ATTACHMENT A

REVISED MARKED-UP AND TYPED COPIES

OF PROPOSED TECHNICAL SPECIFICATION PAGE 316a

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Add this new page

REVISION 0, JULY 1990, APPROVED
BY THE NRC SER DATED
MARCH 11, 1991

6.6.1.F.2 (Continued)

2) WCAP-8385, "Power Distribution Control and Load Following Procedures-Topical Report", September 1974 (Westinghouse Proprietary). (Methodology for Specification: Axial Flux Difference (Constant Axial Offset Control).)

3) WCAP-9220-P-A, Rev. 1, "Westinghouse ECCS Evaluation Model-1981 Version", February 1982 (Westinghouse Proprietary). (Methodology for Specification: Heat Flux Hot Channel Factor.)

4) WCAP-9561-P-A, Add. 3, Rev. 1, "BART A-1: A Computer Code for Best Estimate Analysis of Reflood Transients - Special Report: Thimble Modeling Westinghouse ECCS Evaluation Model", July 1986 (Westinghouse Proprietary). (Methodology for Specification: Heat Flux Hot Channel Factor.)

5) WCAP-10266-P-A Rev. 2, "The 1981 Version of Westinghouse Evaluation Model Using BASH Code", March 1987 (Westinghouse Proprietary). (Methodology for Specification: Heat Flux Hot Channel Factor.)

6) NFSR-0016, "Commonwealth Edison Company Topical Report on Benchmark of PWR Nuclear Design Methods," Revision 0, July 22, 1983, approved by NRC SER dated December 2, 1983. (Methodology for Specifications: ~~Moderator Temperator Coefficient~~, Shutdown Bank Insertion Limit, Control Bank Insertion Limit, Axial Flux Difference, Heat Flux Hot Channel Factor, and Nuclear Enthalpy Rise Hot Channel Factor.)

7) NFSR-0081, "Commonwealth Edison Company Topical Report of Benchmark of PWR Nuclear Design Methods Using the Phoenix-P and ANC Computer Codes," ~~latest NRC approved revision~~. (Methodology for Specifications: ~~Moderator Temperator Coefficient,~~ Shutdown Bank Insertion Limit, Control Bank Insertion Limit, Axial Flux Difference, Heat Flux Hot Channel Factor, and Nuclear Enthalpy Rise Hot Channel Factor.)

3. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

4. The CORE OPERATING LIMITS REPORT, including any mid-cycle revisions or supplements thereto, shall be provided upon issuance, for each reload cycle, to the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

6.6.1.F.2 (Continued)

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HYDRAULIC TEST REPORT

FOR

15x15 LOW PRESSURE DROP AND INTERMEDIATE FLOW MIXER GRIDS

1.0 INTRODUCTION

As part of the verification tests of the 15x15 Low Pressure Drop fuel assembly with Intermediate Flow Mixers, full scale hydraulic flow tests were performed in order to determine the hydraulic characteristics.

2.0 LOOP AND TEST HARDWARE

The tests were performed in the Fuel Assembly Compatibility Test System (FACTS). The flow diagram of this isothermal, closed-loop test system is shown in Figure 1.

Loop flow, which was measured by a venturi flow meter, was controlled by pneumatically operated bypass and series proportional control valves. Heat was injected into the system solely by the work done on the fluid by the main pump. Temperature was controlled by adjusting the flow of cooling water on the secondary side of the heat exchanger. Loop pressure was established by a pneumatically driven hydraulic pump acting against a backpressure regulator.

Tests were conducted on separate assemblies with and without IFMs. In each test, the fuel assembly was placed inside the instrumented flow housing which was contained within the pressure housing. A thimble plugging device was inserted into the assembly to simulate fuel assembly outlet hydraulic conditions. Water circulating in the loop entered the pressure housing at the bottom, flowed upward through the fuel assembly and discharged into a plenum at the top of the pressure housing where it was directed back to the pump.

Figures 2 and 3 describe the arrangement of the differential pressure measurements for the hydraulic tests of the 15x15 LPD and LPD/IFM fuel assemblies, respectively.

3.0 INSTRUMENTATION

A digital data acquisition system was used to gather hydraulic test data. These data consisted of the following:

1. Loop fluid temperature at the flow meter.
2. Loop pressure at vessel inlet and outlet.
3. Loop flow rate.
4. Pressure differentials across test fuel assemblies.

Equipment used to record test data was calibrated as a system with the following minimum system accuracies:

	Range	Accuracy
Loop Fluid Temperature	50 - 250°F.	1.0%
Loop Pressure	0 - 250 psig.	0.5%
Loop Flow Rate	20 psid. (500-2300 gpm.)	0.5%
DP Measurements	Various	0.5%

Calibration of the differential pressure transducer system was performed prior to and checked after the tests.

4.0 TEST PROCEDURES

The hydraulic tests were performed at two different temperatures (150°F. and 250°F.) over a range of flowrates from 700 gpm to 1700 gpm. Upon establishment of each temperature, all differential pressure transducers were zeroed. After establishing each flow rate, sufficient time was allowed for the system to reach steady state before recording data. Each transducer was scanned 60 times over the sampling period by the digital data acquisition system. The mean of these scans was recorded for each transducer.

5.0 TEST RESULTS

5.1 Fuel Assembly Mixing Vane Grid Pressure Loss Coefficient

Figure 2 shows the differential pressure measurements which were used to obtain the pressure loss coefficient of the mixing vane grid. The observed values of pressure drop and loop flow at the different test temperatures were converted to pressure loss coefficients using the following expression:

$$K_x = \frac{1}{N}\left(\frac{DP_x}{DHEAD} - \frac{fl_x}{De}\right)$$

with

$$DHEAD = \frac{\rho V^2}{2g}$$

where:

- RHO : Fluid density, lbs/ft^3
- V : Fluid velocity, ft/sec
- g : Gravitational constant, 32.174 ft-lb$_m$/sec^2-lb$_f$
- DHEAD : Dynamic head, psi
- De : Equivalent diameter, inches

f : Friction factor
DP_x : Pressure differential measured by differential pressure transducer "x", psi.
l_x : Friction length of fuel rod bundle in measurement zone of DP_x, inches
N : Number of grids in measurement zone of DP_x
K_x : Pressure loss coefficient derived from DP_x

The pressure loss coefficient of the mixing vane grid is shown in Figure 4. Using a least squares procedure, these data were fit to the following equation:

$$K = [\qquad\qquad]^{+} \qquad (b, c)$$

Extrapolating the equation to a Reynold's Number of 500,000 gives a mixing vane grid pressure loss coefficient of [ ]$^{+}$ (b,c)

5.2 Intermediate Flow Mixer (IFM) Grid Pressure Loss Coefficient

As shown in Figure 3, there are three IFM grids in the fuel assembly. Figure 3 shows the differential pressure measurements which were used to obtain the pressure loss coefficient of the IFM grid. Several measurements included the effects of mixing vane grids. By subtracting the appropriate multiple of the value of the mixing vane grid loss coefficient determined above, the pressure loss coefficient of the IFM was obtained. The pressure loss coefficient of the IFM grid is shown in Figure 5. Using a least squares procedure, these data were fit to the following equation:

$$K = [\qquad\qquad]^{+} \qquad (b, c)$$

Extrapolating the equation to a Reynold's Number of 500,000 gives an IFM grid pressure loss coefficient of [ ]$^{+}$.(b,c)

FACTS FLOW DIAGRAM

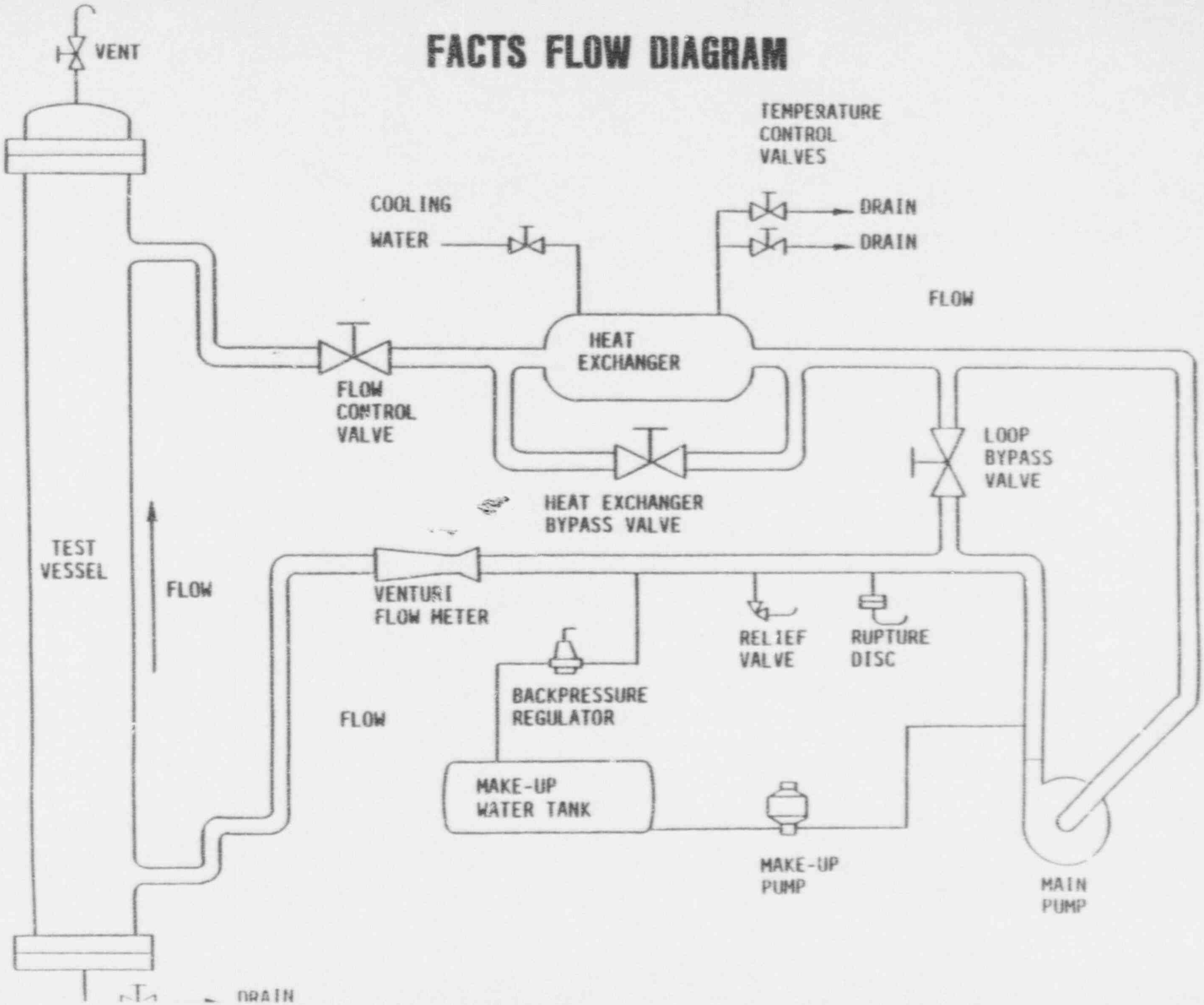
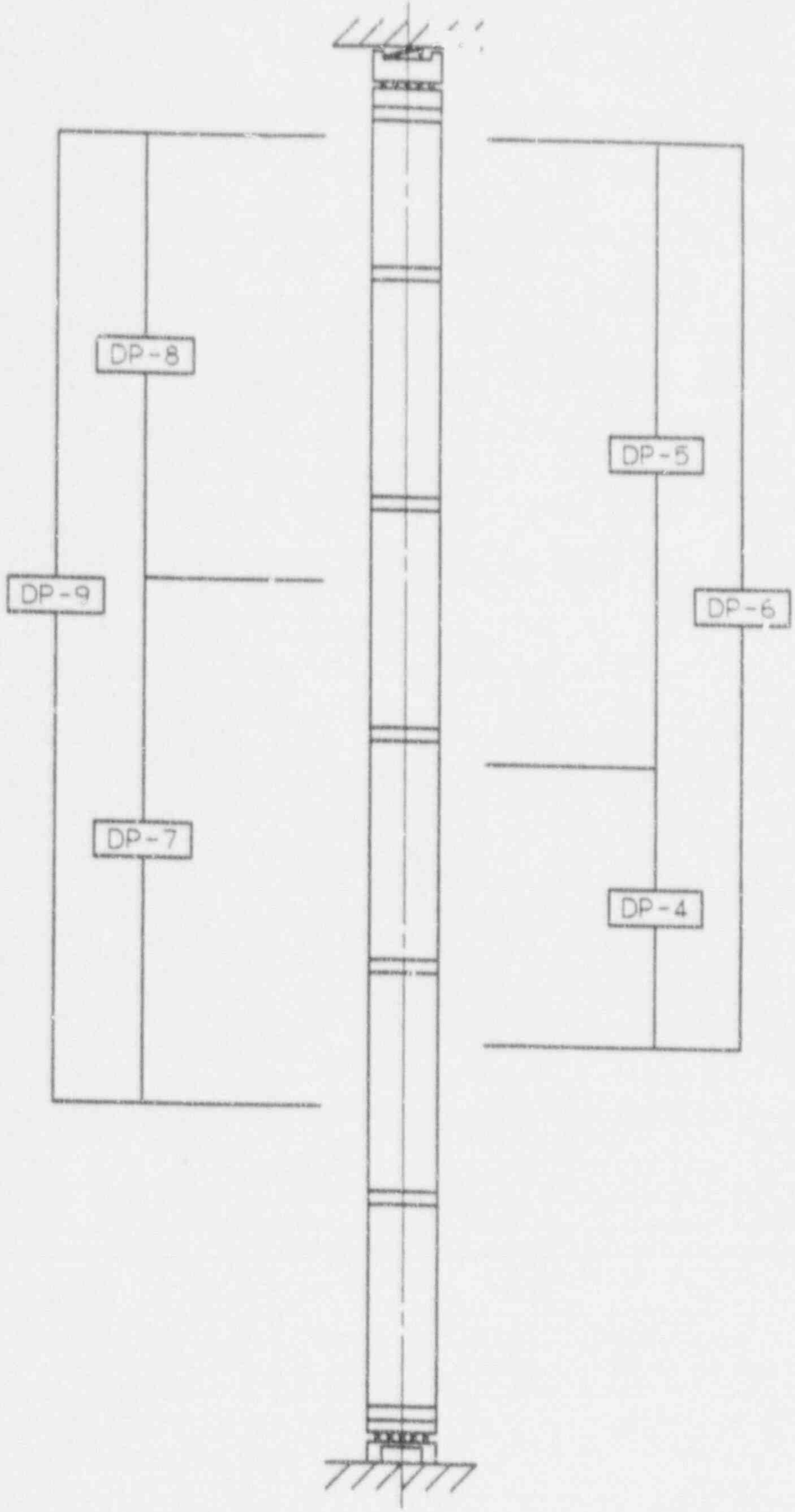
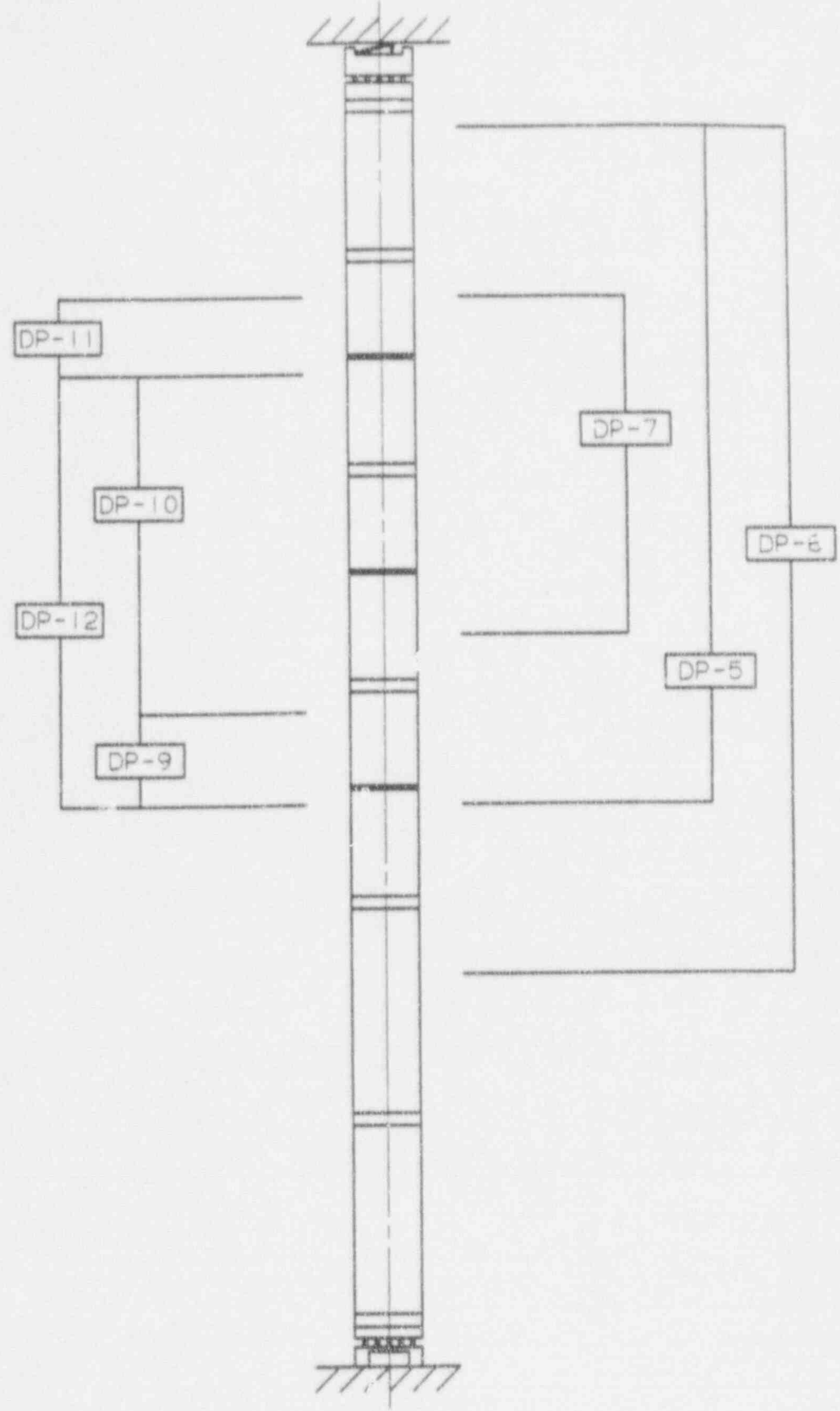


FIGURE 1



FACTS PRESSURE TAP LOCATIONS
15x15 LOW PRESSURE DROP FUEL ASSEMBLY (LPD)

FIGURE 2



FACTS PRESSURE TAP LOCATIONS
15x15 LOW PRESSURE DROP FUEL ASSEMBLY WITH IFMs (LPD/IFM)

FIGURE 3

ATTACHMENT C

PROPRIETARY DOCUMENTATION ASSOCIATED WITH

WESTINGHOUSE HYDRAULIC TEST REPORT

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