FILE

No. 1.10

Date: March 31, 1952

Prepared by George M. Roy

Approved by George M. Roy

Working Committee

Design Committee

Atomic Energy Commission

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Basic Design Specifications for "X" Pile

PURPOSE

The purpose of this specification is to set forth in a single document a coherent set of requirements as affected by interrelated design and operating conditions. Basic values, dimensions, and other parameters fundamental to establishment of design specifications for the individual reactor components are given. The asterisk symbol (*) is used to indicate those values which are not yet firm.

This document will eventually become a part of the complete "Design Specifications for "X" Reactor" to be issued later. At that time some of the information given here (such as the moderator dimensions) will appear elsewhere in the document and therefore there is some duplication. Such information was necessary to give the complete scope.

An attempt is made to give the basis or background at the end of the document. All references pertinent to the choice are probably not included.

I. Process Tubes

- a. Number - 3220
- b. Length - 28.34' active zone and 47' - 8" overall
- c. Material - 2S with 72 S cladding *
Also being considered because of added strength is 63 S
- d. Annulus Size - Area 0.438 In²
- e. Fittings
 - 1. Inlet - Enlarged over present pile design
 - 2. Outlet - 1 inch pigtail connection
- f. Tube Inlet Pressure - ~260 psig at 100,000 gpm
Tube Inlet Pressure - ~480 psig at 140,000 gpm

II. Power Output (No Enrichment)

- a. Nominal at 1300 MW
 - 1. Specific power about 28 KW/ft
- b. Maximum at 1820 MW

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III. Water Requirements

- a. Nominal flow is 100,000 * gpm and a top of riser pressure of 385* psig.
- b. Debottleneck capacity - 140,000 gpm (Top of riser pressure 585* psig)

Debottleneck capacity is defined as follows:

"Debottleneck capacity" - All pile building process piping capacity is to be designed to accommodate a flow of 140,000 gpm. Those portions of the water plant which cannot be modified economically or without extended shutdown will be sized for 140,000 gpm.

- c. Shutdown Requirements - See reference document.
- d. Power Recovery - No special design provisions are being made for power recovery. The effluent system is being designed for 75 psig (fitting - 150 psig) at a temperature of 200°F.

IV. Graphite

- a. Lattice Spacing - 7.5 inches
- b. Overall Graphite Dimensions

Inlet to outlet 33' - 5 $\frac{1}{2}$ "

Side to side 40' - 11 $\frac{1}{2}$ "

Top to bottom 40' - 11 $\frac{1}{2}$ "

- c. Coring and undercutting are planned. Pattern not yet worked out.
- d. Reflector thickness

Front and rear 2' - 6 $\frac{1}{2}$ "

Sides 2' - 6"

Top and bottom 2' - 6"

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V. Shielding

- a. Thermal .. 10 inches of cast iron all around the graphite block. Water cooled on sides, top and bottom. (Water cooled front and

rear by process tubes only.) For any given pile power level the flux on the face of the thermal shield will be taken as 3.0* times the calculated value at 450 inhours of flattening. This factor is to allow for enrichment.

- b. Biological Shield - The design level for front, sides, and top is 1 milli-rem/hr. A neutron flux of 10^3 neutrons above the normal background flux is taken as the design basis for the rear face. The design power level is 2000 MW with an enrichment factor of 3*. The value of 3 has the significance noted above. A concrete shield similar to that used in the Brookhaven Nuclear Reactor No. 1 will be used for the biological shield. Heavy aggregates used in this mix are coarse-steel punchings and limonite ore which are dispersed in a Portland-cement paste.

Shield thicknesses:

Front face - 5' - 3" includes two 1/2 inch skin plates
Outlet face - 3' - 9" includes two 1/2 inch skin plates
Sides - 5' - 3" includes two 3/4 inch skin plates
Top - 6' - 10" (63 inches of heavy-aggregate concrete and about 27 inches of ordinary concrete.)

VI. Overall Dimensions

Front to rear - 45' - 2"

Side to Side - 54' - 2"

- Bottom of packing to top of pile - 49' - 7 13/16"

VII. Control

a. Safety

1. Fifty-one (51) ball slots - 2350 in for dry pile.
2. Thirty-seven (37) vertical ~~slots~~ ^{rods} - 1315 in for wet pile and 1370 in for dry pile.

b. Operational

1. Twenty (20) horizontal control rods - 700 plus inhours for a hot, wet pile. The minimum effective radius will be 1.319 inches.
2. Twenty (20) ink tubes for supplementary control and for purposes of improving flattening. (about 400* inhours)

VIII. Fissionable Material

- a. 485 tons of Uranium in the pile when fully loaded.
- b. Enrichment - Not required for operation at nominal power. Production to be gained by enrichment of "I" has not yet been evaluated.

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The following documents give the background and bases.

I. Process Tubes

(a) Number

HDC-2413 RDA-DC-3 Program for Reactor Design and Development
Reactor Unit Design and Construction Management Section
VD Nixon/JR Wolcott

HW-22526 Variation of Pile Power with Pile Size H Neumann

HDC-2466 Interim Report RDA-DC-3 and Program X.
Jacks/Reed/Roy/Strong

HDC-2433 Determination of Optimum Annulus Size and Tube Length for
RDA-DC-3 Reactor Wetch/Foster/Roy

(b) Length

HDC-2433 Determination of Optimum Annulus Size and Tube Length for
RDA-DC-3 Reactor Wetch/Foster/Roy

HDC-2395 Proposed Longer Tube Length RDA-DC-3

HDC-2413 RDA-DC-3 Program for Reactor Design and Development
Reactor Unit Design and Construction Management
Section VD Nixon/JR Wolcott

(c) Material

HDC-2513 Permissible Design Pressures for 2S-H 14 72S Clad
Process Tubes ER Elder

for 63 S see

HW 23411 Metallurgical Evaluation of 2S and 3S Aluminum Alloy
for Process Tubes PA Johnson

(d) Annulus Size

HDC-2433 Determination of Optimum Annulus Size and Tube Length
for RDA-DC-3 Reactor Wetch/Foster/Roy

(e) Fittings

Test Data, Summary of benefits

HDC-2051 Increase of Pile Operating Level Through Use of En-
larged Pigtaills Interim Report #2 Heat Transfer Test

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(f) Tube Inlet Pressure

HDC-2433 Determination of Optimum Annulus Size and Tube Length
for RDA-DC-3 Reactor Wetch/Foster/Roy

HDC-2513 Permissible Design Pressures for 2S-H14 72S Clad
Process Tubes BR Elder

II. Power Output (No Enrichment)

(a) Nominal

Without exceeding specific power of H at about 650 MW

HDC-2433 Determination of Optimum Annulus Size and Tube Length
for RDA-DC-3 Reactor Wetch/Foster/Roy

(b) Maximum

Based increase in direct proportion to water increase.

III. Water Requirements

(a) Nominal

Not firm. Study in progress by both CT Main, Inc. and General Electric

(b) Debottleneck Capacity

Reasonable upper limit for feasible piping design, tube inlet
pressure and specific power

HDC-2433 Determination of Optimum Annulus Size and Tube Length
for RDA-DC-3 Reactor Wetch/Foster/Roy

HDC-2466 Interim Report RDA-DC-3 and Program "X"
Jaske/Reed/Roy/Strong

(c) Shutdown Requirements

HDC-2523 Shutdown Requirements RDA-DC-3 GL Locke

(d) Power Recovery

No document at present.

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IV. Graphite

(a) Lattice Spacing

Exponential Pile Experiments and calculations by Pile Physics
Summarized in HW-23097 New Lattice Spacing PF Gast

(b) Overall Graphite Dimensions

HDC-2411 Moderator Dimensions - RDA-DC-3

HDC-2400 Graphite Material Status as of 11-12-51

(c) Coring and Undercutting

No document at present

(d) Reflector Thickness

H-1-21403 Active length assumed 28.34 ft.

V. Shielding

(a) Thermal

HW-23193 Pile Shielding Specifications - JA Berberet

HW-22112 On the Neutron Flux at the Thermal Shield - H. Neumann
and calculations in progress

(b) Biological Shield

HW-23193 Pile Shielding Specifications - JA Berberet

HDC 2463 Preliminary Data on the Scope and Design of the
Biological Shield for RDA-DC-3 and Program "X" HS Davis

VI. Overall Dimensions

Dwg. No. H-1-21403

VII. Control

(a) Safety

1. HDC-2462 Safety Control System for RDA-DC-3

HW-23323 RDA-DC-3 Control and Safety Requirements

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VII. Control (Continued)

HW-23502 Comments on Drawing #H-1-21403

HDC-2499 Safety System for RDA-DC-3 Reed/Robinson/Roy

2. Same as above

(b) Operational

1. HW-23323 RDA-DC-3 Control & Safety Requirements JR Triplett

2. H-1-22260

HW-19420 Final Report Ink Facility Development RA Horton, et al.

VIII. Fissionable Material

(a) Based on 250 tons for 2004 tube pile

(b) Enrichment

HDC-2433 Determination of Optimum Annulus Size and Tube Length
for RDA-DC-3 Reactor Wetch/Foster/Roy

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