ABB
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February 13, 1991
ML-91-007

Docket No. 70-1100
License No. SNM-1067

Mr. Charles J. Haughney, Chief
Fuel Cycle Safety Branch
Division of Industrical and Medical
Nuclear Safety
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Subject: Centrifuge Amendment - Revised Information

References: A) Letter, G.H. Bidinger (NRC) to R.E. Vaughan (CE), dated January 14, 1991

B) Letter, J.F. Conant (CE) to C.J. Haughney (NRC), LD-90-081, dated October 25, 1990

Dear Mr. Haughney:

This letter responds to a Nuclear Regulatory Commission request (Reference A) for additional information. The request is in regard to a Combustion Engineering request (Reference B) for authorization to operate a low level liquid waste centrifuge relocated as part of the Windsor Nuclear Manufacturing Facility revitalization program. The information requested is provided in the Enclosures to this letter.

Enclosure I contains a list of license application pages affected by incorporation of the additional information. Enclosure II contains the proposed change pages. Six (6) copies of the enclosures are provided herewith for your use.

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If I can be of any further assistance, please feel free to contact me or Mr. C. M. Molnar of my staff at (203) 285-5205.

Very truly yours,

COMBUSTION ENGINEERING, INC.

Charles M. Molnar

for John F. Conant
Manager
Nuclear Materials Licensing

JFC:cmm

Enclosures: As stated

xc: J. Roth (NRC - Region I)
S. Soong (NRC)

Enclosure I to
ML-91-007

COMBUSTION ENGINEERING, INC.

WINDSOR NUCLZAR FUEL MANUFACTURING FACILITY

LIST OF AFFECTED PAGES

February, 1991

COMBUSTION ENGINEERING, INC.

WINDSOR NUCLEAR FUEL MANUFACTURING FACILITY

LIST OF AFFECTED PAGES

Combustion Engineering requests that the license for its Windsor Nuclear Fuel Manufacturing Facility (SNM-1067) be amended to allow use of a relocated low level liquid waste centrifuge within the controlled access area (Pellet Shop). Information provided previously with respect to this amendment request (October 25, 1990, LD-90-081) has been updated to respond to an NRC request for additional information. The pages provided herewith supersede in their entirety amendment pages provided in our previous submittal on this subject. Changes are denoted by a bar in the right hand margin of each affected page. The affected pages are provided in Enclosure II.

The license application pages affected are as follows:

List of Affected Pages

Delete Page			Add Page		
Page No.	Rev.	Date	Page No.	Rev.	Date
I.4-16A	0	08/16/88	I.4-16A	1	02/13/91
II.8-18	5	08/16/88	II.8-18	6	02/13/91
II.8-19	3	08/16/88	II.8-19	4	02/13/91
--	-	--	II.8-19A	0	02/13/91
--	-	--	II.8-19B	0	02/13/91
--	-	--	II.8-19C	0	02/13/91
--	-	--	II.8-19D	0	02/13/91
--	-	--	II.8-19E	0	02/13/91
II.8-20	3	08/16/88	II.8-20	4	02/13/91
--	-	--	II.8-44A	0	02/13/91
--	-	--	II.8-44B	0	02/13/91
--	-	--	II.8-44C	0	02/13/91
--	-	--	II.8-44D	0	02/13/91
--	-	--	II.8-44E	0	02/13/91

Enclosure II to
ML-91-007

COMBUSTION ENGINEERING, INC.

WINDSOR NUCLEAR FUEL MANUFACTURING FACILITY

AFFECTED PAGES

February, 1991

4.3.20 All storage containers of UO_2 5 gallons or less located outside of hoods or in storage spaces shall be covered. Any storage containers accidentally internally moderated shall be handled as individual mass units and stored in the concrete block storage area.

4.3.21 The UNC-2901 Shipping Containers mounted on the shipping pallet can be opened only one at a time when located in an area free of other fissile material. This area shall be at least 21 ft^2.

4.3.22 The filled press feed hoppers can only be stored or placed in designated areas. Only one filled press feed hopper can be in transit on the pellet shop main floor and one can be in transit on the press feed mezzanine.

4.3.23 The maximum internal volume of the centrifuge shall be 22.0 liters. Other fissile material shall be separated from the centrifuge by at least one foot.

4.3.24 The maximum internal thickness of the slant (storage) tank for the certrifuge system shall be $\leq$4.15 inches.

From Figure 1.E.16 of UKAEA Handbook AHSB 1, the critical infinite slab thickness for 5.0% enrichment fully reflected is about 8 inches for this degree of moderation. Applying the safety factor of 1.2 yields an allowable slab thickness of about 6.7 inches. Accordingly, the rod transfer cart with two 5.5 inches deep boxes is safe as long as the rods are not stacked higher than 6 inches in each box. Carts may be placed alongside each other, or will be spaced a minimum of 1 foot from other fissile material.

8.3.4 Transfer of Material

Material may be transferred on carts which accommodate one mass or slab limited SIU, or may be transferred by hand, one SIU at a time. Carts used for mass limited SIU's shall provide for centering of the unit, and shall measure at least 2.6 feet on a side as specified in Table 4.2.6. Because most spacing areas do not extend beyond the physical boundary of the equipment, spacing between transfer carts and the equipment is of no concern. In cases where the spacing area entends beyond the equipment boundaries, such extends beyond the equipment boundaries, such as the storage facilities, the spacing boundary will be indicated by a colored line. The line may be crossed by carts only when they contain no more than one mass or slab limited SIU, and then only to permit an operator to transfer that SIU to an available storage position.

8.4 Pre-treatment of Low Level Liquid Wastes

Aqueous wastes from low level radioactive cleanup operations such as mop buckets and decontamination solutions are processed through a system designed to remove particulate matter. This system consists of a prefilter and dump tank, a high efficiency (double concentric bowl) centrifuge, a slant storage tank, an open faced ventilated hood, a drying oven, and sundry valves, piping and pumps. Figure 8.14 shows a sketch of the liquid waste processing system layout in the Building 17 Annex. Access to the open face ventilated hood is on the long side facing away from the slant storage tank. The 96 inch long hood has three regions. On the right and left hand sides are work surfaces about 42 inches above the floor. The left hand work surface is about 22 inches in width and 42 inches in depth; this surface is used in the dismantling and cleaning of the centrifuge. The right hand surface is approximately 40 inches in width and 54 inches in depth over the majority of the width. A removable drying oven, approximately 30 x 27 inches, is normally located at the back of this work surface. The front part of the work surface contains a covered powder funnel attached to a 6 inch diameter flexible hose which is inturn coupled to a five gallon bucket sitting at floor level in a fully enclosed bottom section of the region of the hood. An access door on the face side of the hood permits access to the bucket. The central region of the hood contains the Westfalia Clarifier (centrifuge) bolted to a pad on the concrete floor.

The clarifier bowls are below the 42 inch high working levels of the adjacent sections of this hood.

Contaminated liquids are batch processed by this system until sampling checks verify that the activity level is below a specific threshold prior to pumping the contents of the slant (storage) tank to the Building 6 liquid holding tanks. Solids removed from the prefilter and centrifuge are handled and processed as dirty residue (contaminated scrap) material. The overall process is depicted in the flow chart of Figure 8.15. A more detailed description of the process and equipment follows.

The principal components of the liquid processing part of the system are as follows.

1) Prefilter and Dump Tank - The prefilter is located at the inlet to the dump tank and consists of a 20 mesh (0.034") screen backed up by a coarser mesh screen for mechanical support. The dump tank has a capacity of 5 gallons, and is raised above the floor far enough (~9 inches) to provide gravity feed to the dump tank pump.

2) Dump Tank Pump - This pump is located at floor level and is used to pump the contents of the dump tank into the centrifuge. This pump is non-reversible. A check valve is in the outlet line to prevent back flow to the dump tank.

3) Centrifuge - The centrifuge is a Westfalia Clarifier manufactured by Westfalia Separator AG. It is a high efficiency, twin (concentric) bowl system having a total capacity of 19 liters. The bowls are concentric as illustrated in Figure 8.16.

4) Centrifuge Hood - The centrifuge hood is an open face hood which provides forced ventilation to the drying oven, centrifuge, and centrifuge cleaning operation. This hood also minimizes the amount of water incident upon the centrifuge and peripheral equipment within the hood from water emanating from the fire sprinkler system.

5) Slant Tank - The slant tank is a slab geometry stainless steel (304) storage tank. The outer length and breadth are approximately 48 x 54 inches, the internal thickness is ≤4.0 inches, and the wall thicknesses are 11 guage (0.125"). The tank has five internal welded angle struts to preserve the thickness dimension. One strut is at the center and two along each main diagonal, each of the latter being two thirds of the way from the corner to the center strut. Access ports are provided in one of the major surfaces for inspection. Fittings are provided for inlets, outlet, vent line, and a sight glass line. The tank is in a near horizontal plane; two top diagonally opposite

corners are at an elevation of approximately 49 inches and the remaining two are at 52 and 46 inches. The outlet is in the bottom face at the bottom most corner. The inlet and vent fittings are in the upper surface near the highest corner. The sight glass fitting is near the exit fitting. The tank employs 1-1/2" x 1-1/2" x 1/4" angle stiffeners along the diagonals beneath the lower surface. In addition to the four corner legs and bracing, a center support leg is employed to supplement the diagonal stiffeners.

6) Overflow Tank - The overflow tank is on the floor, made of stainless steel, and has a capacity of ≤5 gallons. The large diameter overflow line exiting the slant tank and going to the overflow tank serves both as a vent and overflow to the slant tank. The overflow tank also receives overflow liquid from the centrifuge via the drain line from the lower housing of the centrifuge and a drain line from the floor of the center region of the hood that surrounds the upper part of the centrifuge.

7) Circulating Pump - The circulating pump is employed to recirculate the liquid from the slant tank to the centrifuge. Flow from the centrifuge to the slant tank occurs as a result of the pumping action of the operating centrifuge. When the contents of this system are sufficiently clarified, this pump continues to pump the liquid from the slant tank to the centrifuge and the centrifuge output is diverted from the slant tank to the line going to the Building 6 holdup tanks. This pump is non-reversible. The check valve in the outlet line of the circulating pump prevents backflow through this pump.

The above components are plumbed and valved in the manner illustrated in Figure 8.17. Typical system operation is as follows:

The waste liquid is poured through the prefilter to the dump tank. When the dump tank pump is turned on, the contents of the dump tank are transferred to the centrifuge. The centrifuge is normally operating; if the centrifuge is not turned on and the bowls are full, the water will spill through the overflow rather than go to the slant tank. The pumping action of the centrifuge is required for the excess liquid flowing to the centrifuge to be directed to the slant tank. Thus, all contaminated liquid flows through the operating centrifuge prior to filling the slant tank. When the dump tank is empty, the dump tank pump is turned off.

To recirculate the contents of the slant tank through the centrifuge, the circulating pump is turned on. Recirculation through the operating centrifuge continues until the clarity of the water flowing through a sight glass in the centrifuge discharge line is judged to be acceptable. If clarity does not improve sufficiently, the centrifuge may require cleaning. If clarity is acceptable, a sample is withdrawn, dried, and counted to determine residual contamination. If not acceptable, further recirculation is carried out. If acceptable, the centrifuge effluent is diverted to the drain line going to the holding tanks at Building 6. When the slant tank is emptied, the circulating pump is turned off and the valves reset to refill the slant tank, if more liquid is available to process. If the centrifuge requires cleaning, it is turned off, dismantled, and the solids are cleaned out of the two bowls and collected in a pan and dried in the oven.

The working floor level in the vicinity of the dump and overflow tanks is raised about one inch above the concrete floor by a steel grating. This grating is contained within a large steel pan so as to contain liquid spilled in handling operations.

Nuclear Safety

Nuclear safety of the liquid waste processing system is predicated on the following observations and conclusions. It will be noted that the primary barrier against criticality is the use of geometrically favorable containers. Secondary barriers consist of engineered design features and administrative controls.

1) The prefilter in the dump tank screens out particles larger than 0.034 inches from entering the dump tank.

2) The dump tank has a capacity of 5 gallons or 18.9 liters. This value is 26% less than the critical, fully reflected volume of 25.5 liters inferred from the most conservative data of Figure 8.18 for 0.050 inch diameter pellets. In the event that the prefilter failed, the dump tank is still 15% less than the critical, fully reflected volume of 22.1 liters for the optimum pellet diameter of 0.3 inch diameter pellets. The bottom of the dump tank is about nine inches off the floor, consequently the likelihood of full reflection is small as is the likelihood of having the 0.3 inch diameter pellets uniformly distributed throughout the volume of the dump tank with a water to oxide volume ratio of about 2.8.

3) All solution pumped into the slant tank has passed through the operating centrifuge. Therefore, the larger particles should be removed from the solution entering the slant tank providing the sludge regions of the centrifuge bowls are not fully loaded. The slant tank has a slab geometry with a maximum solution thickness of $\leq$4.0 inches (see discussion below). In addition, the slant tank has a screen barrier around it so as to prevent the close approach of any significant moderating type material to either of the major faces of the slab.

   Under normal operating conditions, the concentration of UO2 in the slant tank is sufficiently low that it is impossible to achieve criticality regardless of the tank volume or geometry. The concentration of UO2 in the slant tank only approaches that of the solution being poured into the dump tank when the sludge volume of the centrifuge bowls approaches full capacity. Nevertheless, the slant tank geometry is set so as to preclude criticality in the event that the slant tank is fully reflected and filled with a uniform distribution of optimally sized UO2 pellets at optimum moderation.

The most conservative data of Figure 8.18 on critical slab thickness for an optimally moderated and reflected slab versus particle size shows that the minimum slab thickness occurs for particles/pellets having a diameter of 0.2 to 0.4 inches. The critical slab thickness is 4.15 inches. The corresponding water to oxide volume ratio is about 2.3. If the presence of the screen barrier is assumed to reduce the reflection of the tank by 50%, this is equivalent to an increase in the critical slab thickness of 1.6 inches for optimum moderation conditions within the tank. The slant tank is approximately four feet off the floor, consequently flooding of the surrounding area so as to reflect the tank is highly improbable. An approach to criticality, even under the postulated failure of the prefilter and centrifuge to remove UO2 particles from the solution entering the slant tank, cannot occur as long as the slant tank thickness is maintained.

The slant tank engineering design is such that dimensional changes with postulated loading of the tank are minimized. In the absence of any structural supports other than at the edge of the tank and calculating the deflections for two coupled (via five internal braces) 1/8 inch thick plates, it was estimated that the deflection resulting from a mass distribution of liquid of density 1 g/cc (pure water) would be 0.128 inches; for a contaminated solution density of 2.5 g/cc, the deflection is estimated at 0.249 inches; and for a solution density of 3.5 g/cc, the deflection is 0.333 inches. To minimize deflections, the 1.5 x 1.5 x 0.25 angle braces were run diagonally along the lower face of the tank and a central support leg to the floor was added.

In summary, the slant tank is structurally reinforced and vented so as to minimize possible deflection of the tank and enlargement of the liquid slab thickness. The critical slab thickness for optimum moderation and particle size conditions within the slant tank and assuming half reflection of the tank is conservatively estimated as 5.75 inches. This value is based on using the most adverse data of Figure 8.18 as well as the critical buckling and reflector savings data of DP-1014 for 5 w/o enriched UO2. This derived value exceeds the 4.0 inch maximum design thickness criterion for the slant tank by 44 percent.

4) The centrifuge has twin, concentric bowls with a total capacity of 19 liters. This volume is sufficiently close to that of the dump tank (18.9 liters) that the same nuclear safety arguments of item 2, above, apply.

5) As noted in the descriptive section, the hood is a three part hood. The central section is occupied by the centrifuge. The right and left sections are designated as mass limited regions; the contaminated scrap is handled under the SIU mass limits defined in Chapter 4 of Part I. The central region of the hood containing the centrifuge has a floor that is below the right and left work surfaces by about 20 inches. However, this well type area is drained by a line going to the overflow tank. It is also noted that a city water line enters the hood but the valve is exterior to the hood, thus, should the line break within the hood, it would not flood the hood.

6) The overflow tank is a five gallon, or less, capacity stainless vessel. As noted above in the discussion of item 2 (and 4) above, all scenarios involving 5 gallon or 19 liter containers are safe.

7) As noted in Figure 8.14, the centrifuge complex is located in the Annex near the stairway leading to the mezzanine. Since waste processing is planned for the mezzanine area, one pathway for waste is up the stairway over the slant tank. Therefore, scenarios of possible interest have to do with potential neutronic interaction between media on the stairway and material in the slant tank.

The stairway employs an open grill type of stair tread, thus material can fall through it. However, a barrier in the form of sheet metal has been attached to the beams supporting the stair tread and rail. Should material be spilled on the stairs and pass through the open treads, it will strike the sheet metal and slide downward away from the slant tank. One scenario of interest postulates that a 35 Kg amount of 5 w/o enriched UO_2 powder is being carried up the stairway and the 5 gallon container also has sufficient water in it to yield an optimum solution density (1.6 gU/cc) in the bottom of the five gallon container. The container is set on the stairway at the closest point of approach to the slant tank. For the geometry of Figure 8.14, the closest distance of approach is along the upper edge of tank closest to the stair tread. The minimum separation distance between the bucket and slant tank is calculated to be approximately 8 inches; the minimum separation distance between the sheet metal dust cover and the slant tank is approximately 3.5 inches.

To quantify the magnitude of the neutronic interaction between the postulated 5 gallon container of UO_2 and the slant tank, the following conservative representation was modelled in a KENO-IV calculation. The slant tank was modelled as horizontal, four feet above a 16 inch thick concrete floor, and filled with a homogeneous mixture of 5 w/o enriched UO2 and water at optimum moderation. The tank internal dimensions were taken as 48" x 54" x 4" and the walls were taken as one eighth inch thick stainless steel. Twelve-inch thick vertical water walls were assumed along the four sides of the slab tank extending from the floor to a 20 foot level. At the latter level a twelve-inch water slab was modelled. The five gallon bucket was assumed to be 11.75" O.D., 13.25" tall, and having a 28 gauge steel wall thickness. The base of the bucket was five inches above the slab tank and centered on the face of the tank. The homogeneous mixture of optimally moderated UO2 was 10.909 inches deep in the bucket. The KENO-IV computed multiplication factor, using Hansen-Roach cross sections was 0.76086 ± 0.00489.

Additional analyses were done under the assumption that the UO2 in the bucket and the slant tank is heterogeneous material having an average particle diameter of 0.325 inches. The water to oxide volume ratio in both containers was taken as 2.4 which is close to optimum for the slab geometry slant tank. The UO2 - water depth in the bucket was taken to be the same as in the previous homogeneous UO2 - water calculation. By preserving the volume of the solution in the bucket the mass of UO2 increased in the heterogeneous calculation from 35 Kg UO2 to 58.4 Kg UO2. The calculation was run versus separation distance between the bucket and slant tank. Sixteen group heterogeneous cross sections were generated by the NITAWL-XSDRNPM routines and employed in the KENO-IV code to yield the following multiplication factors versus separation distance.

Separation Distance (inches)	Keff
2	0.81741 ± 0.00488
5	0.78378 ± 0.00462

From these homogeneous and heterogeneous calculations it is concluded that interactions between material passing up the stairway, resting upon the stairway, or spilled upon the dust cover attached to the under side of the stairway result in acceptable calculated subcriticality margins.

In view of: 1) the highly conservative interactive geometry assumed between the container and slant tank, 2) postulated loadings of the mass limited container (>150 lbs of H2O/UO2) and slant tank (optimum moderation and particle size) and 3) complete reflection of array, the above analysis constitutes a worst case scenario.

8.5 Rod Loading and Assembly Fabrication

8.5.1 Pellet Stacking

Pellets from the pellet fabrication facility, or from outside vendors are placed on a table where they are aligned for rod loading. On the table, the pellet configuration is limited to the slab limit as specified in Table 4.2.5. The UO2 pellets are placed on troughs one pllet high before being loaded into rods.

8.5.2 Rod Loading and Fuel Rod Transport Carts

Pellets are transferred from stacking troughs into rods. The loaded rods are placed into carts each of which can hold up to 250 fuel rods in parallel sleeves which are spaced on four rings in an annular fixture with an I.D. of approximately 10 inches and an O.D. of approximately 22 inches. Guard rails prevent the carts from coming any closer than 3 feet center-to-center. The carts are used in normally dry areas to transfer the rods to operations which include end plug welding, weld deflashing and leak testing. The welding and deflashing operations are performed on one rod at a time. The leak testing operation is performed on two rods at a time. Welded and deflashed rods are immediately returned to the cart after each step is completed. Finished rods are fluoroscoped and are checked for enrichment with a maximum slab limit as specified in Table 4.2.5

FIGURE 8.14

CENTRIFUGE COMPLEX LAYOUT IN BUILDING 17
(DIMENSIONS ARE APPROXIMATE)

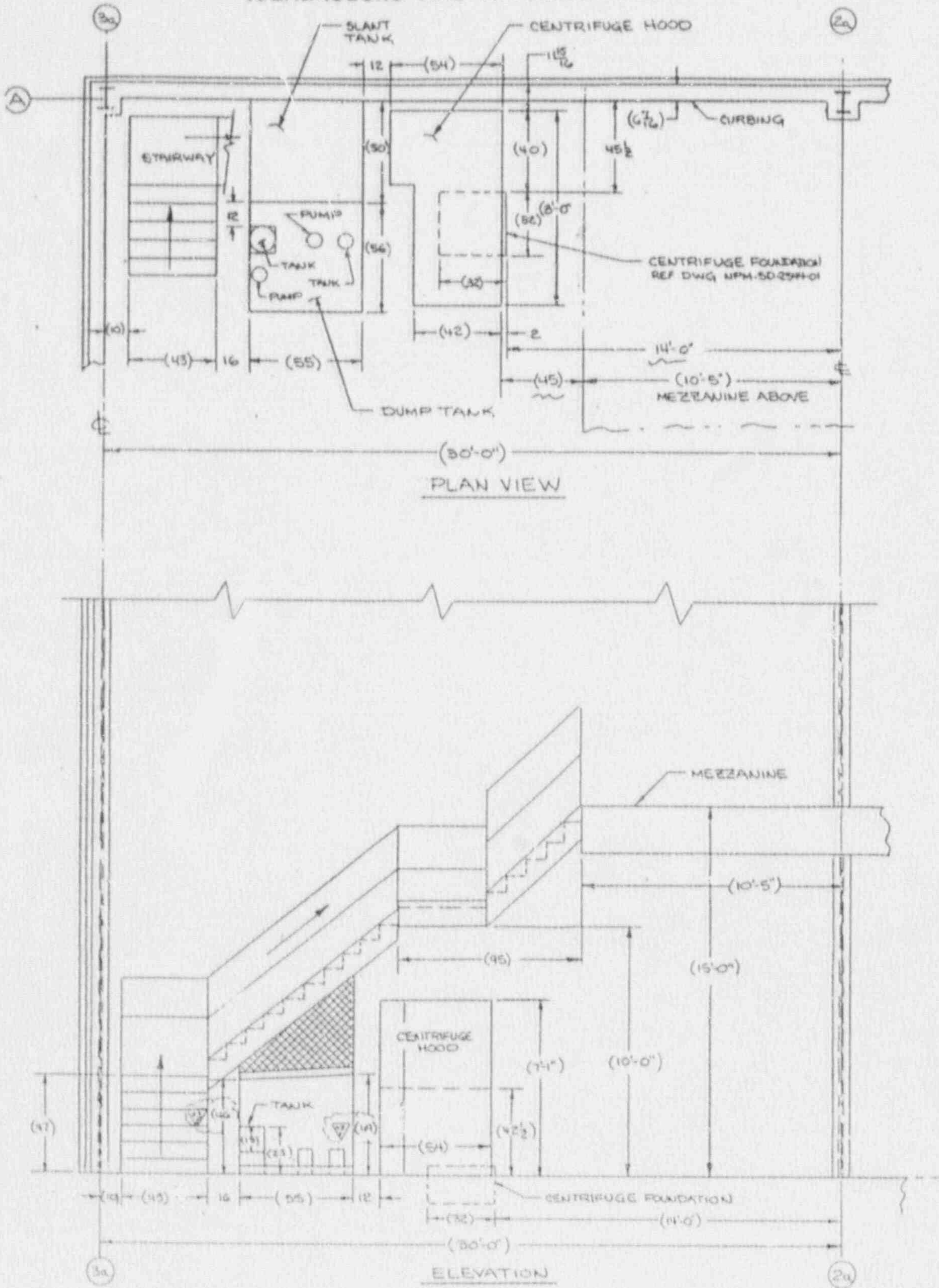


FIGURE 8.15
FLOW CHART FOR THE BUILDING 17 CENTRIFUGE COMPLEX

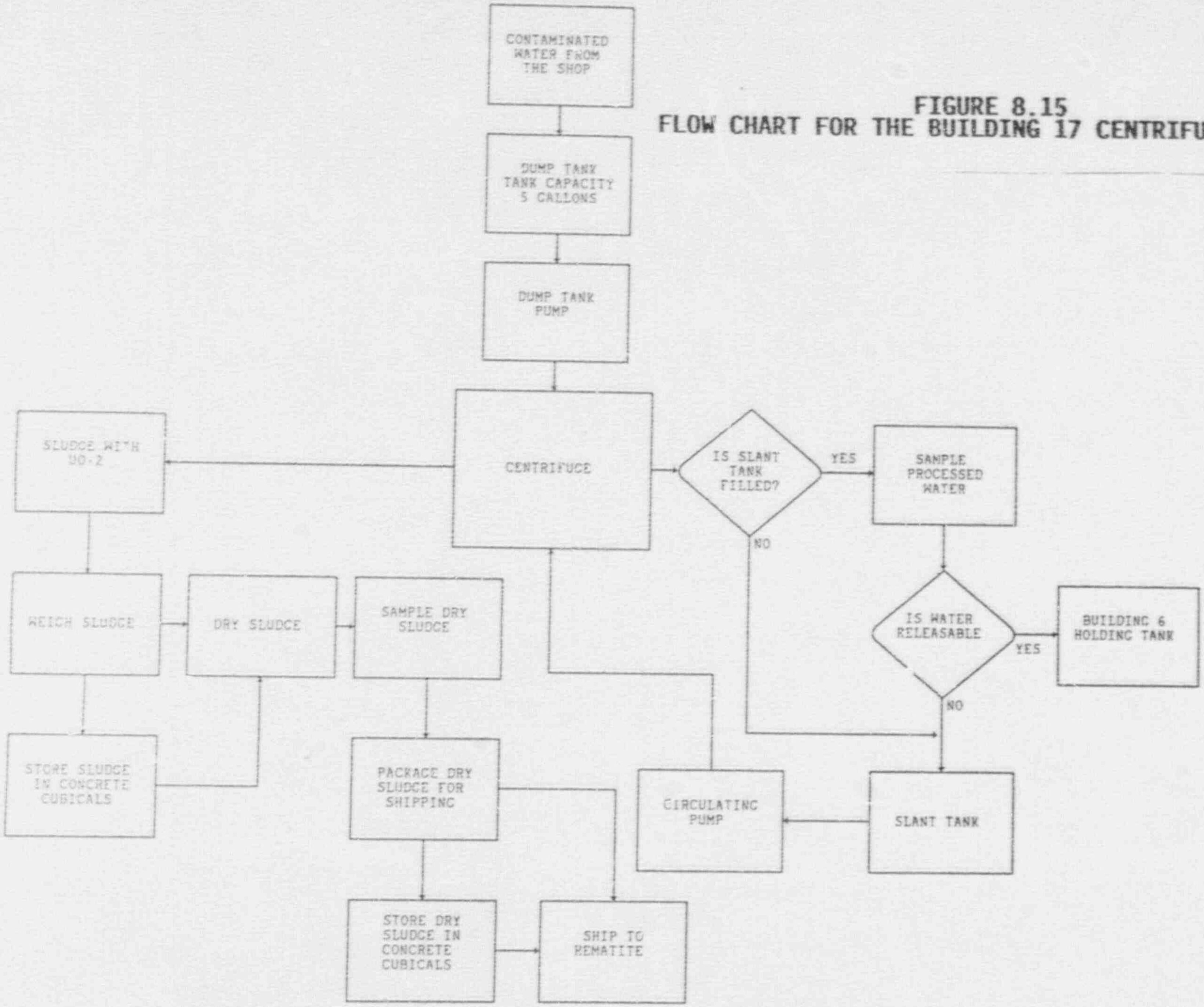
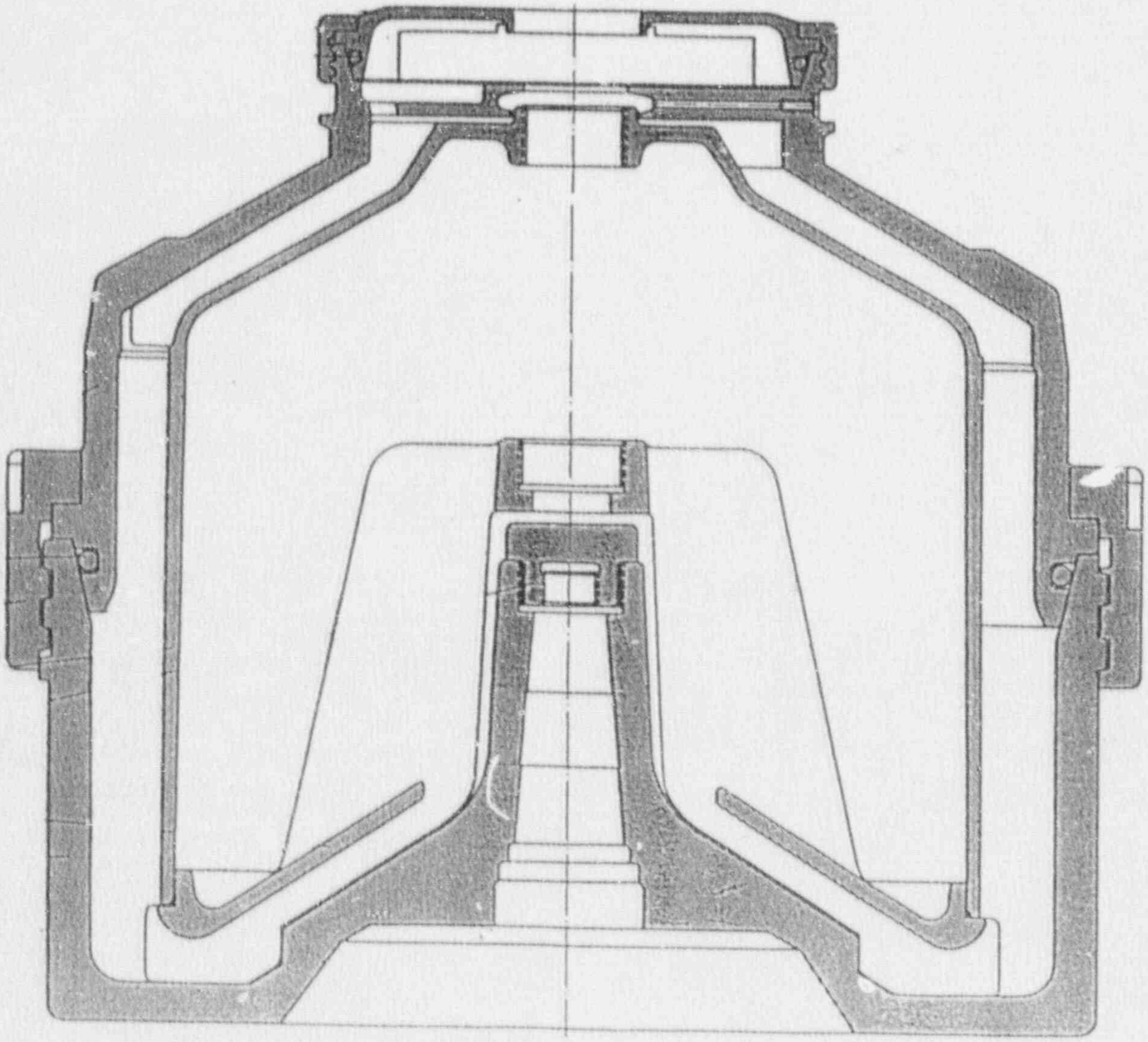


FIGURE 8.16
TWO COMPARTMENT BOWL OF WESTFALIA CLARIFER



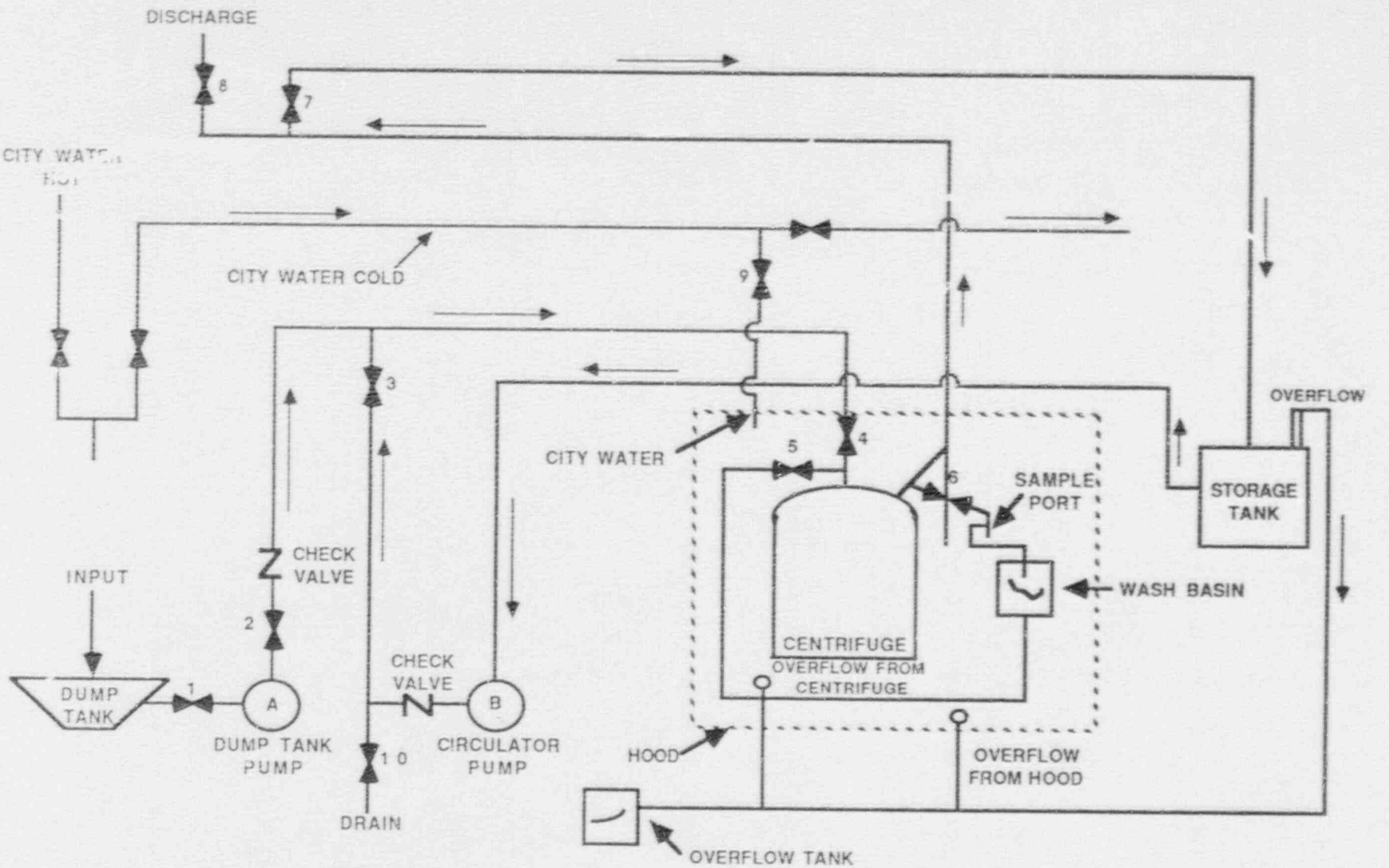


FIGURE 8.17 PIPING LAYOUT DIAGRAM FOR CENTRIFUGE COMPLEX

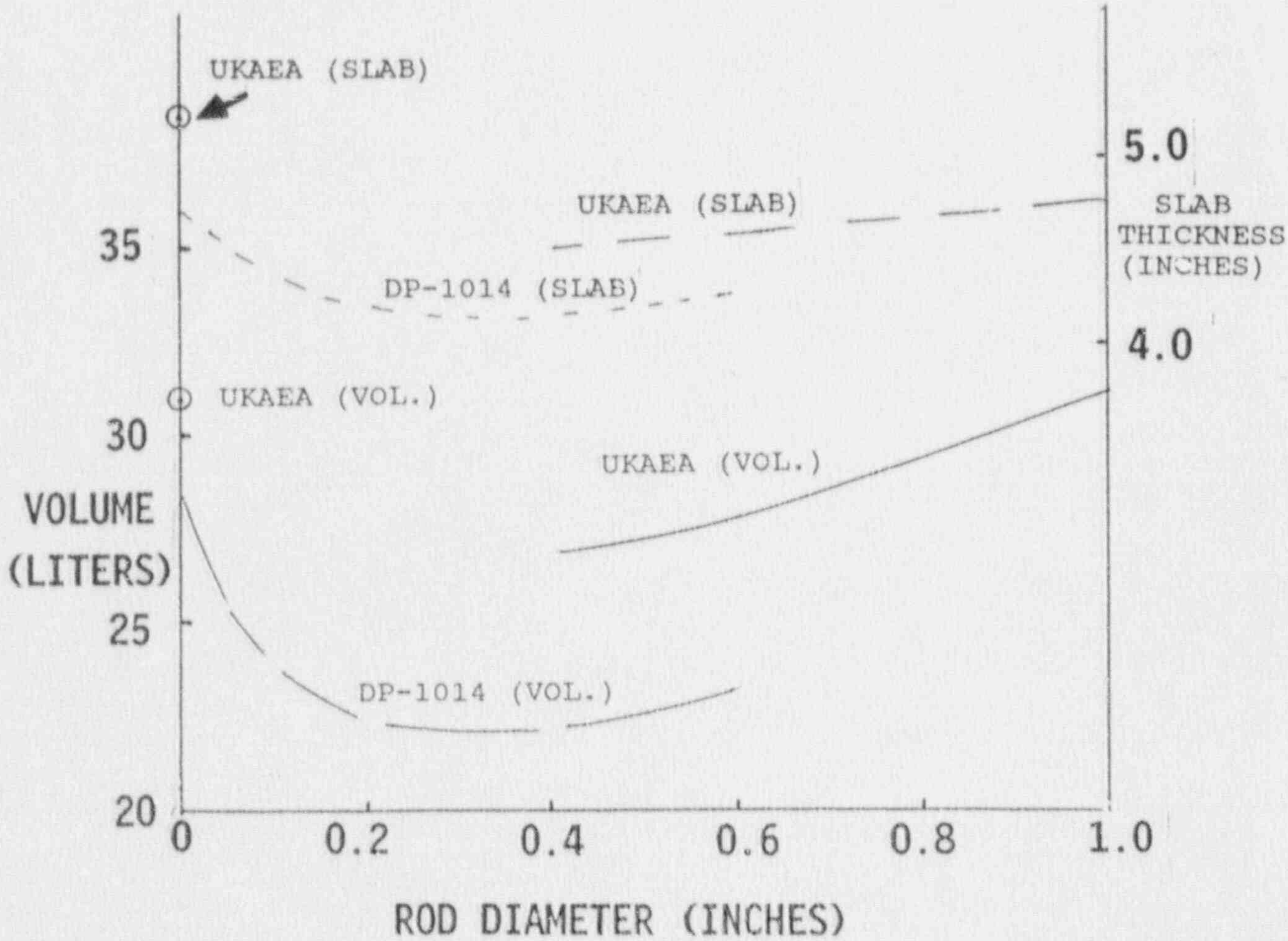

UKAEA (SLAB)
UKAEA (SLAB)
DP-1014 (SLAB)
UKAEA (VOL.)
UKAEA (VOL.)
DP-1014 (VOL.)
35
30
25
20
VOLUME
(LITERS)
5.0
4.0
SLAB
THICKNESS
(INCHES)
0
0.2
0.4
0.6
0.8
1.0
ROD DIAMETER (INCHES)

FIGURE 8.18