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November 21, 1978

Mr. R. E. Tiller, Director
Reactor Operations & Programs Division
Idaho Operations Office - DOE
Idaho Falls, ID 83401

TRANSMITTAL OF FINAL REPORT ON 3-D EXPERIMENT PROJECT AIR-WATER UPPER PLENUM TESTS - RDW-100-78

Dear Mr. Tiller:

Attached is the final report for the Air-Water Upper Plenum Tests. The report covers the data and analysis of the nine test groups which constituted the test program. Included in this analysis are comparisons of the experimental results to TRAC computer code simulations for several test conditions and countercurrent flooding correlations based upon the results for each test configuration.

This report terminates the 3-D Experiment Project Air-Water Upper Plenum Test Program and completes Node 20530, Page 1-73 of the Buff Book dated September 22, 1978.

Sincerely,

R. D. Wesley, Manager
Engr. Support Projects

CMM:clj

Attachment:
As stated

NRC Research and Technical Assistance Report

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FOR U.S. NUCLEAR REGULATION COMMISSION

FINAL REPORT ON
3-D EXPERIMENT PROJECT
AIR-WATER UPPER PLENUM EXPERIMENTS

NRC Research and Technical Assistance Report

NOVEMBER 1978

EG&G Idaho, Inc.

IDAHO NATIONAL ENGINEERING LABORATORY

DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE UNDER CONTRACT EY-76-C-07-1570

FINAL REPORT ON

3-D EXPERIMENT PROJECT

AIR-WATER UPPER PLENUM EXPERIMENTS

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ABSTRACT

This report summarizes the results from upper plenum air-water reflood behavior testing performed as part of the program to investigate three-dimensional aspects of PWR LOCA research. The test program was performed in mid-1978 by EG&G Idaho Inc. at the Idaho National Engineering Laboratory. Tests described were performed at near ambient temperature and pressure in a plexiglass vessel which included the important features of the upper core and upper plenum regions corresponding to a single fuel bundle in both Westinghouse Electric Corporation (Trojan) and Kraftwerk Union (KKU) PWR designs. The data included observed two-phase flow characteristics, particularly with regard to countercurrent flow, and cinematography of the characteristic upper plenum flow patterns.

SUMMARY

A series of air-water reflood behavior experiments has been performed by EG&G Idaho Inc. at the Idaho National Engineering Laboratory with a full size model of the upper core and upper plenum regions corresponding to a single pressurized water reactor (PWR) fuel bundle of both Westinghouse Electric Corporation (Trojan) and German Kraftwerk Union (KKU) designs. The purpose of tests performed was to increase the basic understanding of two-phase flow characteristics in the upper core and upper plenum regions of a PWR during core reflooding following a loss-of-coolant accident (LOCA). This increased understanding will help to assure optimum design and planning of subsequent experiments intended to investigate important aspects of the reflooding process.

PWR upper plenum designs include several different categories of internals. Consequently, KKU flow tests included separate test series with plexiglass models of KKU open hole upper core support plate (UCSP), support column, and control rod guide shroud upper plenum configurations. Westinghouse test series included models of Westinghouse designs for the open hole UCSP, support column, guide shroud, and stub mixer configurations. In addition, tests were performed to investigate the behavior of the UCSP to be used in the cylindrical core reflood test facility planned by the Japanese Atomic Energy Research Institute.

In a PWR undergoing reflood, it is anticipated that steam generated by elevated temperature fuel rods would entrain sufficient core region liquid water to build a significant inventory of water in the PWR upper plenum, provided that

sufficient de-entrainment occurs in the upper plenum region. Consequently, the direction of the experiments performed herein was to provide basic information on that process. The entrainment - de-entrainment process was simulated by the injection of air into the bottom of the test vessel, and water droplets into the resulting air stream.

Most air flow velocities typical of PWR reflooding steam velocities resulted in buildup and establishment of a froth layer in the test section upper plenum. This froth layer was observed to oscillate rather violently about the upper plenum outlet after a quasi-steady condition was reached. Neither phase appeared to be continuous throughout the upper plenum region, in fact, local areas with the gas phase continuous and local areas with the liquid phase continuous existed simultaneously. De-entrainment did not occur by the process of droplets striking structures, but rather by droplet growth from coalescence in the region where gas flow deceleration was occurring slightly above the UCSP. Countercurrent flow characteristics of the apparatus were found to be heavily dependent on the geometry of the upper end box, UCSP, and upper plenum structures, but were well correlated by a linear combination of the liquid and gas Kutateladze numbers:

$$(K_g)^{1/2} + A(K_L)^{1/2} = B,$$

where A and B are constants dependent on the system geometry.

Some difficulty was experienced in obtaining core region water entrainment typical of anticipated PWR reflooding values. Typical entrainment may, in fact, require heated fuel bundle regions to ensure that a liquid film does not build up on the upper ends of fuel rods.

Future tests of this nature should include one or more of the following features: 1) a heated core section to correctly simulate the core region entrainment process, 2) multibundle geometry to investigate the effects of upper plenum flow in the radial direction, or 3) facilities for injection and testing with steam and water rather than air and water.

CONTENTS

CONTENTS (CONT.)

FIGURES

FIGURES (CONT.)

FIGURES (CONT.)

FIGURES (CONT.)

TABLES

I. INTRODUCTION

Air-water upper plenum tests were conducted by the 3-D Experiment Project, Engineering Projects Division of the Water Reactor Research Directorate, EG&G Idaho, Inc., for the United States Department of Energy and Nuclear Regulatory Commission in order to provide visual evidence of PWR upper plenum flow behavior during reflood conditions and to provide data on the tendency of upper plenum liquid inventory to drain back into the core under such conditions. The results acquired provided a better understanding of the role played by upper plenum hydraulics in the postulated loss-of-coolant accident (LOCA) and contributed to the development and preliminary verification of LOCA analysis computer codes.

The analysis of postulated loss-of-coolant accident (LOCA) behavior for pressurized water reactors (PWRs) requires detailed knowledge of the hydraulic phenomena occurring during the transient. An important feature of the analysis of the reflood portion of such a transient, when coolant water covers the core and reduces fuel rod temperatures, is the behavior of water stored in the upper plenum region of the reactor vessel. This water could either exit the vessel through the hot leg nozzle or could, possibly, fall back into the core, thus enhancing the core cooling. In addition, the return of water to the core would minimize the "steam binding" problem and would allow a swifter reflood, thus minimizing fuel rod temperatures.

The rate at which upper plenum water could flow down to the core would be limited by the upflow of steam from the core. While such vertical countercurrent flow limiting (CCFL) behavior has been studied in the past, the experiments have not modeled realistic PWR geometries. Studies in such geometries are required to verify the potential for the occurrance of CCFL phenomena under reflood conditions and to develop analytical models required to describe it quantitatively.

The tests were conducted in a single fuel bundle sized vessel incorporating components representing the fuel bundle, grid spacer, upper end box, upper core support plate (UCSP), upper plenum, and upper plenum internal structures (if appropriate). Tests were conducted under flow conditions believed to be representative of PWR reflood. Configurations based upon typical U.S. and German reactor designs and a Japanese experiment design were tested. The data gathered in the tests were analyzed to provide both a qualitative description of the flow behavior above the core under reflood conditions and a preliminary data base for modeling the CCFL behavior of typical reactor vessel designs.

The following sections contain a description of the test system, including the vessel, piping, associated equipment and instrumentation, the procedures used to perform the several tests, and the results and conclusions drawn from the observation of the test behavior and the CCFL data. The appendices to this report contain the raw test data (Appendix A), an estimate of experimental error (Appendix B), a listing of the computer routines used to reduce the data (Appendix C), and the TRAC computer code model used to simulate the test vessel behavior (Appendix D).

II. TEST SYSTEM

The test system was designed to allow the testing of full size components. A one-bundle sized section of the reactor core and components above the core bundle up to and including the upper plenum were represented. Air and water flow rate capabilities were sized to allow reproduction of the full range of core flows predicted for reflood conditions. The test vessel and air and water supply subsystems were instrumented to allow the monitoring of input flows and vessel hydraulic response. A feedback control system was used to permit control of inlet flows and vessel pressure. The remainder of this section describes the details of the various test subsystems.

1. TEST VESSEL

The vessel used in the tests is shown on Figure 1. Tables I and II give the internal flow areas associated with the KKU and Westinghouse configurations, respectively. The material used for the vessel is plexiglass, with the exception of the back of the vessel which is polystyrene. Polystyrene was chosen because it absorbs less of the gamma radiation used in the density measurement system. The top and bottom vessel support plates are stainless steel.

Air was introduced to the test section through two stainless steel diffusers on opposite sides of the vessel, near the bottom. This scheme for air injection has been found to produce a nearly-uniform flow (as desired) at the top of the simulated core.

Water may be introduced into the vessel in two ways. First, the core-entrained water may be simulated by injection upward into the bottom of the core via a water injection nozzle. This device has a 14 x 14 array (Westinghouse) or 15 x 15 array (KKU) of tubes allowing direct injection into each bundle subchannel. This tubing was of sufficiently small size to force rapid stability-induced breakup of liquid jets over the range of anticipated injection rates. In order to maintain a steady state liquid inventory in the upper plenum, a second water inlet directly above the UCSP was included. This inlet introduces the water by means of slots around all four sides of the vessel, thus flooding the UCSP evenly from all directions.

The air or two-phase mixture exits the vessel through the stainless steel exit diffuser, which extends across the entire side of the vessel piece in which it is located. A number of positions for this outlet may be used, ranging from 0.3 m to 1.5 m (approximate) above the UCSP.

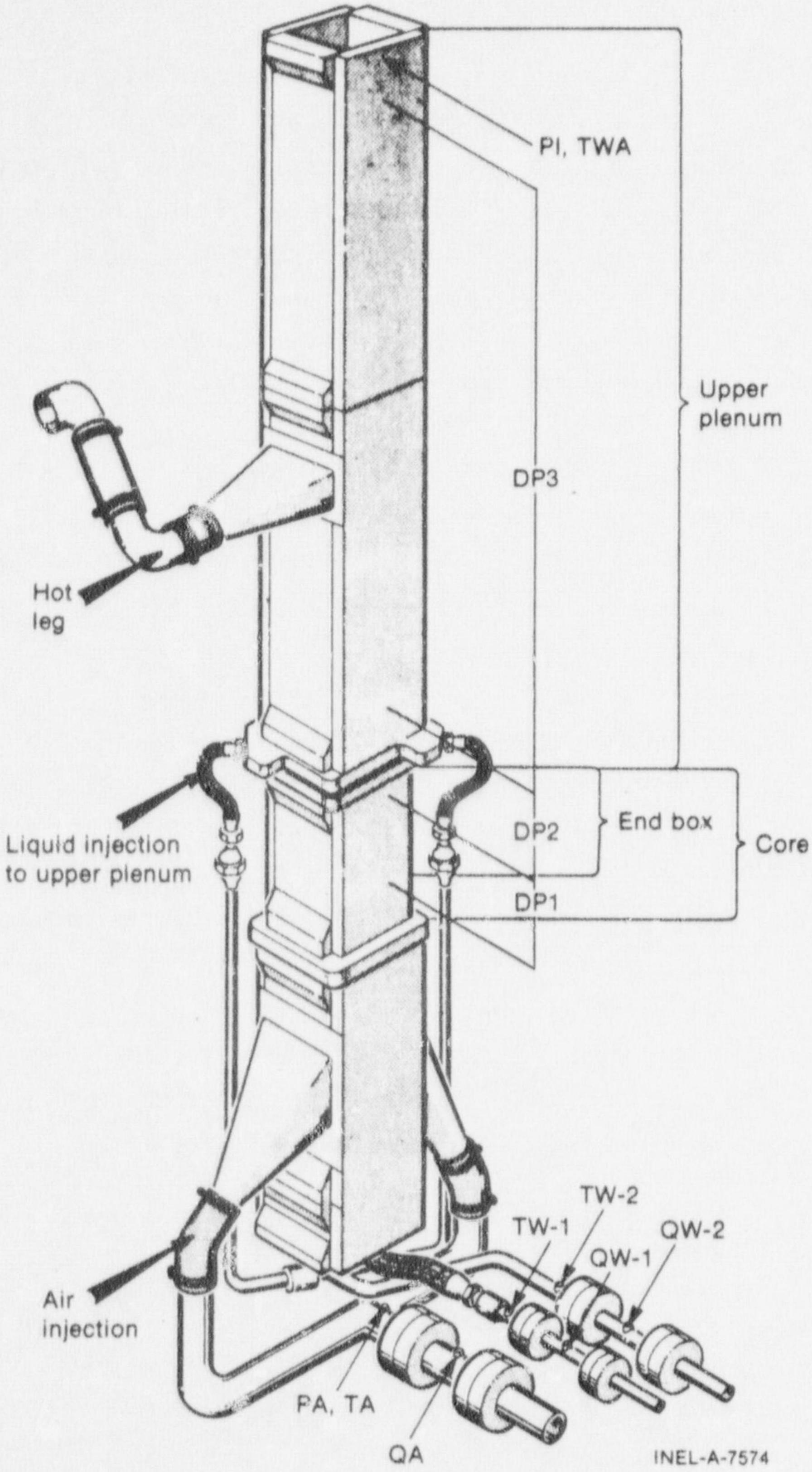


Fig. 1 Air-water test vessel.

TABLE I

INTERNAL DIMENSION, KKU MODEL VESSEL
(all dimensions in meters)

Core overall measurement	0.24mx0.24mx0.241m high
Core flow area	0.0289 m^2
End box flow area	0.0130 m^2
UCSP flow area	
round hole	0.0213
square hole (guide shroud test)	0.0194 m^2
U.P. flow area	0.071 m^2
U.P. area blockage due to internal	
support column (max blockage)	0.00811 m^2
guide shroud (max blockage)	0.0172 m^2
Outlet diffuser entrance area	0.0272 m^2
JAERI UCSP flow area (used in KKU vessel & end box)	0.0274 m^2

TABLE II

INTERNAL DIMENSION, WESTINGHOUSE MODEL VESSEL
(all dimensions in meters)

Core overall measurement	0.216x0.216m,0.305m high
Core flow area	0.0247 m^2
End box flow area	0.0156 m^2 (all tests except control rod guide shroud)
	0.0166 m^2 (test with control rod guide shroud)
UCSP flow area	
round hole	0.0213 m^2
square hole (guide shroud test)	0.0277 m^2
U.P. flow area	0.0575 m^2
U.P. area blockage due to internal	
support column (max blockage)	0.0071 m^2
guide shroud (max blockage)	0.0304 m^2
flow mixer (min flow area)	0.0095 m^2
Outlet diffuser entrance area	0.0244 m^2

Water which falls back into the core from the upper plenum gathers at the bottom of the vessel and exits to the fallback steam trap through a pipe nozzle in the bottom support plate.

The upper plenum internals used in the different test series are shown on Figures 2 through 9. Also shown are the UCSPs used with these internals. For both the Westinghouse and KKU designs, a square (or "scalloped" for the KKU model) UCSP hole design is used when the control rod guide shroud (Figures 3 and 5) is located above it, while a round hole is used for the remainder of the tests. The UCSP holes used with the two guide shroud models are shown in Figures 3 and 8. The UCSP for the Japan Atomic Energy Research Institute (JAERI) cylindrical core reflood test facility (CCRTF) is shown on Figure 9. Four holes are shown since this test facility will have electrically heated 8 x 8 rod bundles. The 16 x 16 core and end box used in the KKU tests were retained in this test to provide the flow area and core dimensions corresponding to a 2 x 2 array of the smaller bundles. In this test, no upper plenum internals were included, although scaled down internals will be used in the CCRTF experiments. The Westinghouse type end box used in the last four test groups is shown in Figures 7 and 8. Figure 7 shows the end box (with slotted flow openings) partially covered by a square plate with circular and scalloped holes in it. This plate was used in test groups W-1, W-2, and W-3, and simulates the plate which blocks and supports the control rod guide tubes in bundles without control rods. In rodded bundles, this plate is replaced by a control rod drive spider, as shown in Figure 8, which was used in test group W-3 and represents the control rod mechanism in the scrammed position. The KKU end box (not shown) consisted of a 15 x 15 array of holes aligned above the core flow channels. These holes are 1.05 cm in diameter.

2. AUXILIARY COMPONENTS

A piping schematic is shown on Figure 10. A number of components besides the vessel are shown. Among these are:

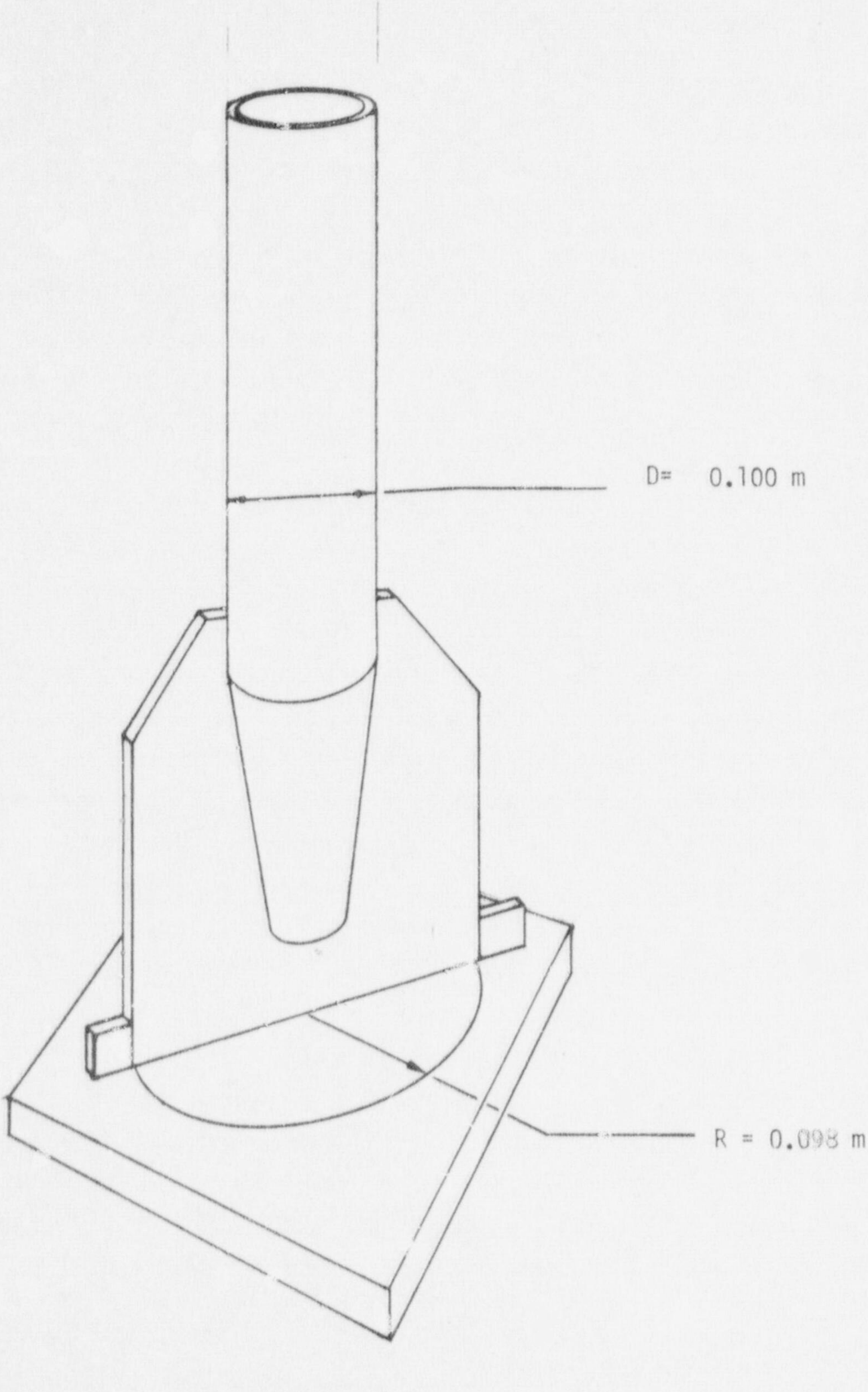
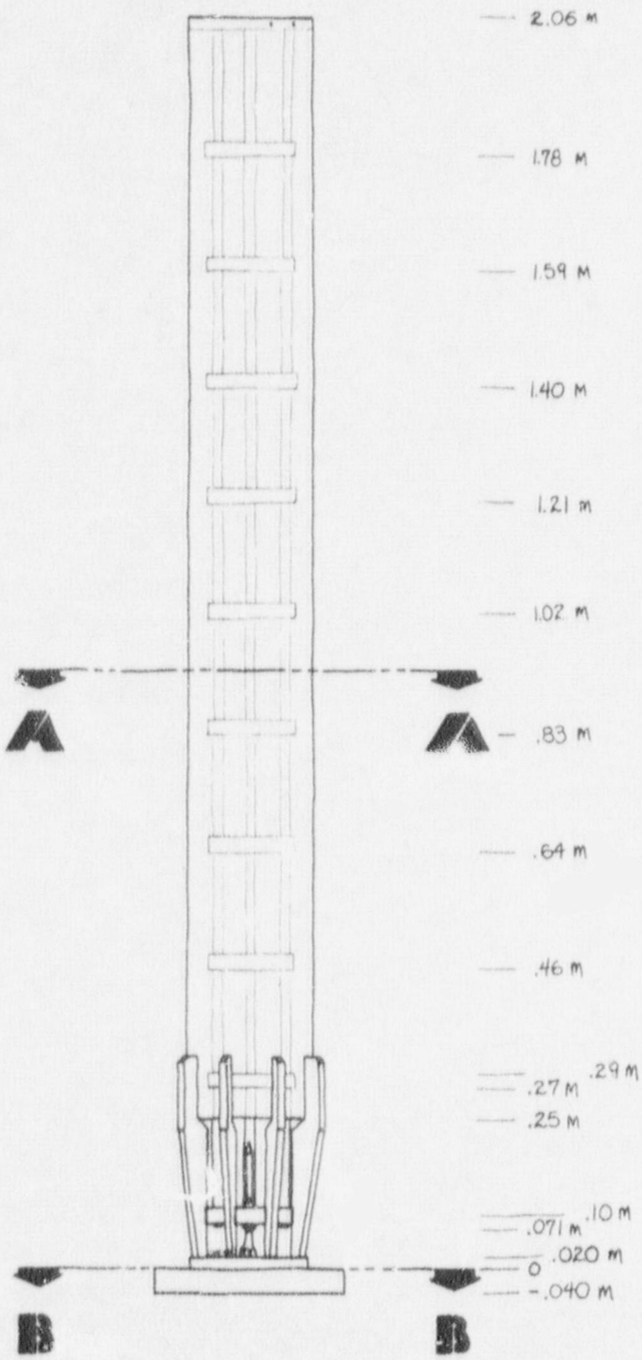
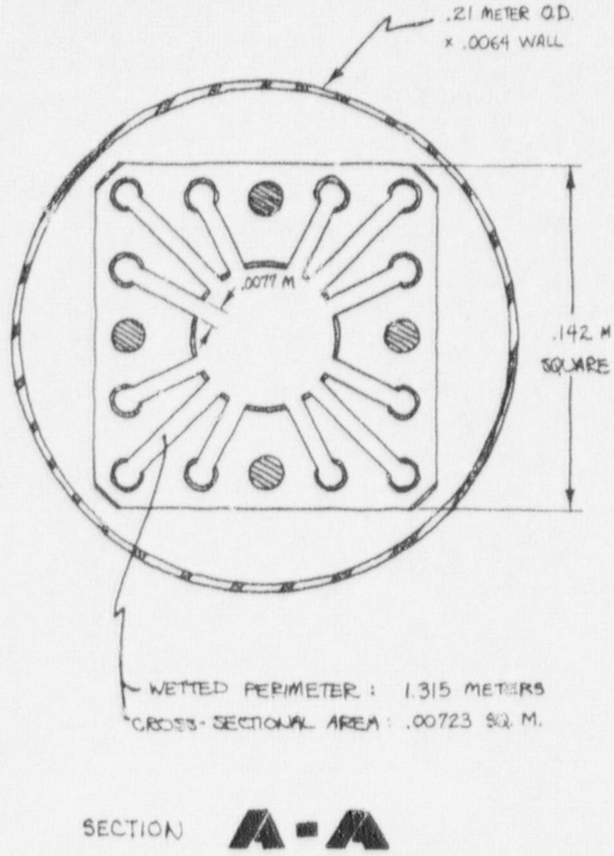


Fig. 2 KKU support column model and upper core support plate.





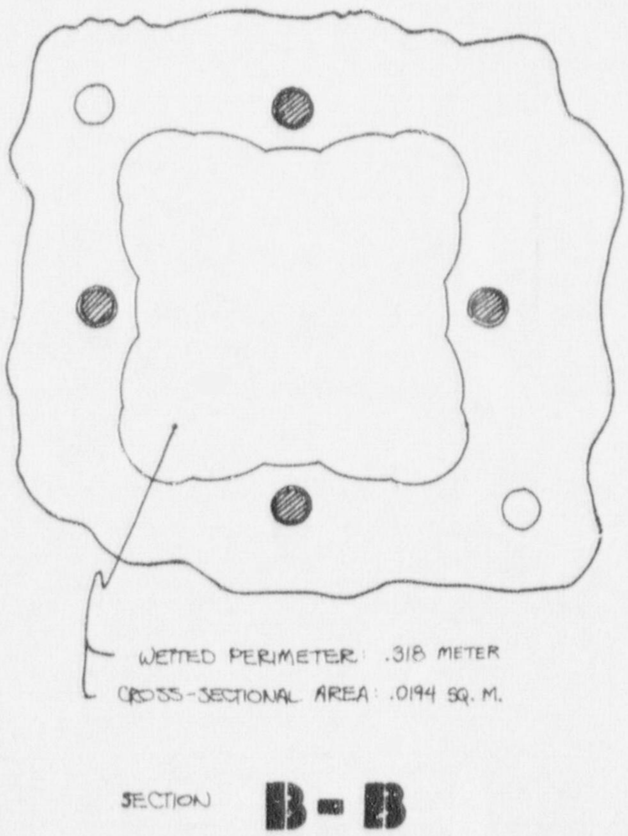


Fig. 3 KKU control rod guide structure model and core support plate.

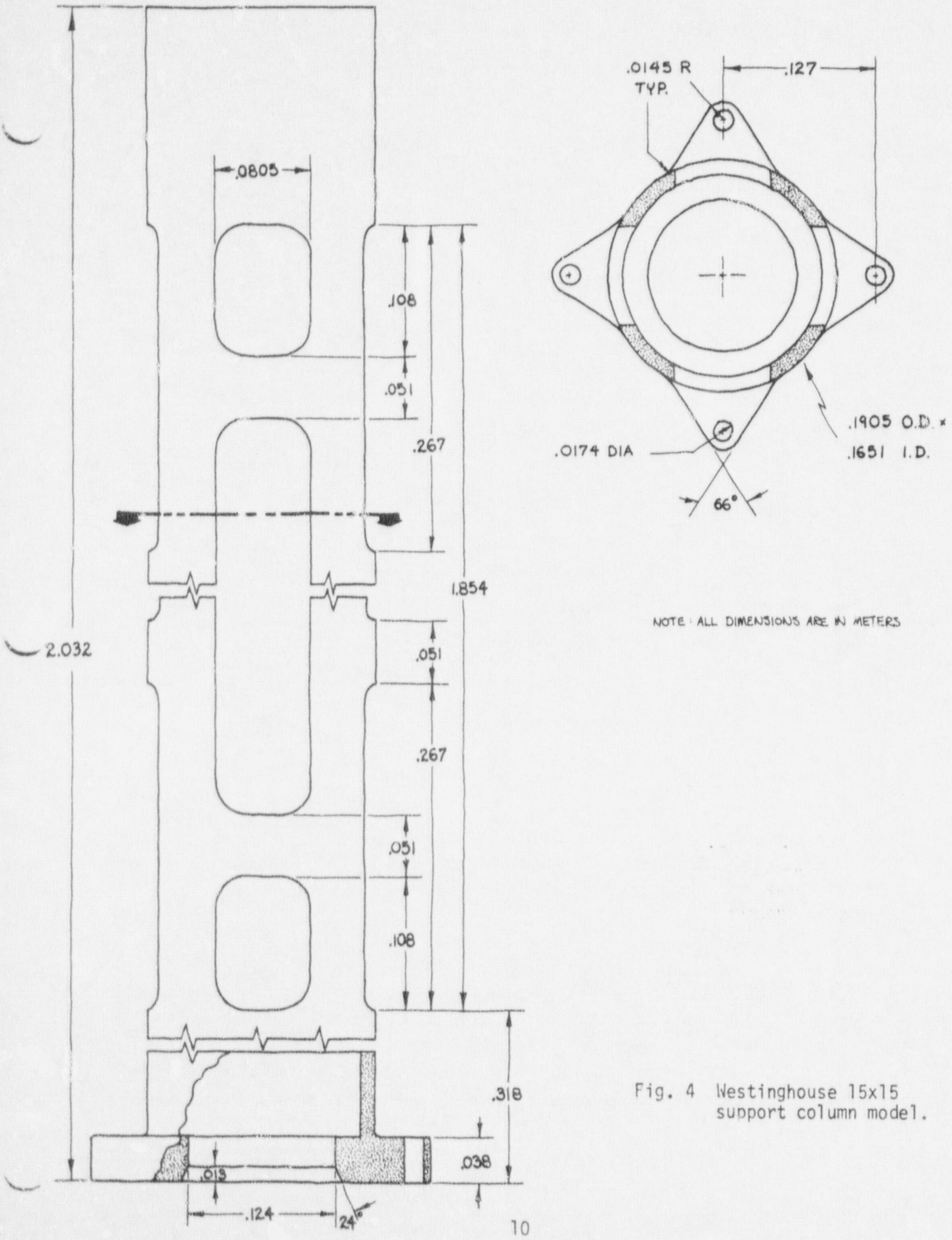


Fig. 4 Westinghouse 15x15 support column model.

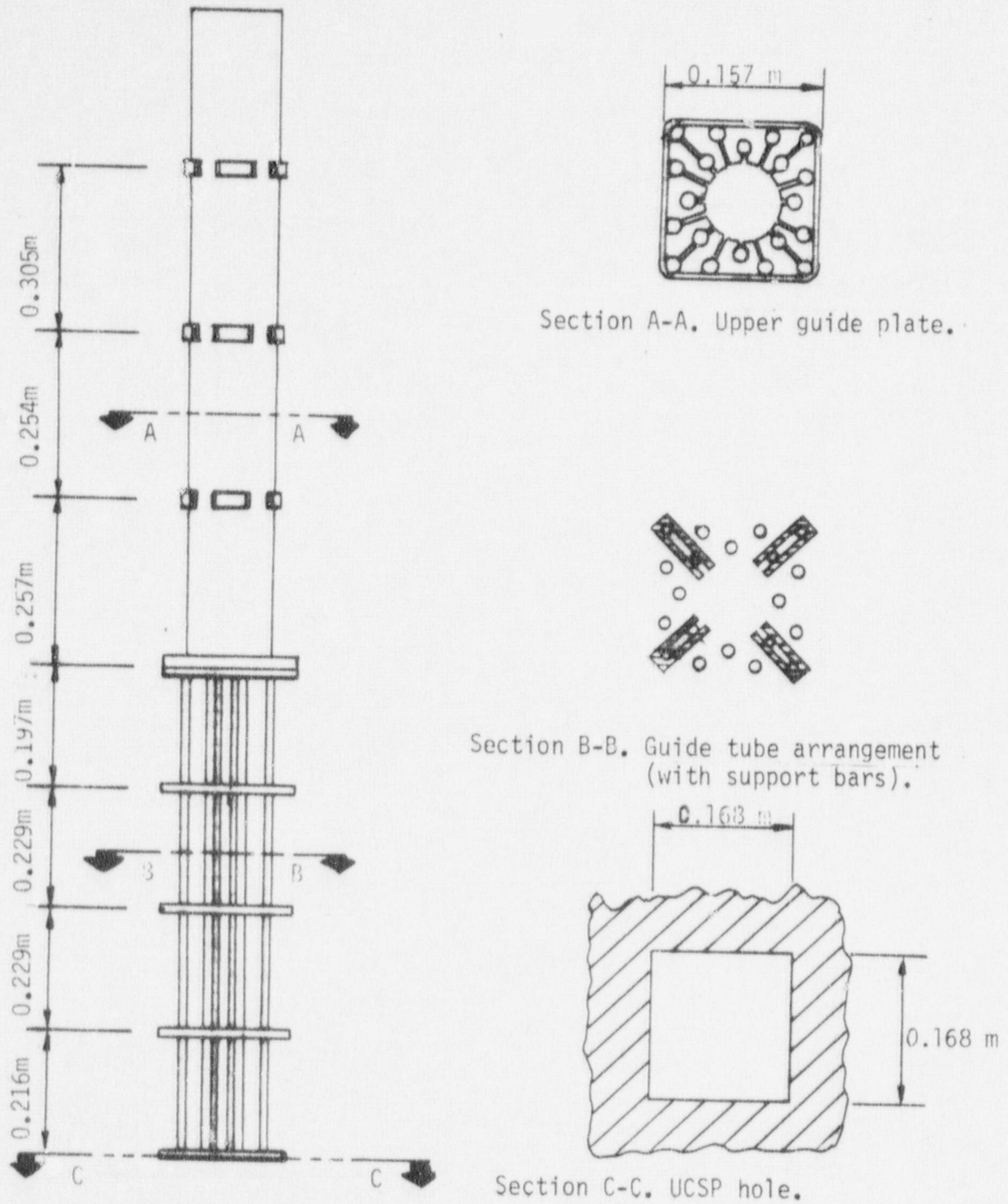


Fig. 5 Westinghouse control rod guide shroud model.

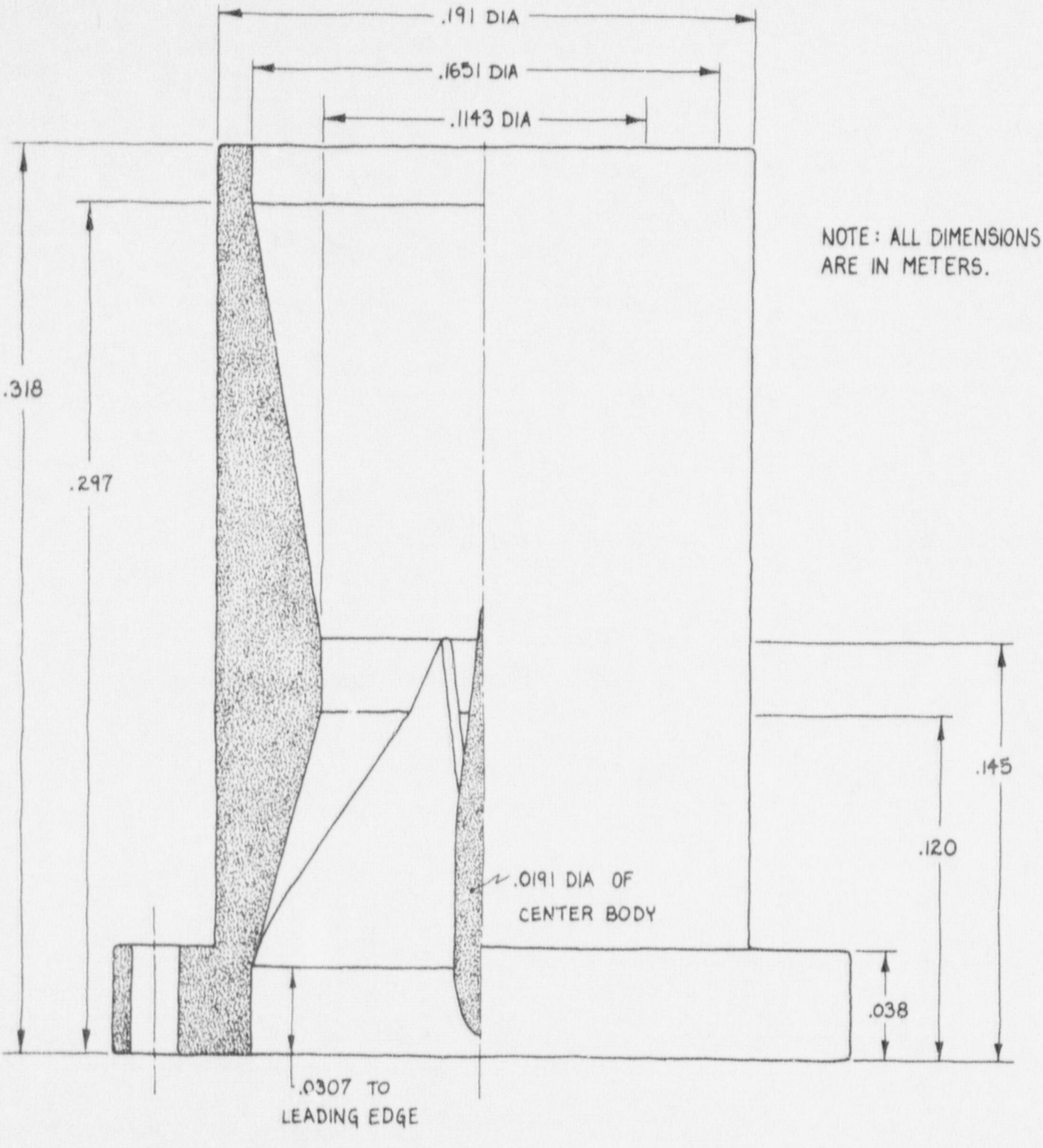


Fig. 6 Westinghouse stub mixer model.

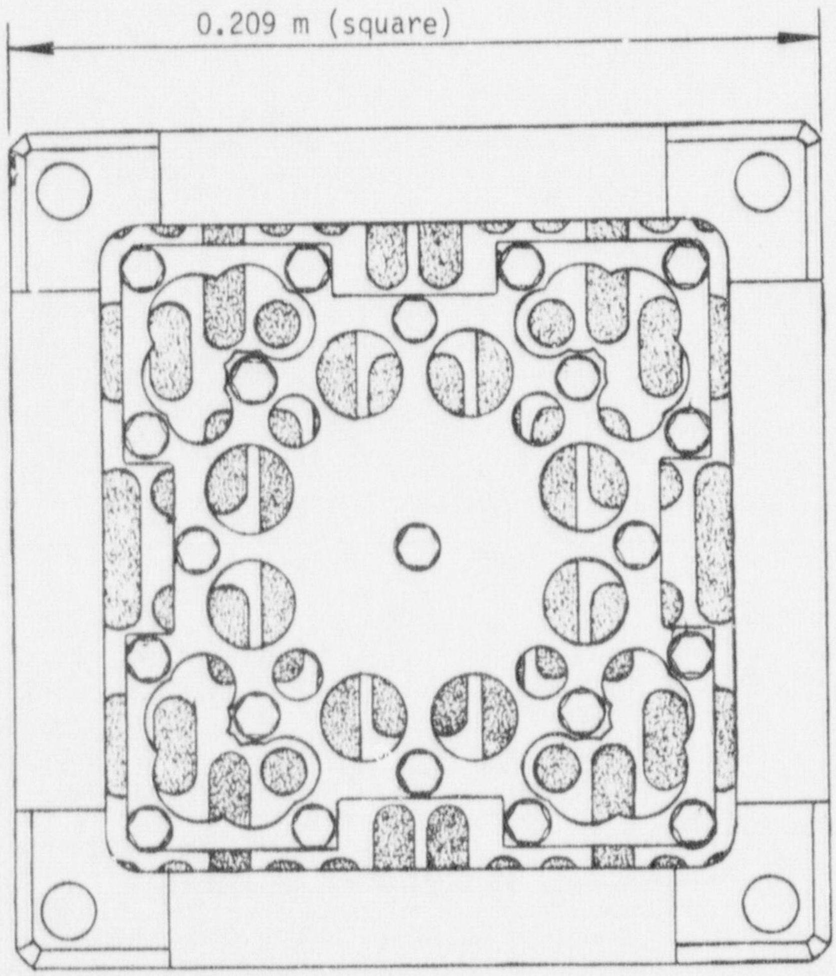


Fig. 7 Westinghouse upper end box model (shaded areas represent areas open to flow).

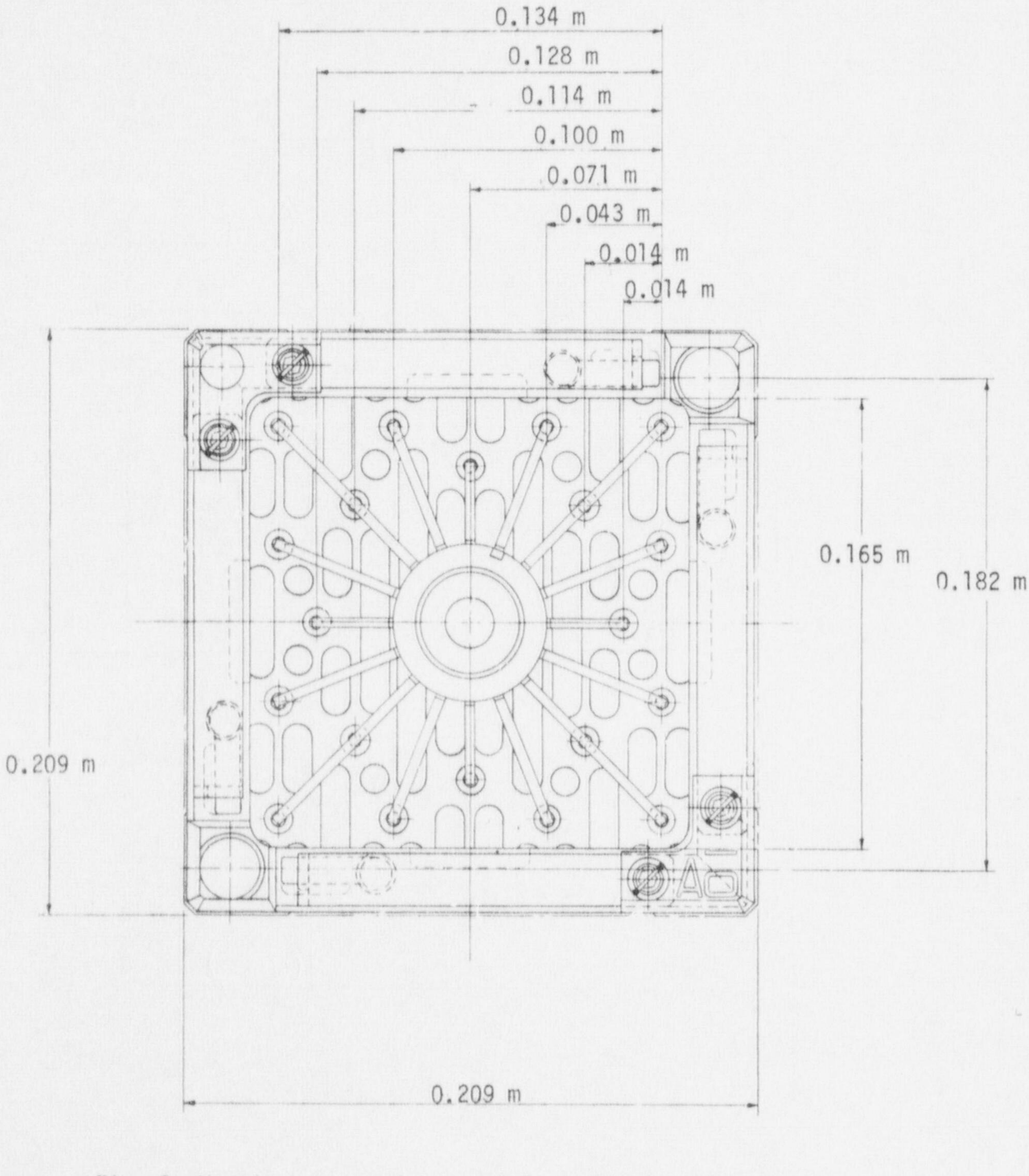


Fig. 8 Westinghouse end box model with rod spider.

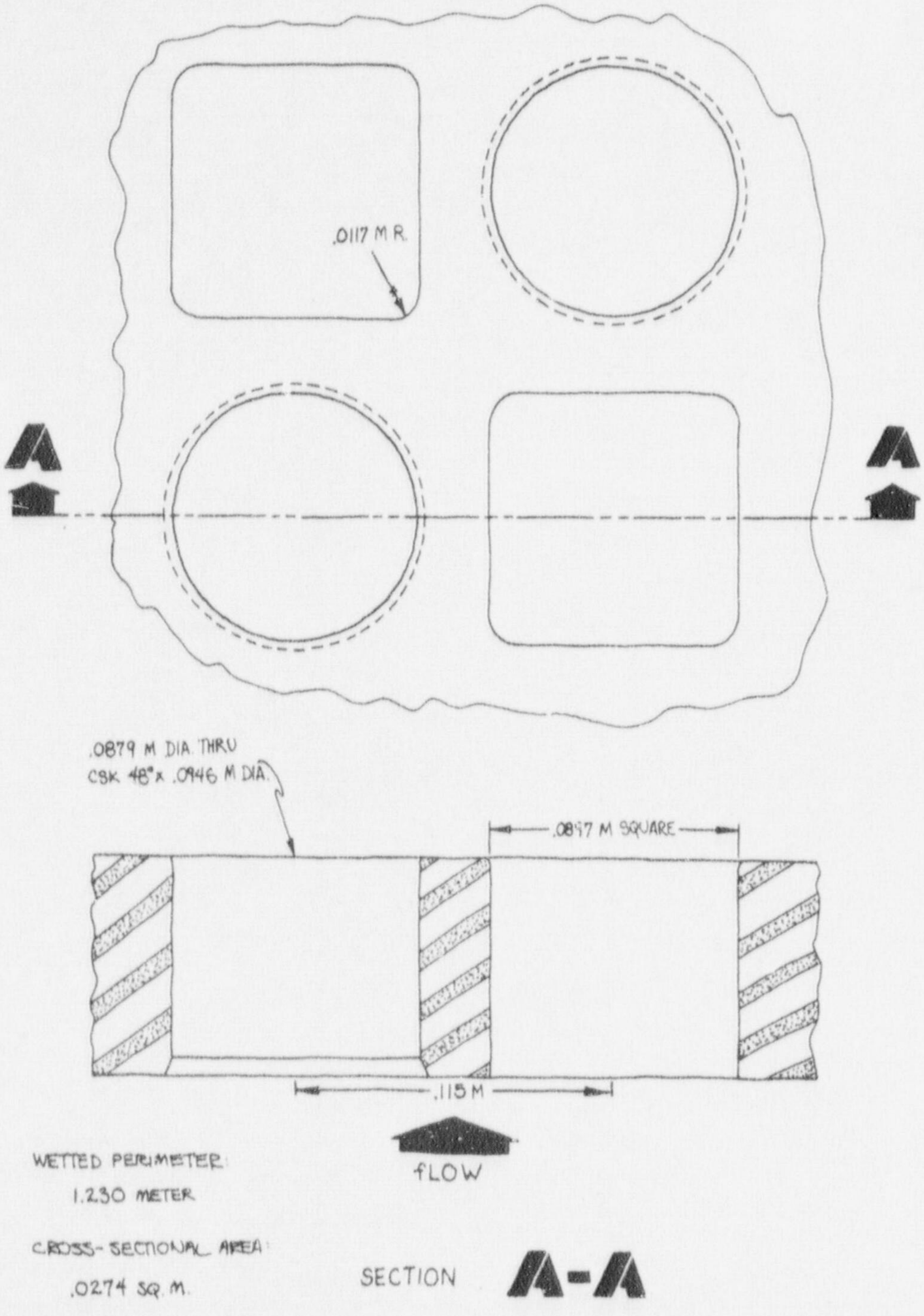


Fig. 9 JAERI CCRTF UCSP.

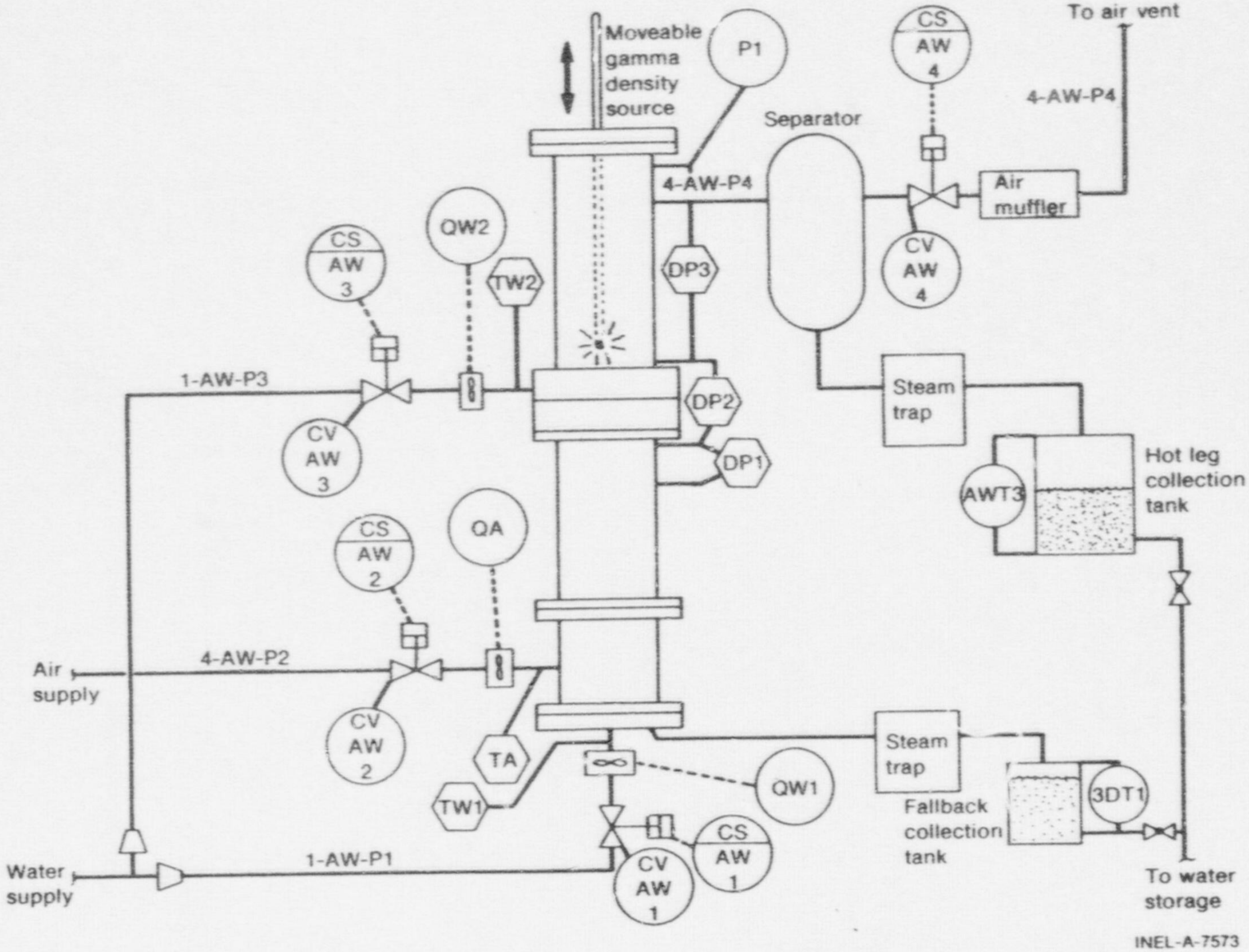


Fig. 10 Piping and instrumentation diagram for air-water test system.

1. Separator; This serves to separate, using gravity and a demister screen, the outlet two-phase mixture, allowing measurement of the outlet liquid phase flow rate.

2. Steam Traps (2); These permit the removal of liquid from the pressurized system without venting the air. One is located below the vessel for removal of the fallback water. The other is below the separator to allow removal of the carryout liquid.

3. Measuring Tanks (2); The fallback and carryout steam traps each drain into a separate measuring tank. The fallback and carryout flow rates are determined by tracing the rate of change of liquid level in these tanks.

4. Air Supply; An auxiliary diesel compressor (capacity 0.42 m^3/s at standard conditions) was used to augment the normal plant air. The plant air could be used alone for air flow rates less than 0.12 m^3/s. The air supply lines were 4-inch carbon steel.

5. Water Supply; Demineralized water was used in these tests. Typical water chemistry for this supply is shown in Table III. The water supply lines were stainless steel to minimize corrosion fouling. Circulation was provided by an external pump (not shown). The system was closed-loop with respect to water in that the measuring tanks could be emptied (using an auxiliary pump) into the water supply storage tank. The water was emptied and renewed frequently due to the presence of slight oil-fouling by compressor air.

TABLE III

TYPICAL SEMISCALE DEMINERALIZED WATER COMPOSITION[a]

pH	10.70
Conductivity (μmho/cm)	130.
Lithium (μ/mℓ)	3.2
Chlorides (ppm)	<0.1
Fluorides (μ/mℓ)[b]	<0.4
Oxygen (cc/ℓ)	0.06
Total gas (cc/l)	162.5
Suspended solids (μ/mℓ)	1.67

[a] B. L. Collins, C. E. Coppin, K. E. Sackett, "Experiment Data Report for Semiscale Mod-1 Test S-28-1 (Steam Generator Tube Rupture Test), TREE-NUREG-1148, October 1977.

[b] Present analytical methods prevent accurate determination of fluorides at concentrations of less than 0.4 ppm.

3. CONTROL SYSTEM

The four parameters controlled in this experiment were inlet air flow rate, core-injected water flow rate, upper plenum injected water flow rate, and upper plenum pressure. The sizes and performance characteristics of the control valves are shown in Table IV. On both the inlet air and core-injected water supplies, controlled by-pass routes were provided. This system allowed constant flow through the air and water lines which enhanced the quality of control possible, since a constant pressure was thereby maintained upstream of the control valves.

Vessel pressure control was achieved by using a back-pressure control valve (CVAW4 on Figure 10). This valve was located downstream of the separator. The characteristics of this valve are shown in Table IV.

Feedback control of these four variables was achieved through the use of specially designed electronic three-mode controllers intended for fast-response operation.

4. TEST INSTRUMENTATION

The experimental measurements recorded for each experiment and the approximate location of the sensors are shown on Figure 10. The accuracies required for each measurement are shown in Table V. In general, these required accuracies were met, with the exception of air flow rate accuracy and stability at air rates below 0.038 m^3/s. Since most tests used greater air injection rates, this lack of stability is not considered to be a serious difficulty. The stability of the air-flow a... analysis of associated error in calculations is discussed in Appendix B.

TABLE IV

CONTROL VALVE CHARACTERISTICS

VALVE DESIGNATION (FIGURE 8)	FUNCTION	VALVE CHARACTERISTICS	VALVE SIZE
CV AW 1	core injection water control	Linear position versus flow curve full open to full closed in 0.25 sec full closed to full open in 0.25 sec	1" (2.5 cm)
CV AW 2	air injection control	Linear position versus flow curve full open to full closed in 0.25 sec full closed to full open in 0.25 sec	3" (7.6 cm)
CV AW 3	upper plenum water injection control	Linear position versus flow curve full open to full closed in 0.25 sec full closed to full open in 0.25 sec	1" (2.5 cm)
CV AW 4	back pressure control	Linear position versus flow curve full open to full closed in 0.25 sec full closed to full open in 0.25 sec	3" (7.6 cm)

TABLE V

EXPERIMENT MEASUREMENT SPECIFICATIONS

TYPE OF MEASUREMENT	INSTRUMENT NUMBER	LOCATION	RANGE	ACCURACY
MASS FLOW RATE	QW1	Inlet water (below core)	0.0-0.00227 m^3/sec	±5%
	QW2	Inlet water (to upper plenum)	0.0-0.00227 m^3/sec	±5%
	QA	Inlet air	0.0472-0.472 m^3/sec	±5%
PRESSURE	P1	Upper plenum	0-0.2078 mPa	±1.38 kPa
	PA	Inlet air	0-0.2078 mPa	±1.38 kPa
FLUID TEMPERATURE	TA	Inlet air	288.7-322°K	±2.77°K
	TW1	Inlet water	"	"
	TW2	Inlet water (upper plenum)	"	"
	TWA	Upper plenum	"	"
PRESSURE (DIFFERENTIAL)	3DT1	Measuring tank (from bottom of vessel)	0-24.88 kPa	±1% F.S.
	AWT3	Measuring tank (from separator)	0-24.88 kPa	±1% F.S.
	DP1	Across grid plate	0-4.98 kPa	±.0249 kPa
	DP2	Across upper core support plate	"	"
	DP3	Top of UCSP to top of U.P.	"	"
FROTH DENSITY (GAMMA DENSITOMETER)	GD-1	Upper plenum	0-1041 kg/m^3	±8%

5. DATA ACQUISITION SYSTEM

Sixteen data channels were scanned and recorded by the Semiscale DAS[(1)]. Output data for the tests were available in two forms. A transient record of each channel for the duration of a 60-second tests was plotted for each test. In addition, tapes recording the average value of each measurement were provided for each 60-second test. In general, the tape of average values during the test was used for further data reduction and handling with two exceptions:

1. The liquid outflow measurements were made by following the level changes in the collection tanks. The reduction of these measurements to flow rates required direct use of the transient data.

2. Occassional control or instrument malfunction invalidated the results during portions of some tests. These failures would render meaningless the average sensor readings for the entire 60-second test. In many instances, the results of portions of the 60-second test were still meaningful, and the transient data were used to estimate average sensor readings during the proper portion of the tests.

In addition, the transient data were found useful in the determination of the validity of individual tests.

III. TEST METHOD

The tests were run under conditions representative of PWR LOCA reflood. Steady state tests were used to gather the CCFL data. Important considerations during the conduct of these tests were: (a) accurate flow rate and pressure setpoints on controls, (b) establish-

ment and maintenance of steady state flow conditions, and (c) periodic checking and calibration of the gamma densitometer electronics and DAS amplifiers.

The following sections describe the operational procedures used for each type of test run, and the method used to determine the range of flows to be tested.

1. TEST MATRIX SELECTION

For each upper plenum geometry tested, the range of air flowrates which allowed countercurrent flow of water from the upper plenum was determined by visual observation of the flow. This range was then divided into suitable increments and several water injection flowrates were selected which resulted, in general, in establishment of a froth layer in the upper plenum.

For the KKU tests, designated G-1 thru G-3, and the JAERI CCRTF test, designated J-1, the fuel bundle region water injection flowrate was chosen to correspond with the FLOOD4 (Reference 2) predicted entrainment value for each air flow rate tested. Sufficient additional water was added by upper plenum injection to result in a total water injection of either 8, 13, 17, or 22 x $10^{-4} m^3/s$. The variation in upper plenum injection was intended to provide a variation in upper plenum average density and corresponding liquid content, because these variables could possibly have an effect on countercurrent flow.

In tests with the Westinghouse upper plenum internals (designated Groups W-1 thru W-4), the lowest air flow rate which resulted in any entrainment of fuel bundle region water injection was found sufficient to completely prevent liquid penetration (countercurrent flow) from the upper plenum. Consequently, all data points in Groups W-1 thru W-4 were obtained with no fuel bundle region water injection.

Between the KKU and Westinghouse test series, a number of supplemental experiments were performed to investigate, (a) the influence of the method of air injection on the CCFL behavior of the system, (b) the effectiveness of the fuel bundle region water injector in entraining water into the core air flow, and (c) the effects on countercurrent flow caused by varying the relative proportion of liquid injected into the upper plenum and fuel bundle regions.

The air and water flow rates for each of these investigations were chosen to provide a sufficient number of countercurrent flow points at the "flooding" (maximum liquid downflow) condition such that valid conclusions could be drawn in each case.

2. PROCEDURE

For the original test section configuration, and after completing changeovers to a new upper plenum internals arrangement, motion pictures were taken of several representative upper plenum upper end box flow combinations. The test matrix was then selected by the method of Section III. 1. and CCFL testing commenced. After the desired water and air injection flow rates for a test point were established, flows were held constant until a steady froth layer was obtained in the test section upper plenum. Flow, temperature, pressure, and density data were then recorded for a period of sixty seconds. Upper plenum liquid carryout and UCSP liquid fallback flow rates were measured by recording the rate of liquid level change in the carryout and fallback collection tanks. Froth height (defined as the highest elevation above the UCSP which the froth regularly reached during its oscillation about the upper plenum outlet) was checked visually and recorded in the test log. Flows were then reset for the next test point and the procedure repeated.

At selected test points, a direct measurement of upper plenum liquid content was made by simultaneously stopping all test section inflows and outflows, and measuring the liquid volume which fell to and collected in the test section lower plenum. The volume collected was measured visually with a ruler and recorded in the test log.

The special tests to investigate fuel bundle region entrainment characteristics were qualitative in nature. For each flow combination tested, the test engineer categorized the upper plenum/end box flow condition as (a) no liquid into end box, (b) some liquid into end box, very little in upper plenum, (c) immediate flow into end box, slow buildup in upper plenum, or (d) rapid froth buildup in upper plenum.

The flow rates used in each test appear in the data summaries, and are not repeated here.

IV. RESULTS

Data taken for each test section configuration consisted of 60-seconds of tape recorded transducer output voltage for each channel listed in Table V, and visual observations of both froth height (all tests) and upper plenum liquid content (Westinghouse tests only). Motion pictures of the upper plenum flow field were taken of selected sample points for most of the upper plenum configurations. The following sections describe the methods used in the reduction and reporting of this data and the important features of these results. In addition, the results of a computer simulation of the test system are presented and compared to the experimental data, and the suitability of classical CCFL correlations for the prediction of PWR reflood behavior are discussed.

1. UPPER PLENUM FLOW CHARACTERISTICS

The experiments suggest that the two-phase mixture in the upper plenum region behaves as a churn-turbulent froth when the air flow rates are chosen to represent reflood steam flows. Although to determine which, if either, phase is continuous is difficult, apparently small liquid droplets do not contribute significantly to the upper plenum liquid inventory. This contrasts with the assumptions made in some previous analyses of upper plenum flow behavior. The model employed in Reference 2 pictured the upper plenum (during reflood) to consist of a liquid pool from which small droplets were entrained and convected with the steam flow. These droplets were then assumed to exit the upper plenum or (more likely) strike an internal structure. This behavior is unlike that observed in the test vessel in which large and irregularly shaped drops could be observed near the top of the froth. These drops, in general, fall back into the froth, although some near the outlet nozzle are swept out. The liquid is postulated to be projected upward in the regions of high air velocity (the end box and UCSP), and then was dominated by gravity in the upper plenum except in a region near the outlet nozzle where the air was again accelerated.

As expected, the top of the froth was found to oscillate around the upper plenum outlet, in those cases where a froth became established. Froth heights reported in the raw test data (Appendix A) can be interpreted as the maximum height which the froth regularly reached during its oscillations around the upper plenum outlet.

In those cases where a permanent froth failed to become established, occasional excursions of liquid were carried into the upper plenum. Reported froth heights lower than the upper plenum outlet height may be interpreted as the height which these excursions regularly reached.

These froth height results are not considered to be indicative of large scale upper plenum behavior. In a multi-bundle reactor upper plenum, upward steam flow would be expected to persist above the height of the outlet nozzle above bundles not located near the hot leg outlets. This could permit a froth to persist locally whose height exceeded the outlet nozzle level. The vessel used in these experiments did not permit an upward air velocity above the outlet and thus limited the heights of the resultant froths. Some froth heights reported do exceed the outlet level, but this is due to the upward momentum of the liquid droplets and is not a result of an air-supported froth above the outlet level.

2. RAW DATA

Raw data from each test series were available for subsequent examination in two forms, specifically, as (a) engineering unit plots of the transducer output vs time (60-seconds), and (b) time averaged values for each channel recorded. Typical transducer output voltages converted to engineering units by the Semiscale data acquisition system are shown on Figures 11 thru 24. These data are included herein to illustrate the relative time-variation in each transducer signal and to acquaint the reader with the characteristics of the data obtained.

3. CALCULATED DATA

After being converted to engineering units, the raw data were examined to eliminate any obvious errors, and delete any invalid tests. Time averaged data were then analyzed by a small computer program, designated "CALC", to convert the air flow and water fallback data to gas and liquid Kutateladze numbers, K_g and K_f;

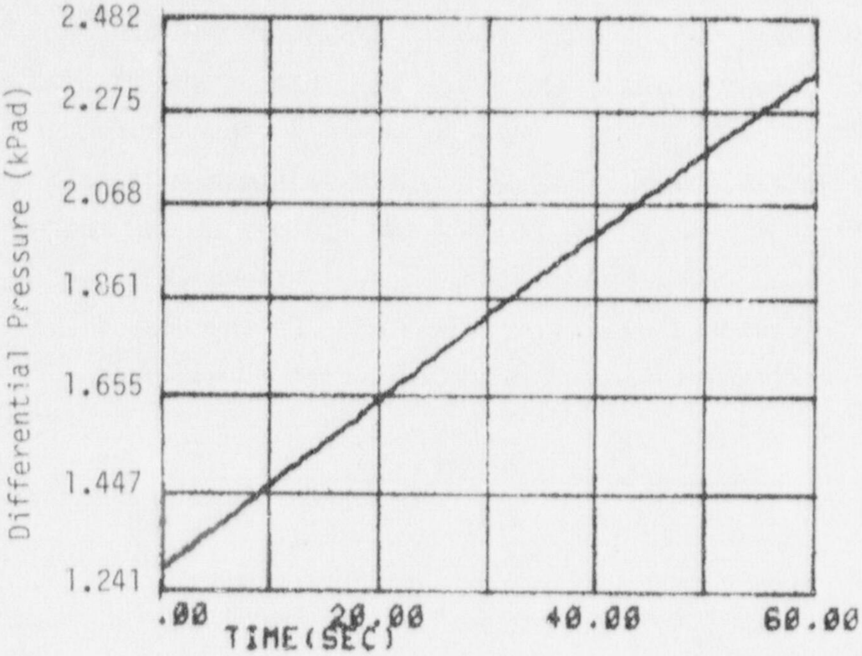


Fig. 11 Fallback measuring tank liquid level, transient data, Test L-21.

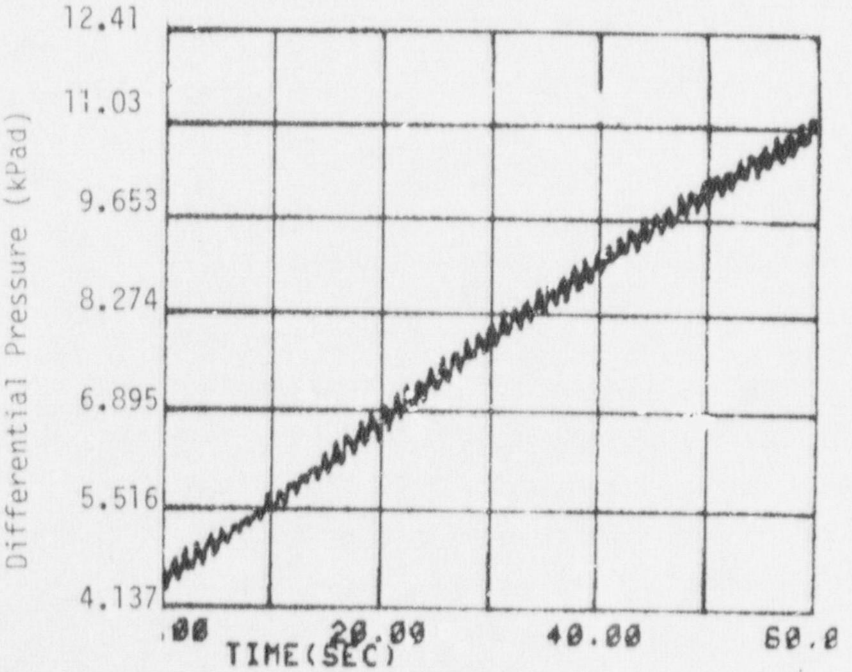


Fig. 12 Carryout measuring tank liquid level, transient data, Test L-21.

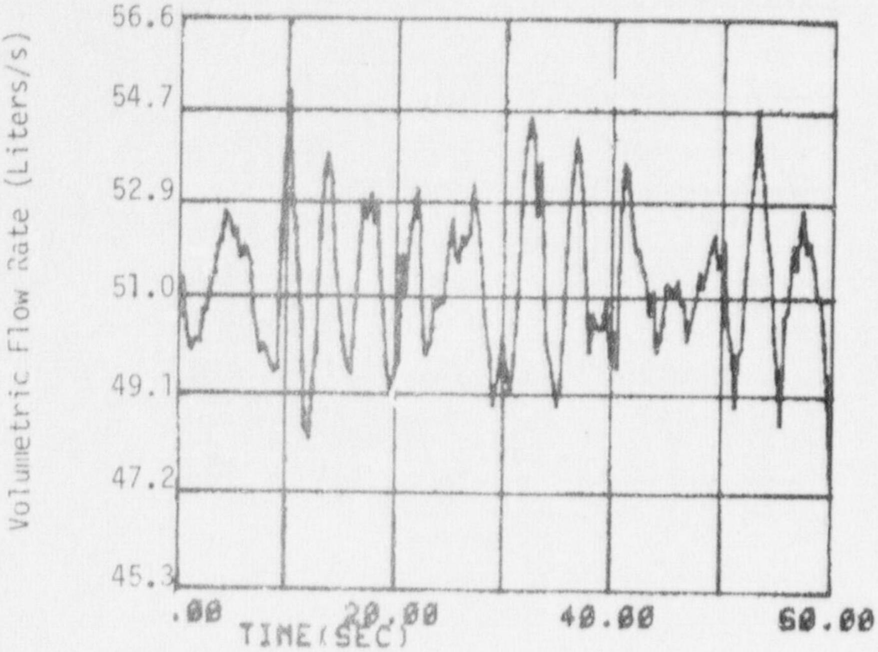


Fig. 13 Test section air flowrate, transient data, Test L-21.

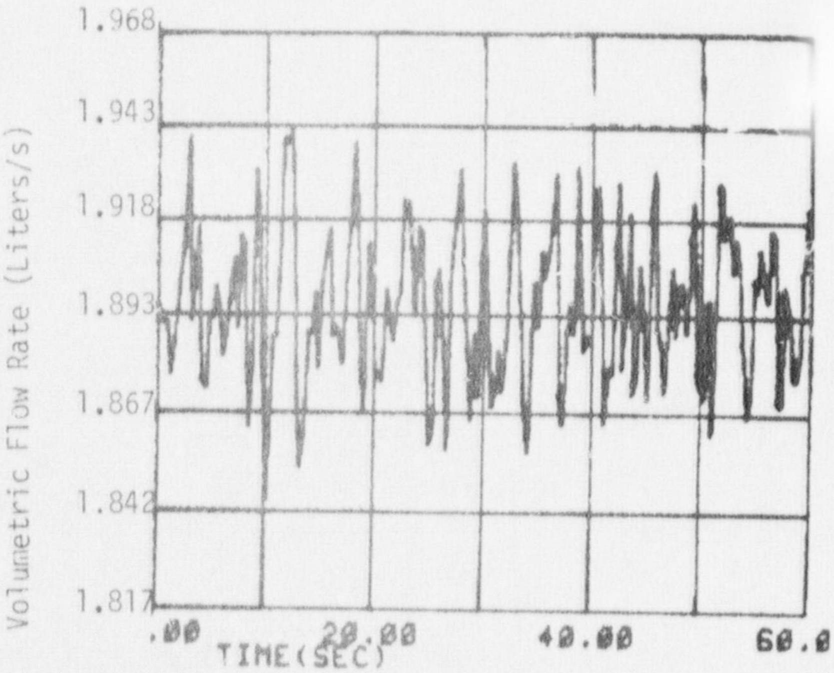


Fig. 14 Upper plenum water injection rate, transient data, Test L-21.

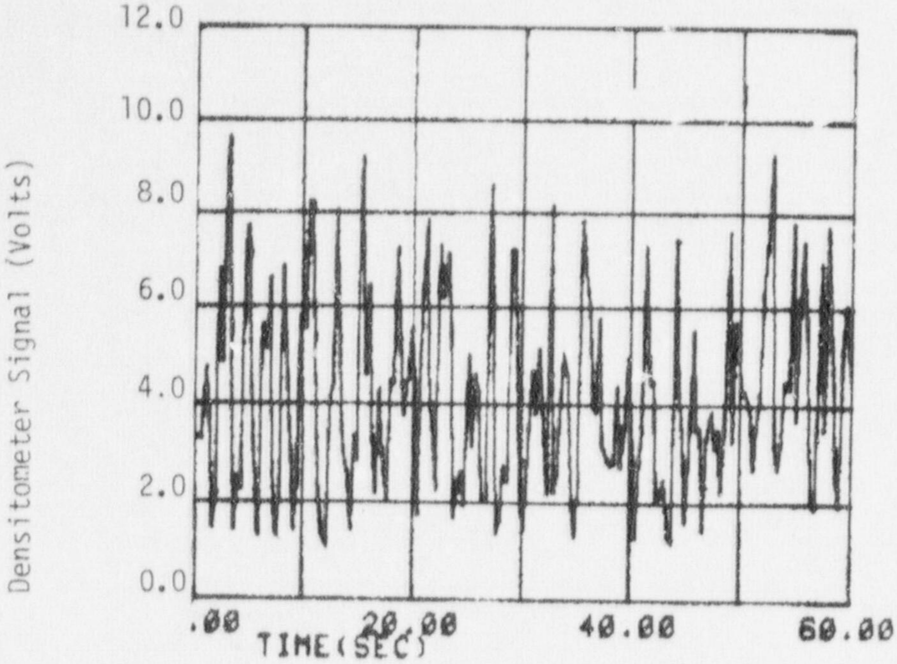


Fig. 15 Upper plenum gamma densitometer output, transient data, Test L-21.

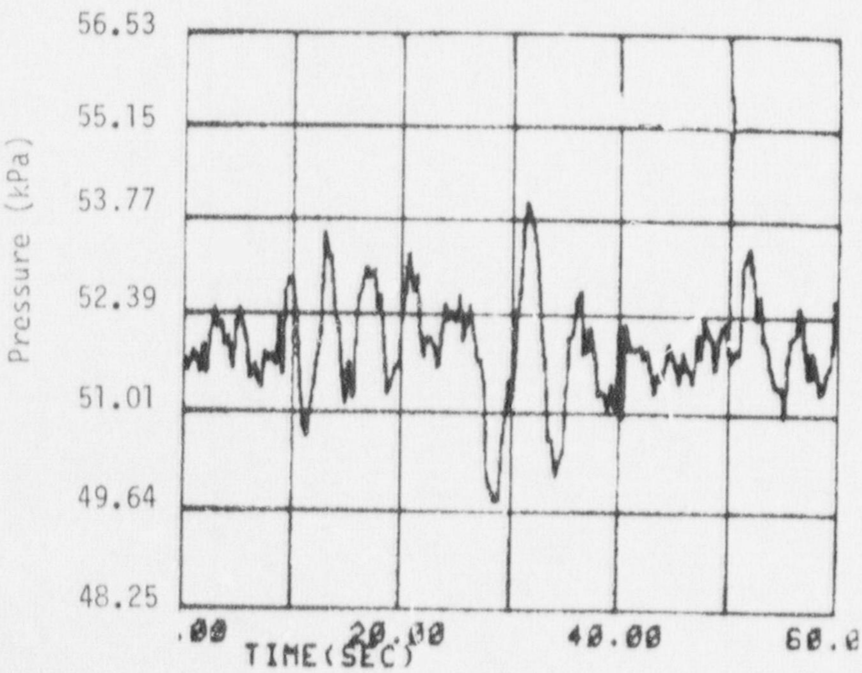


Fig. 16 Test section air supply pressure, transient data, Test L-21.

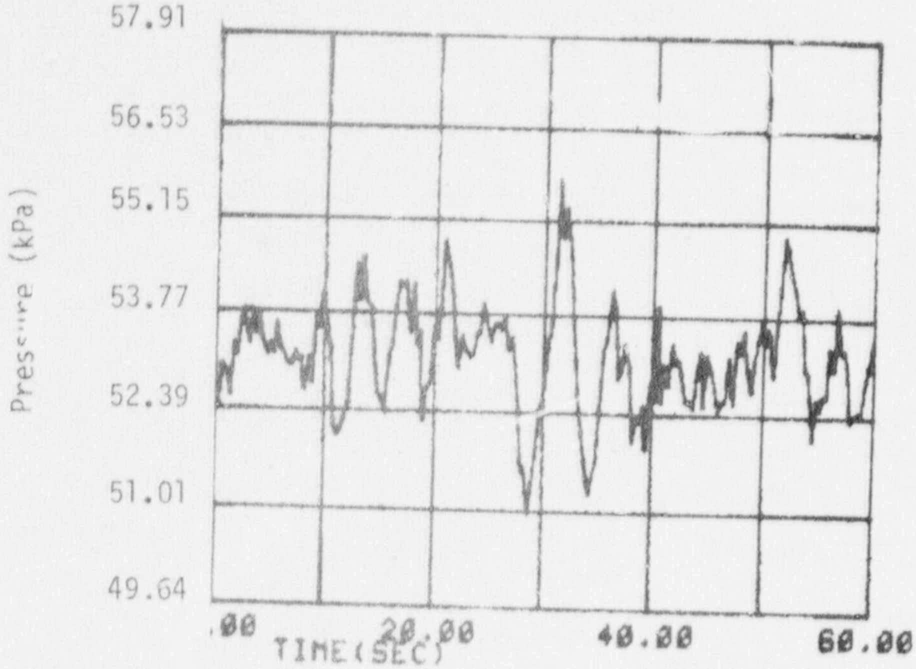


Fig. 17 Upper plenum pressure, transient data, Test L-21.

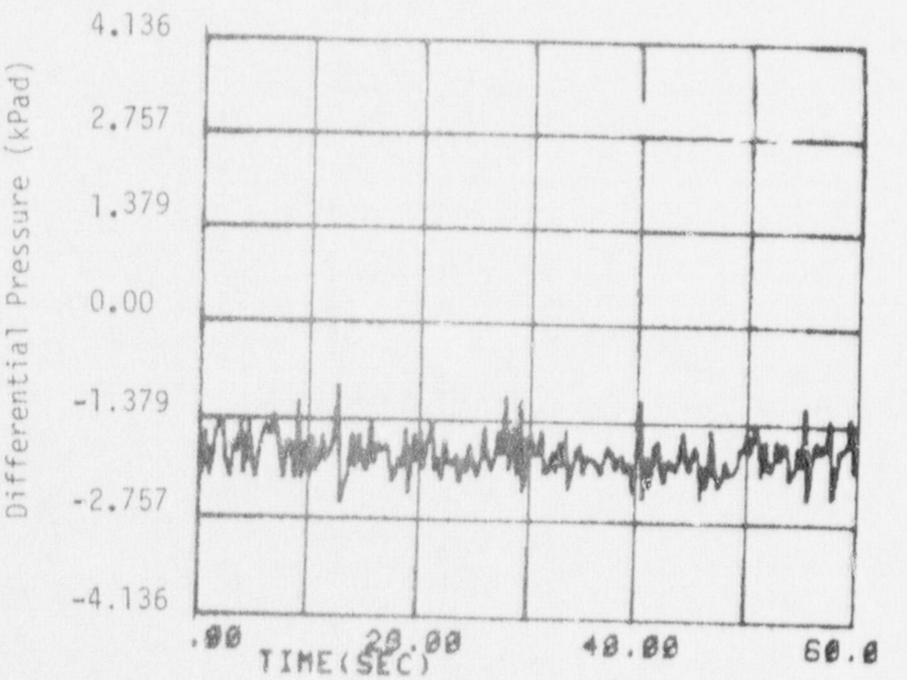


Fig. 18 Differential pressure across upper core support plate, transient data, Test L-21.

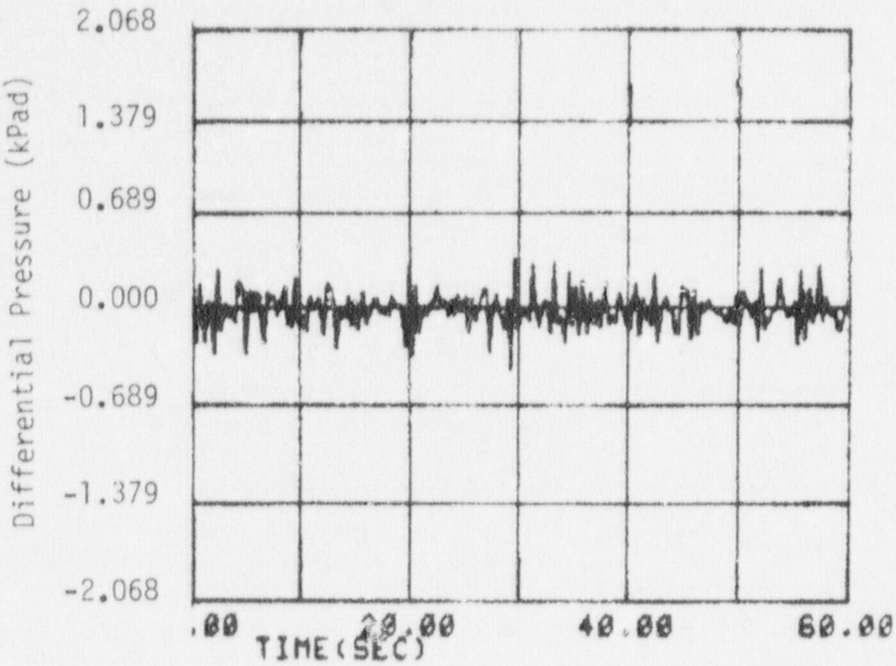


Fig. 19 Differential pressure across end box, transient data, Test L-21.

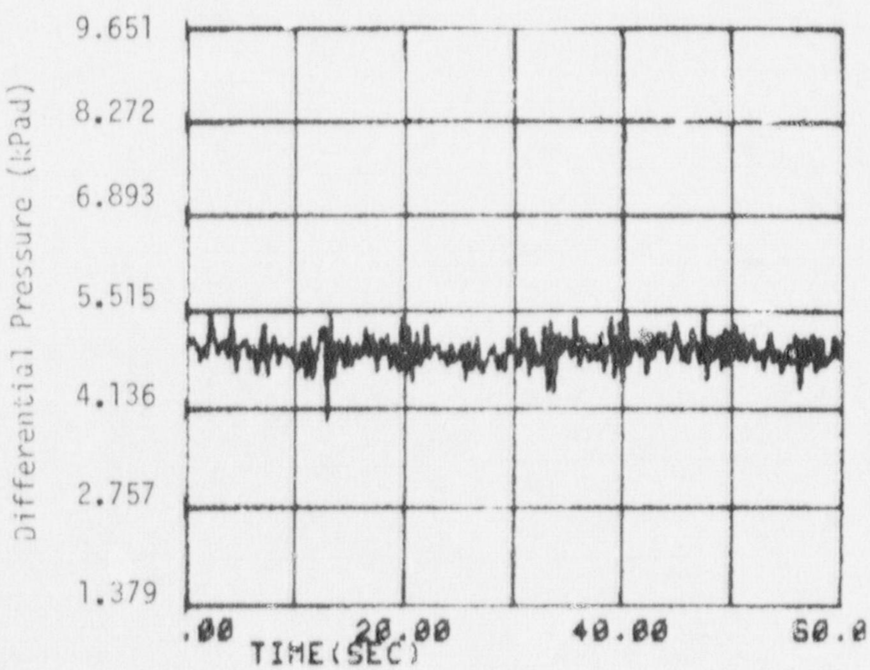


Fig. 20 Differential pressure from bottom to top of upper plenum, transient data, Test L-21.

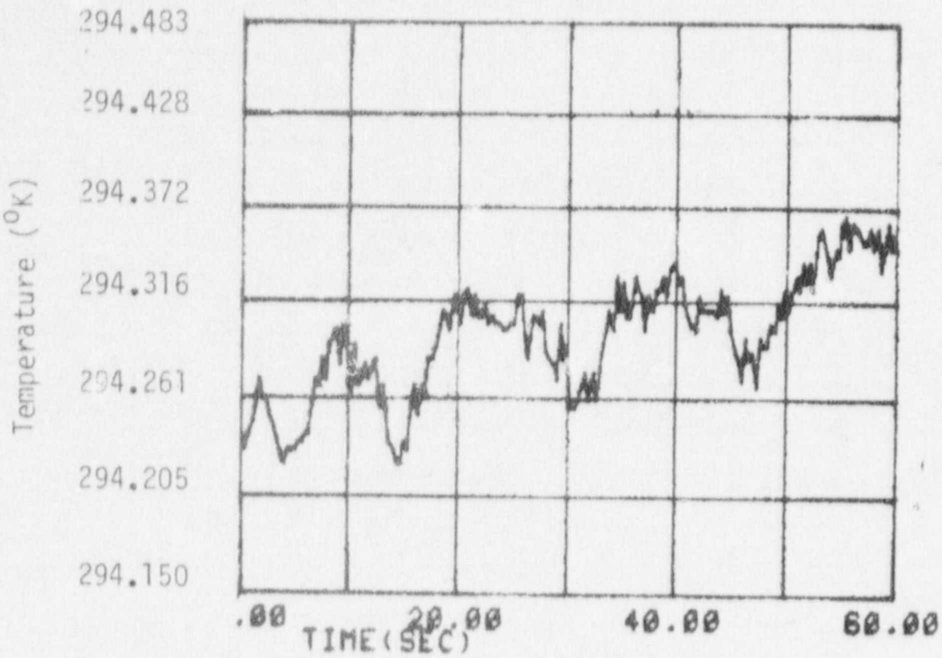


Fig. 21 Test section inlet air temperature, transient data, Test L-21.

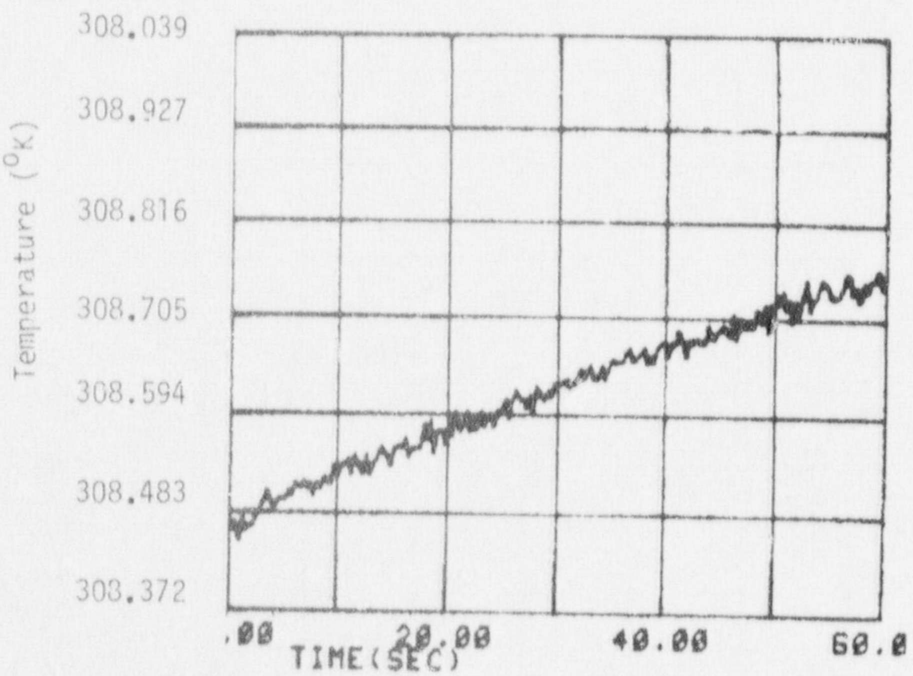


Fig. 22 Upper plenum water supply temperature, transient data, Test L-21.

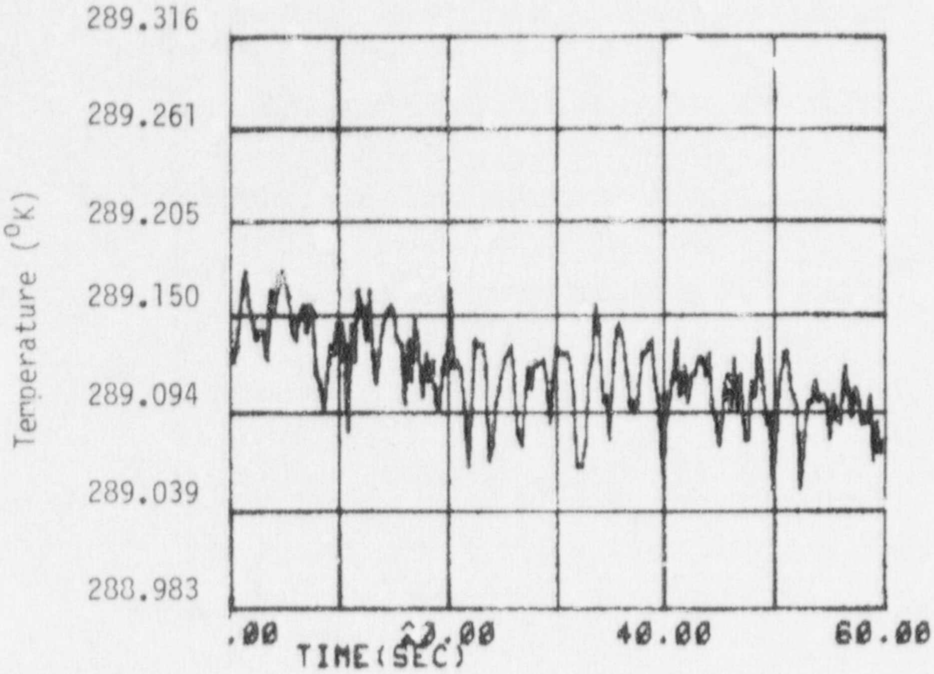


Fig. 23 Core water injection temperature, transient data, Test L-21.

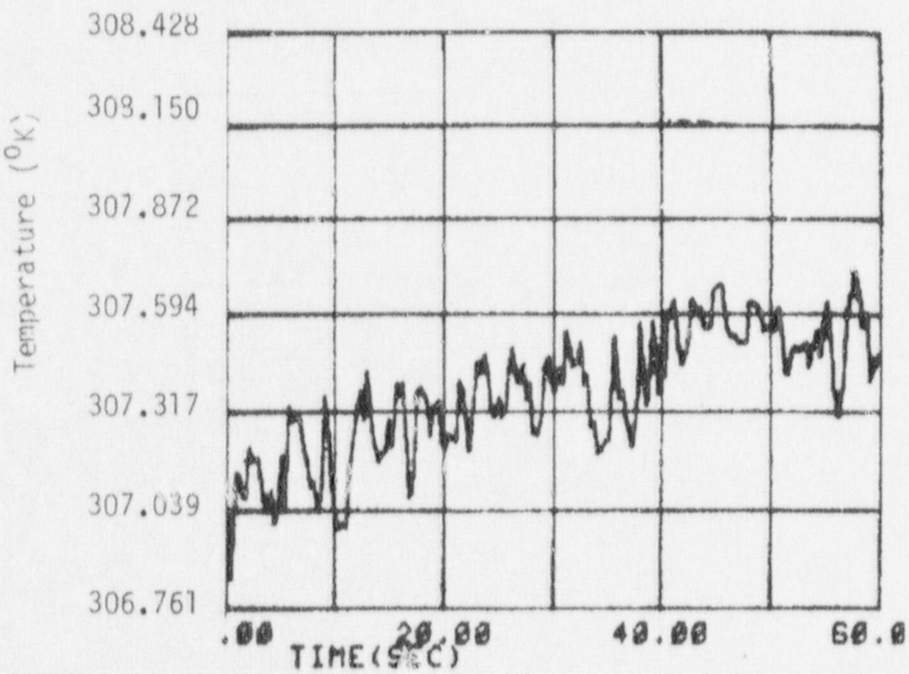


Fig. 24 Upper plenum mixture temperature, transient data, Test L-21.

$$K_g = j_g \rho_g^{0.5}(g_c\sigma(\rho_f - \rho_g))^{-0.25}, K_f = j_f \rho_f^{0.5}(g_c\sigma(\rho_f - \rho_g))^{-0.25},$$

where: j = volumetric flux (gas or liquid)

ρ = density (gas or liquid)

g_c = gravitational constant

σ = surface tension

f subscript denotes liquid, g subscript denotes gas

A listing of the CALC program is included in Appendix C.

Fallback and carryout flow rates were determined external to "CALC" and then input directly to the program. The method of calculating these quantities was to determine the time rate of change of the differential pressure type level detectors located in the fallback and carryout measuring tanks (by hand) and multiply by the individual tank cross-sectional areas. Generally, the method of data analysis (by CALC) consisted of first adjusting the measured air flow rate for variations in temperature and pressure occurring downstream of the air measurement location and then calculating the required dimensionless quantities from the adjusted air rate and input values of the fallback flow rate.

Tabulated raw and calculated data are given in Appendix A for the entire series of air-water tests. Table VI presents the breakdown of the test section configuration used for each test group and series. In all cases, volumetric fluxes used for calculating the Kutateladze numbers were based on the flow area through the upper end box. These flow areas are listed in Tables I and II.

TABLE VI

TEST SECTION CONFIGURATIONS AND TEST SERIES DESIGNATIONS

TEST GROUP	TEST SERIES	UPPER PLENUM/ UCSP CONFIGURATION	HOT LEG OUTLET HEIGHT (m)	SHOWN IN FIGURE(S)
G-1	A	KKU open hole UCSP	0.813	25
	B	KKU open hole UCSP	0.305	26
G-2	C	KKU support column	0.305	27
	D	KKU support column	0.813	28
G-3	E	KKU control rod guide	0.813	29
	F	KKU control rod guide	0.305	30
J-1	G	JAERI open hole UCSP	0.305	31
	H,Y	JAERI open hole UCSP	0.813	32,33
W-1	I	Westinghouse open hole UCSP	0.813	34
W-2	J	Westinghouse support column	0.813	35
W-3	K	Westinghouse control rod guide shroud	0.813	36
W-4	L	Westinghouse stub flow mixer	0.813	37

4. COUNTERCURRENT FLOODING AND ENTRAINMENT TEST RESULTS

Countercurrent flooding data with the square roots of the liquid and gas Kutateladze numbers plotted against each other are presented on Figures 25 through 37. These plots represent direct reduction of the raw data.

Investigation of the anamolous data behavior exhibited in Test Series E and F, (Figures 29 and 30) led to the conclusion that a significant amount of water injected into the fuel bundle region was, in fact, not being entrained, but falling back to and being collected in the fallback collection tank. A series of tests was then undertaken to investigate entrainment characteristics of the test apparatus, by injecting water into the fuel bundle region at varying rates of air flow, and observing the relative speed at which a froth was established in the upper regions of the test section. The results of these tests are shown in Figure 38. In general, entrainment is shown not to exist at air flows below 0.125 m^3/s and is shown to reach the upper plenum in significant quantity for air rates greater than 0.140 m^3/s. The nature of the tests did not allow determination of the air rate required for complete entrainment. Subsequently, it was decided to treat the data for test groups G-1, G-2, G-3, and J-1 [illegible] subtracting out all, or a portion of the fuel bundle region in[illegible] flow rate from the fallback flow rate, depending on the magnitude of the air flow rate.

Test results from Series E were used to determine a suitable method of data treatment because of the small relative data scatter and large number of test points. The Series E fuel bundle region water injection flow rates (QW1) were subtracted from the fallback flow rates for all data points and the resulting $(K_L)^{1/2}$ and $(K_G)^{1/2}$ values cross-plotted. These results showed a resulting $(K_G)^{1/2}$ intercept of approximately 1.8, indicating that negligible

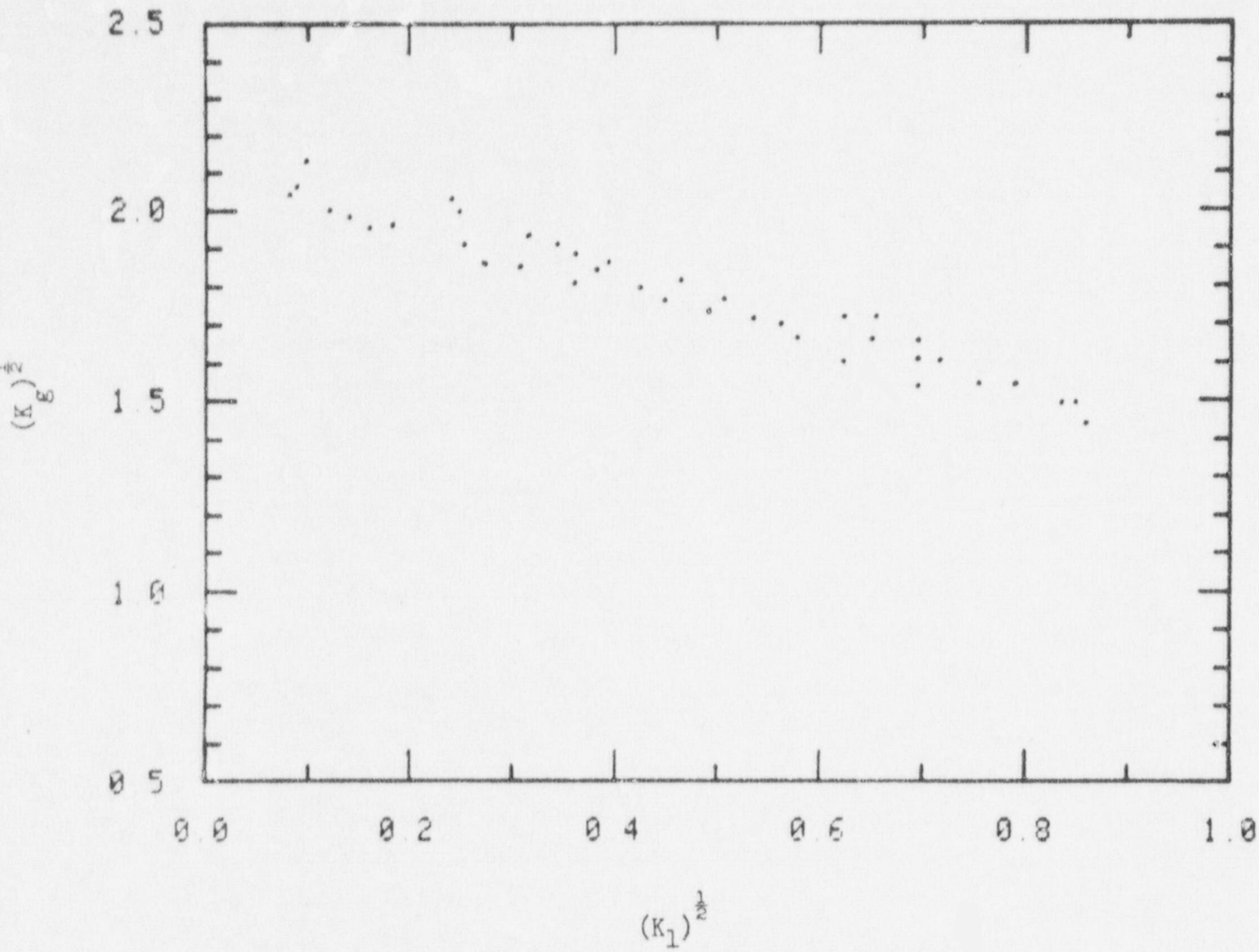


Fig. 25 Uncorrected CCFL results for KKU Open Hole UCSP (Test Series A) outlet height = 0.813m.

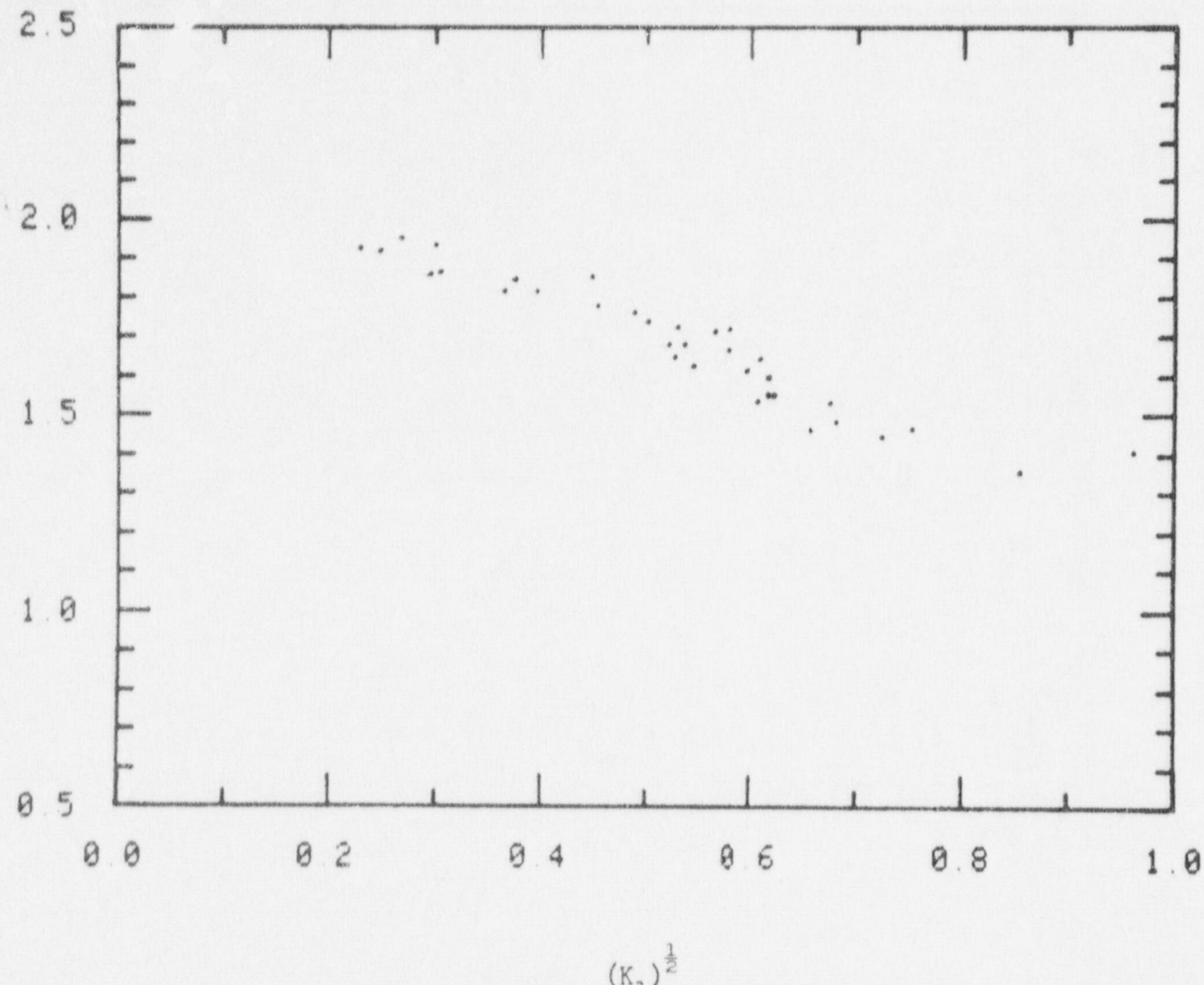


Fig. 26 Uncorrected CCFL results for KKU Open Hole UCSP (Test Series B) 0.305m outlet height.

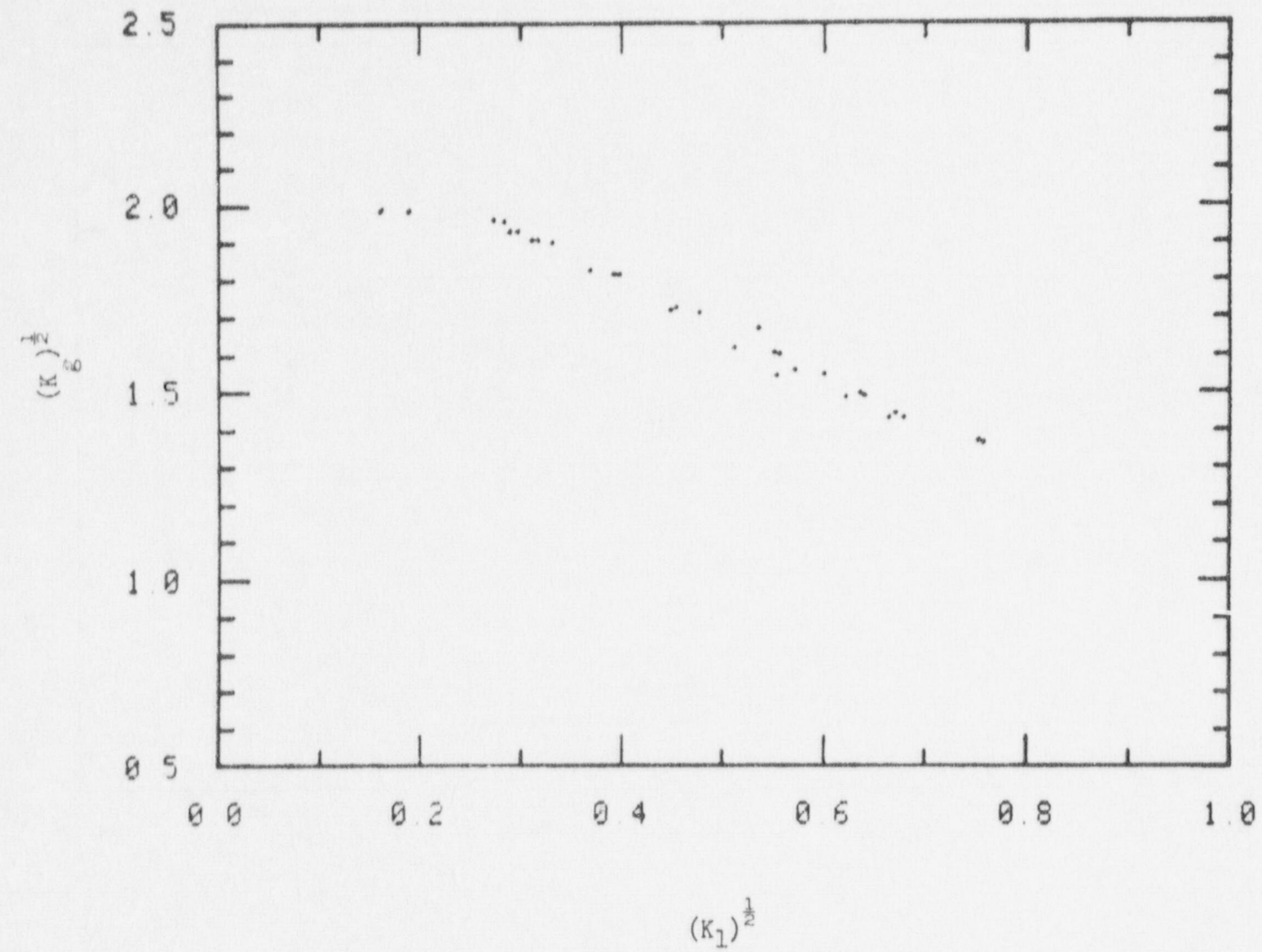


Fig. 27 Uncorrected CCFL results for KKU Support Column (Test Series C) outlet height = 0.305m.

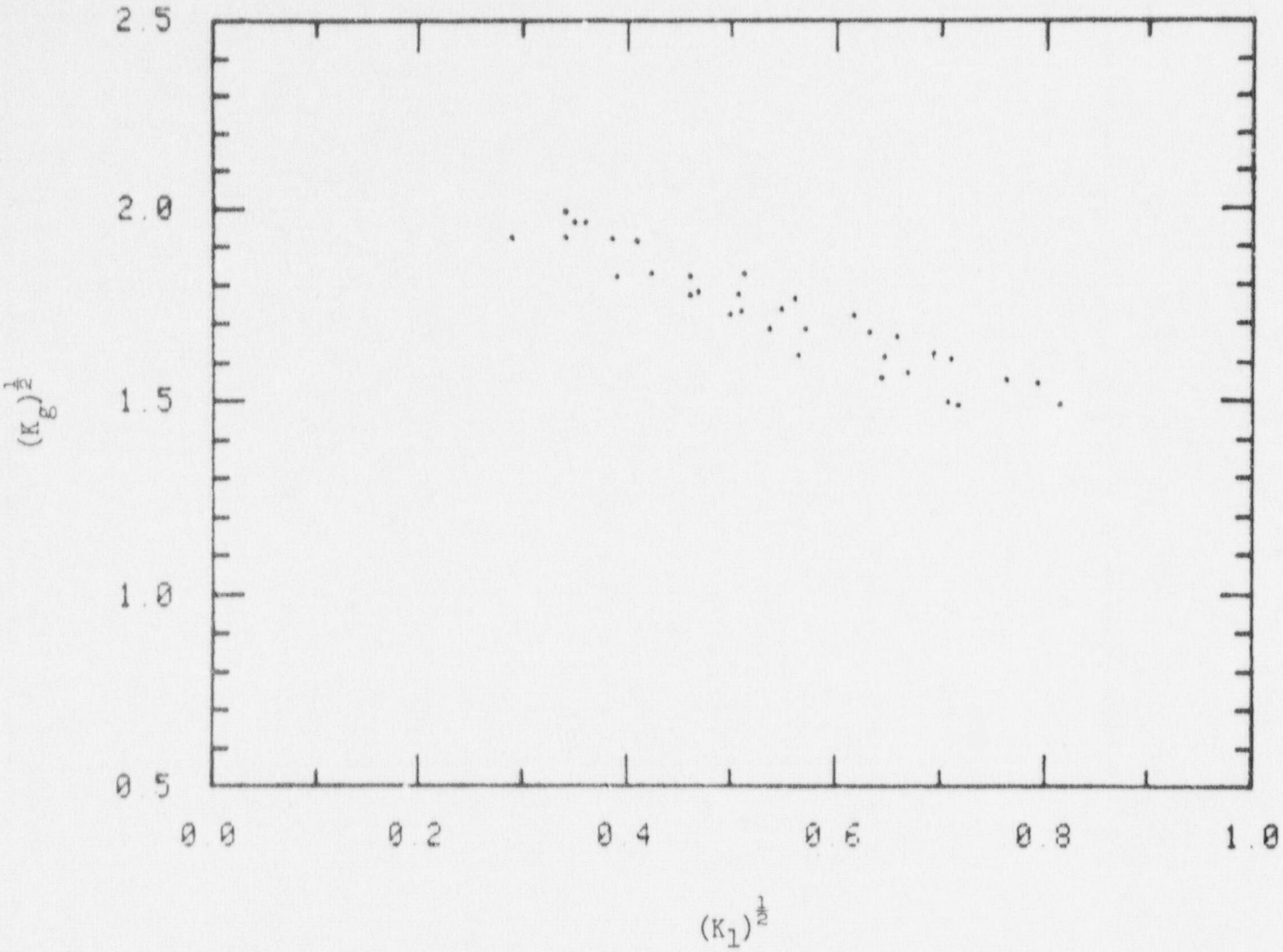


Fig. 28 Uncorrected CCFL results for KKU Support Column (Test Series D) outlet height = 0.813m.

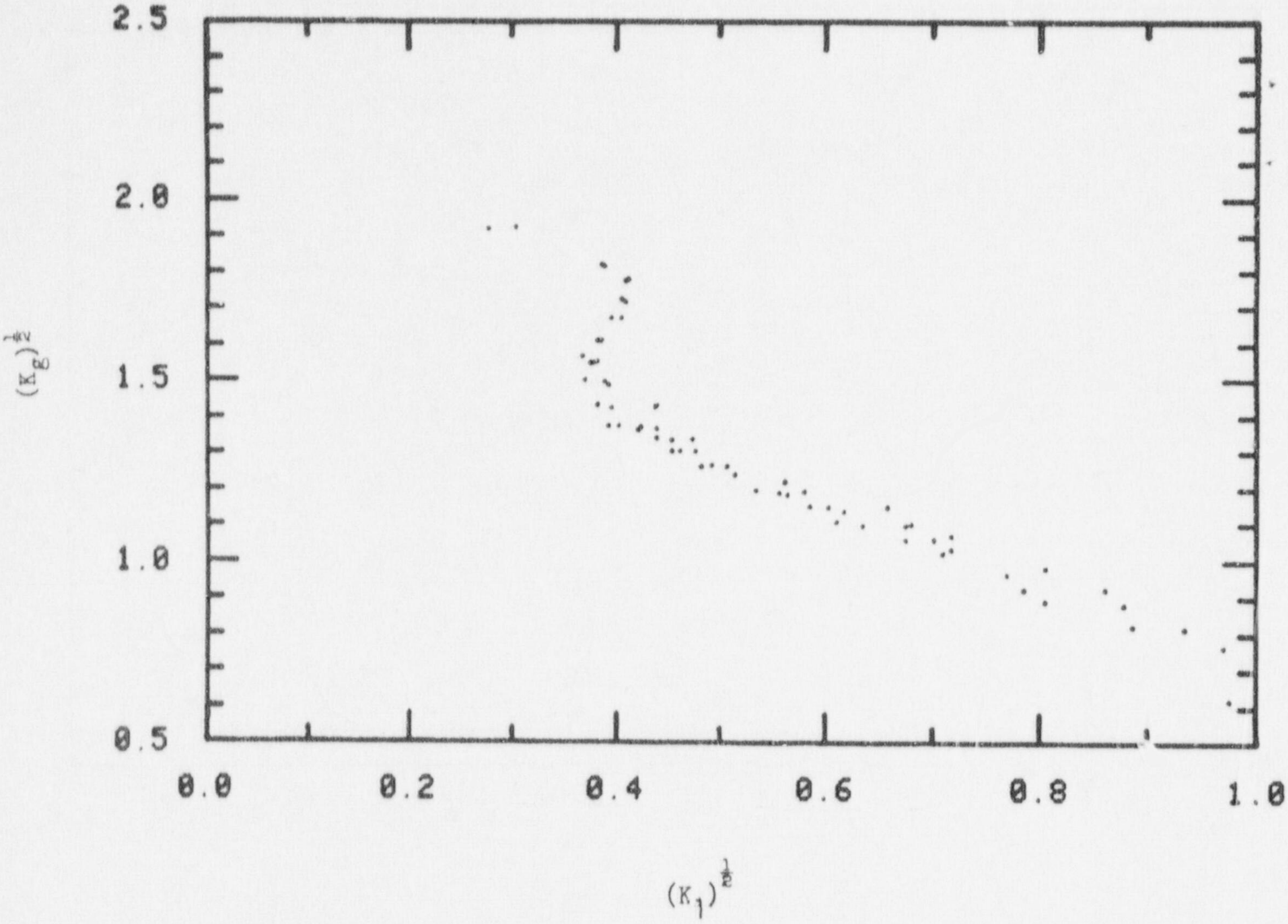


Fig. 29 Uncorrected CCFL results for KKU Control Rod Guide Shroud (Test Series E) outlet height = 0.813m.

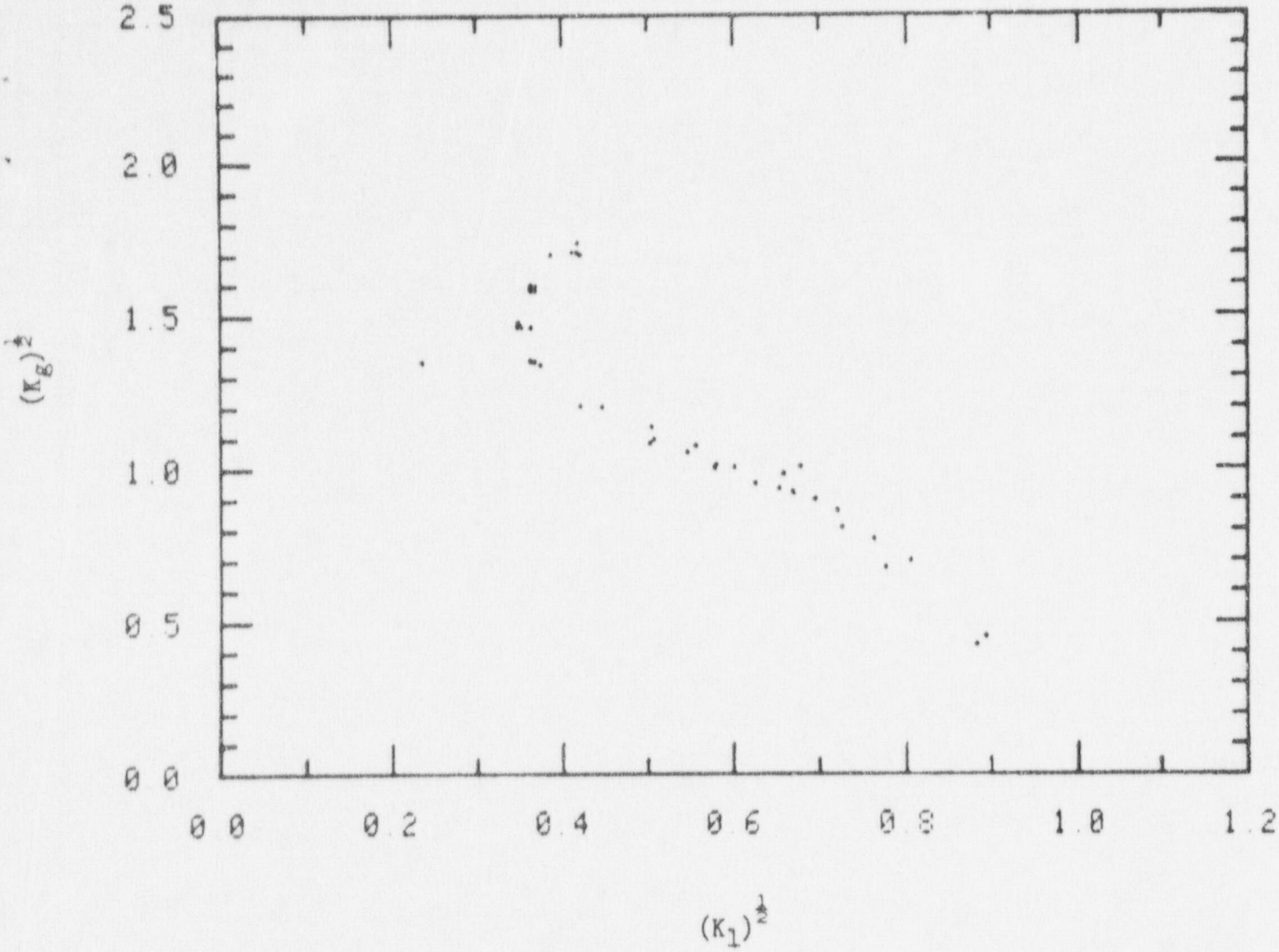


Fig. 30 Uncorrected CCFL results for KKU Control Rod Guide Shroud (Test Series F) outlet height = 0.305m.

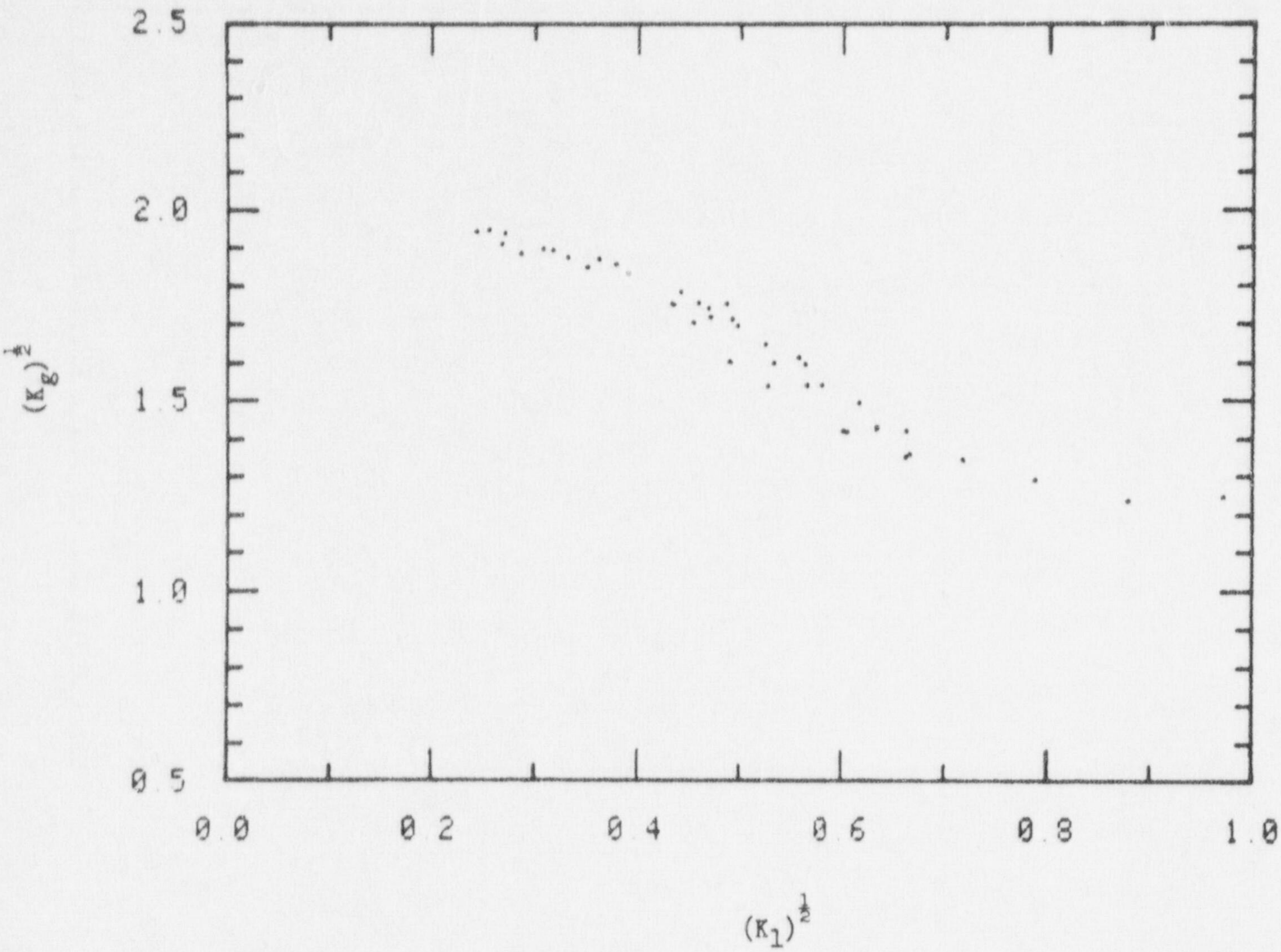


Fig 31 Uncorrected CCFL results for JAERI UCSP (Test Series G) outlet height = 0.305m.

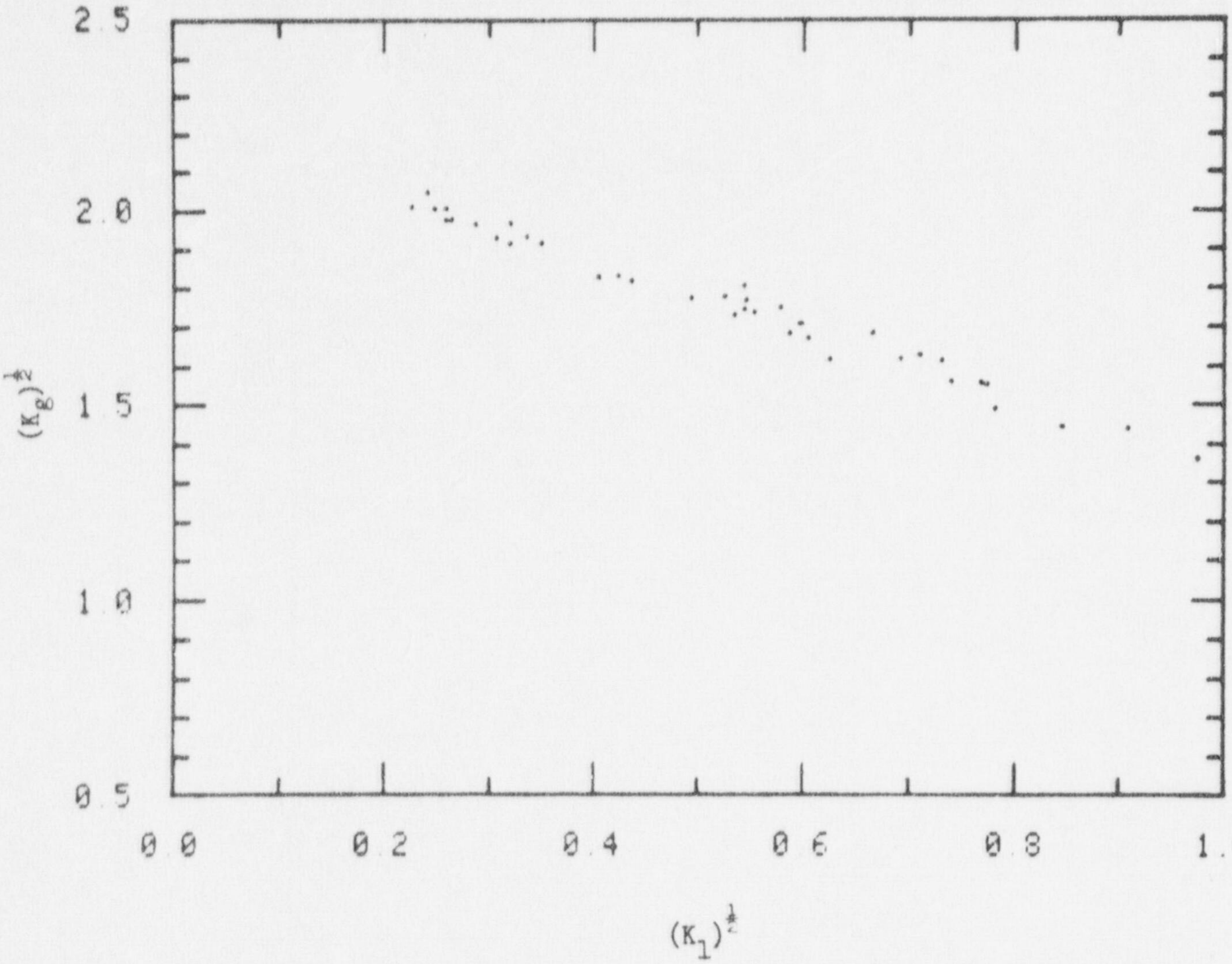


Fig. 32 Uncorrected CCFL results for JAERI UCSP (Test Series H) outlet height = 0.305m.

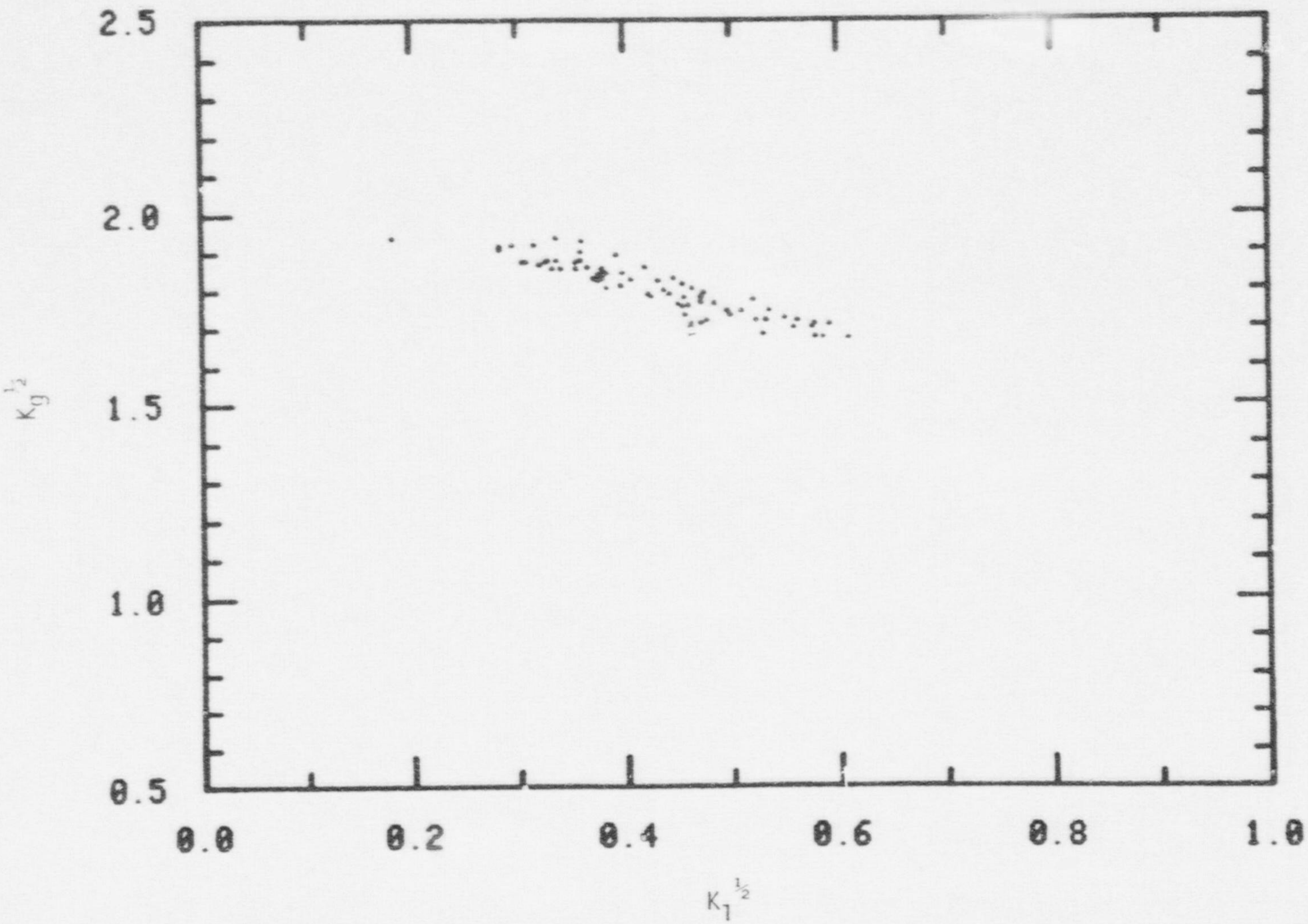


Fig. 33 Uncorrected CCFL results for JAERI UCSP supplemental tests (Test Series Y) outlet height = 0.813 m.

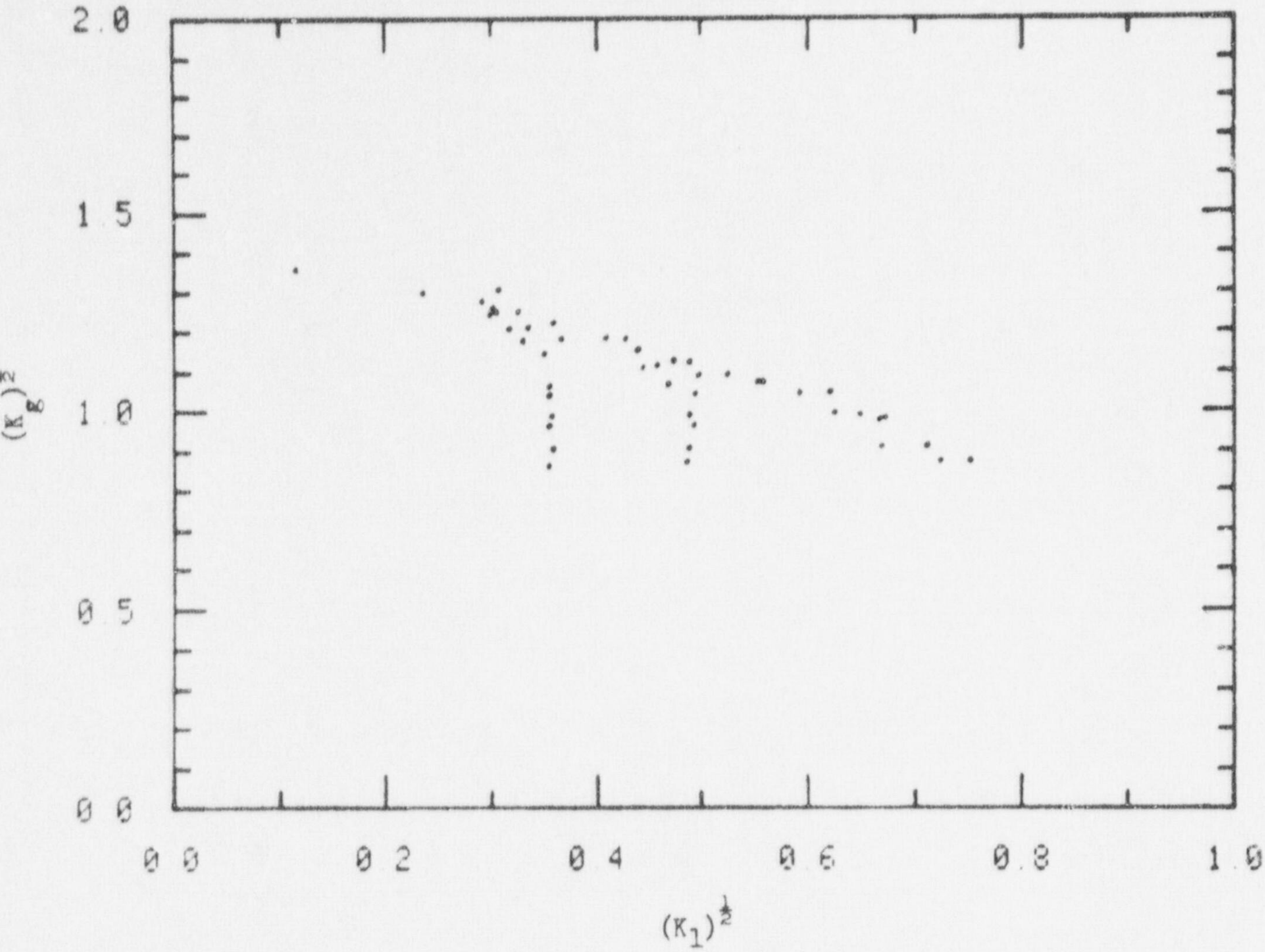


Fig. 34 CCFL results for Westinghouse 15x15 (TROJAN) Open Hole UCSP (Test Series I).

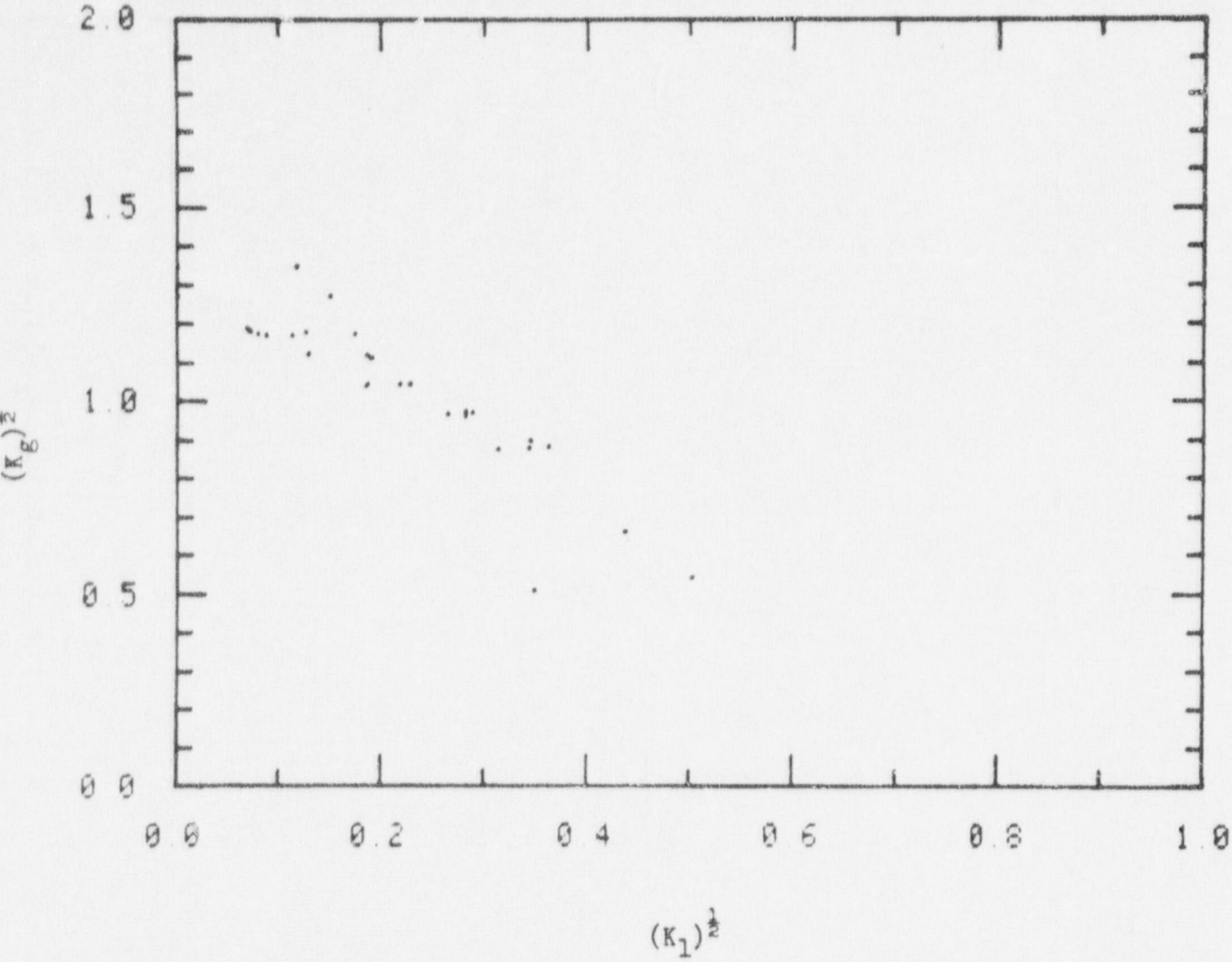


Fig. 35 CCFL results for Westinghouse 15x15 (TROJAN) Support Column (Test Series J).

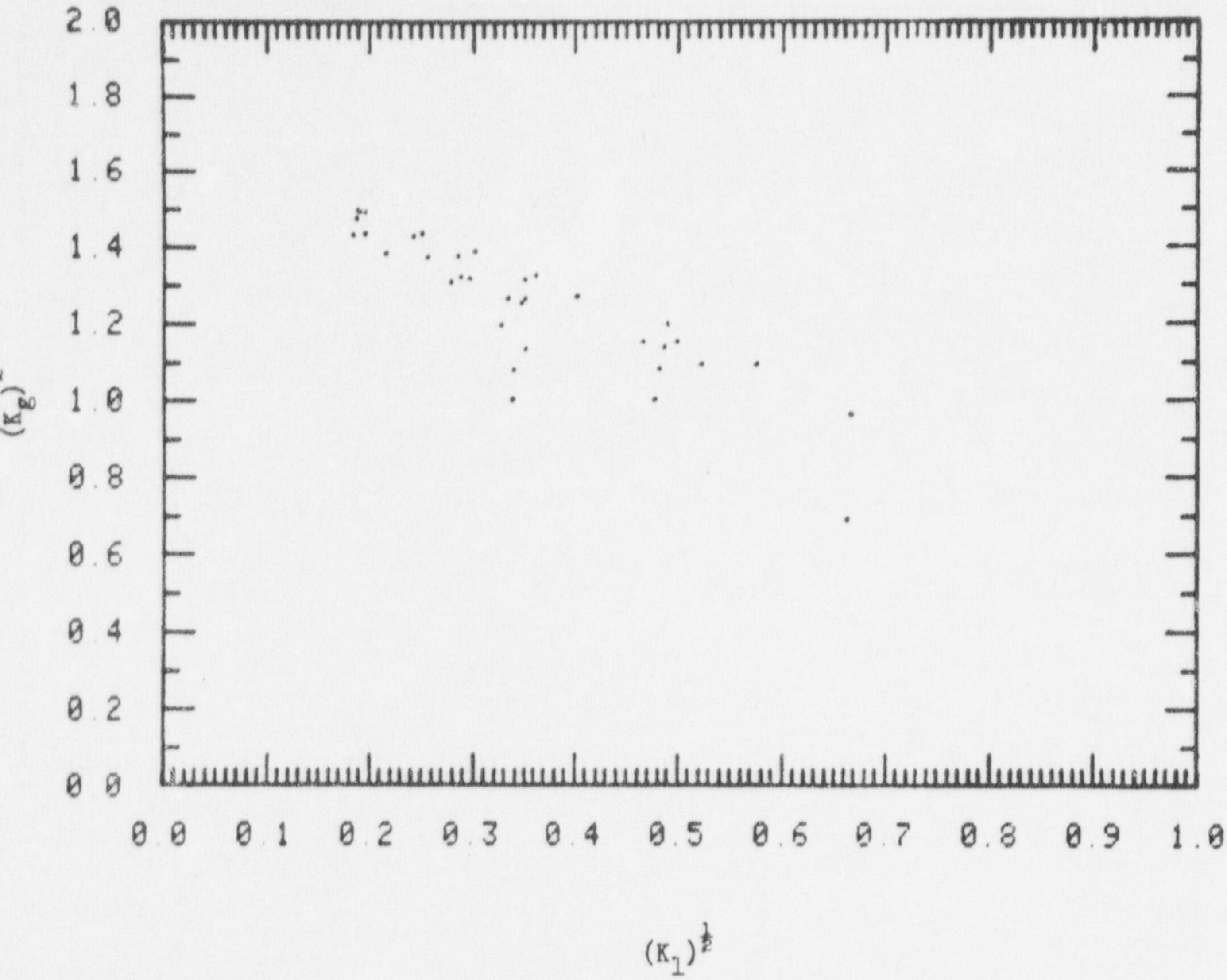


Fig. 36 CCFL results for Westinghouse 15x15 (TROJAN) Control Rod Guide Shroud (Test Series K).

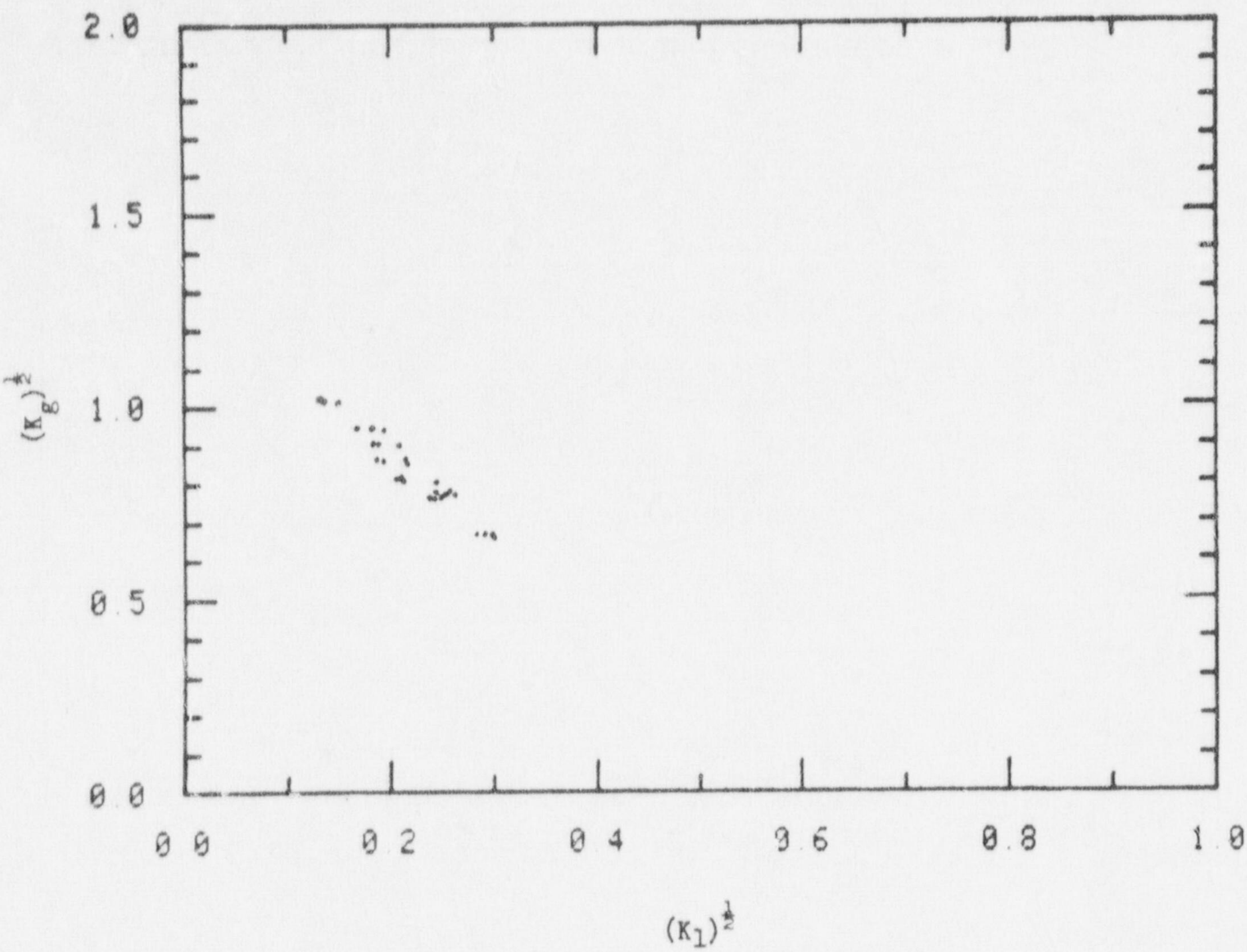
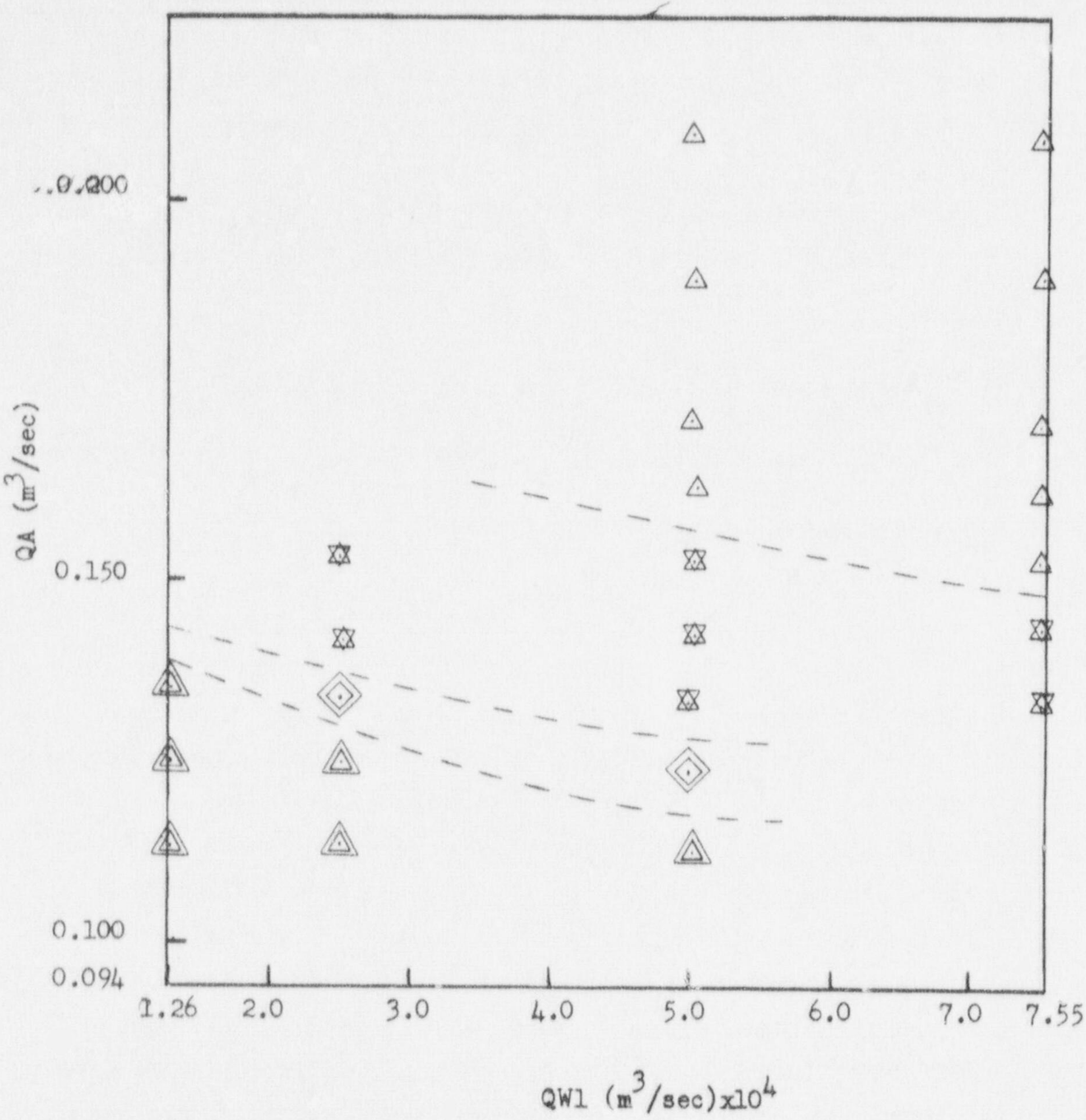


Fig. 37 CCFL results for Westinghouse 15x15 (TROJAN) Stub Mixer (Test Series L).



LEGEND: QA = Air Volumetric Flow Rate
QW1 = Core Region Water Injection Flow Rate
= Rapid Froth Buildup in Upper Plenum Occurred
= Immediate Flow into End Box, Slow Buildup in Upper Plenum
= Some Liquid in End Box, Very Little in Upper Plenum
= No Liquid into End Box

Fig. 38 Observed results of Special Entrainment Tests.

countercurrent liquid flow was penetrating downward from the upper plenum through the upper end box for $(K_G)^{1/2} > 1.8$., a mathematical function was then derived which predicts the observed division of QW1 fuel bundle region into entrained and fallback portions for those tests having $(K_G)^{1/2} < 1.8$. This function was as follows:

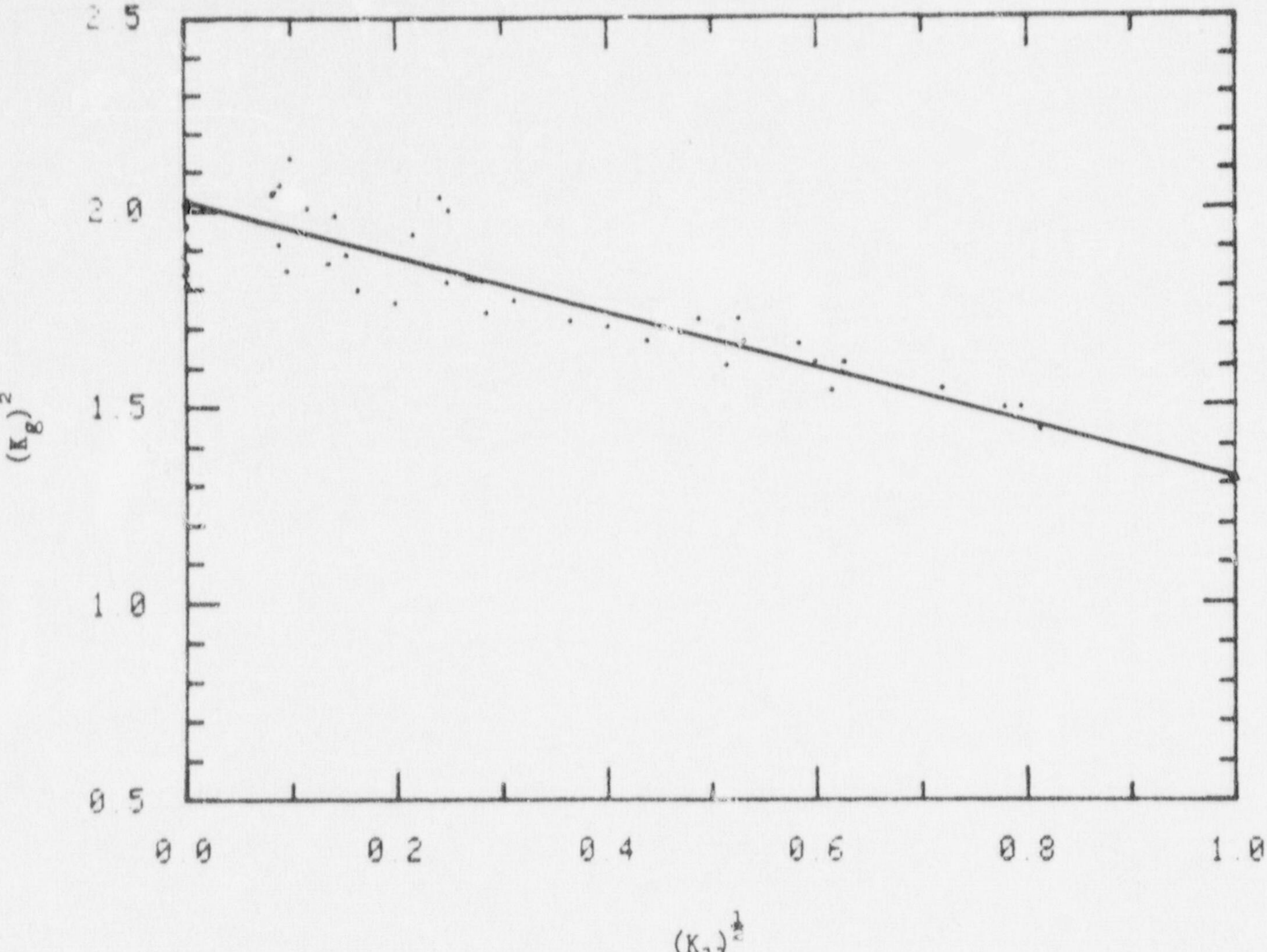
(1) for air flow rates (QA) < 0.142 m^3/s (300 CFM);
actual fallback (AFB) = measured fallback (MFB) - fuel bundle injection (QW1),

(2) for airflow rates 0.142 $m^3/s \leq QA \leq 0.209\ m^3/s$;

$$AFB = MFB - QW1\left[1 - \left(\frac{QA - 0.142}{0.209 - 0.142}\right)^2\right]$$, and

(3) for airflow rates QA > 0.209 m^3/s,
AFB = MFB

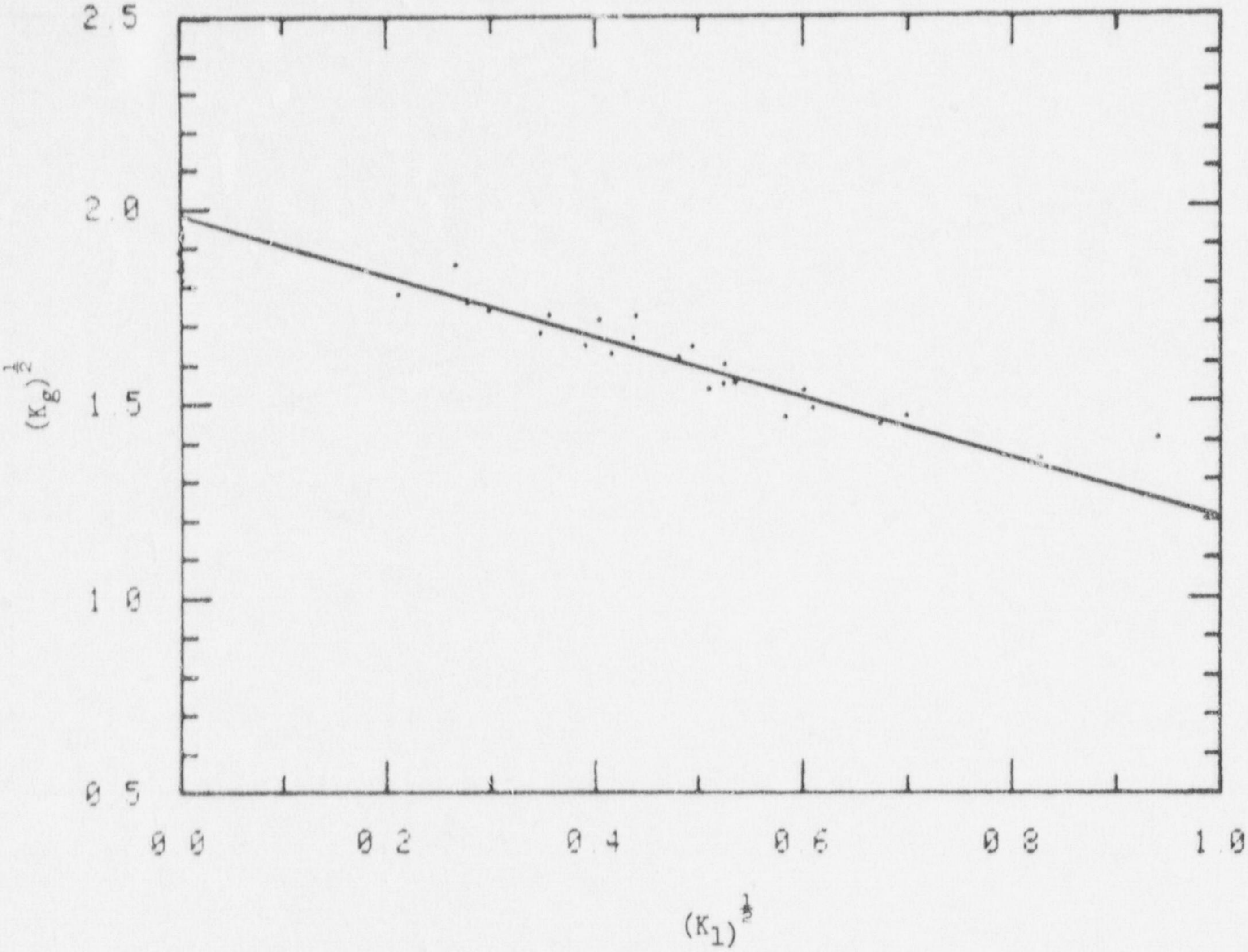
A direct comparison of the predictions of this function with results illustrated in Figure 38 can not be made, since the figure is only qualitative in nature and indicates the rate at which liquid builds up in the upper regions of the test section at various air and fuel bundle region water injection rates. Some degree of agreement, however, is indicated. Apparently, at air rates between 0.125 m^3/s and 0.142 m^3/s, entrainment is too limited to have any discernable effect on the overall mass balance, and for air rates greater than 0.142 m^3/s, entrainment increases more and more rapidly until complete entrainment occurs. Results of the treatment adjusting countercurrent flooding data for fallback of core region injection are shown on Figures 39 through 46 for Series A thru H. Test Series E and F results, which previously showed anomalous behavior, are depicted in Figures 43 and 44. Use of the entrainment fallback correction has resulted in excellent straight line correlations for Series E and F gas versus liquid Kutateladze number plots. Also included on the figures are straight lines fitted to the data by the least squares



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 0.720(K_l)^{\frac{1}{2}} = 2.04$$

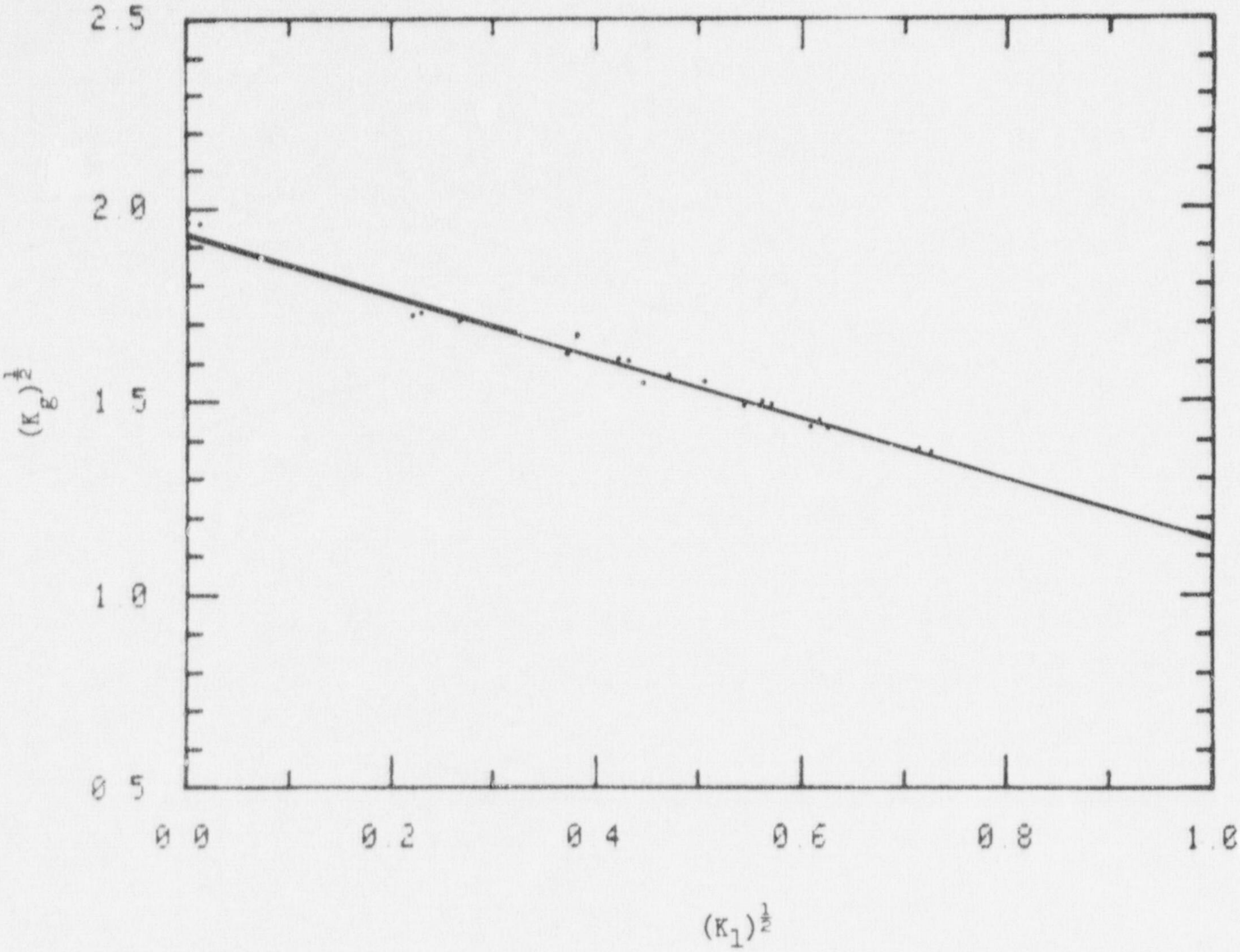
Fig. 39 CCFL results adjusted for core region injection fall-back, including least squares fit data, KKU Open Hole UCSP (Test Series A) outlet height = 0.813m.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 0.784(K_l)^{\frac{1}{2}} = 1.98$$

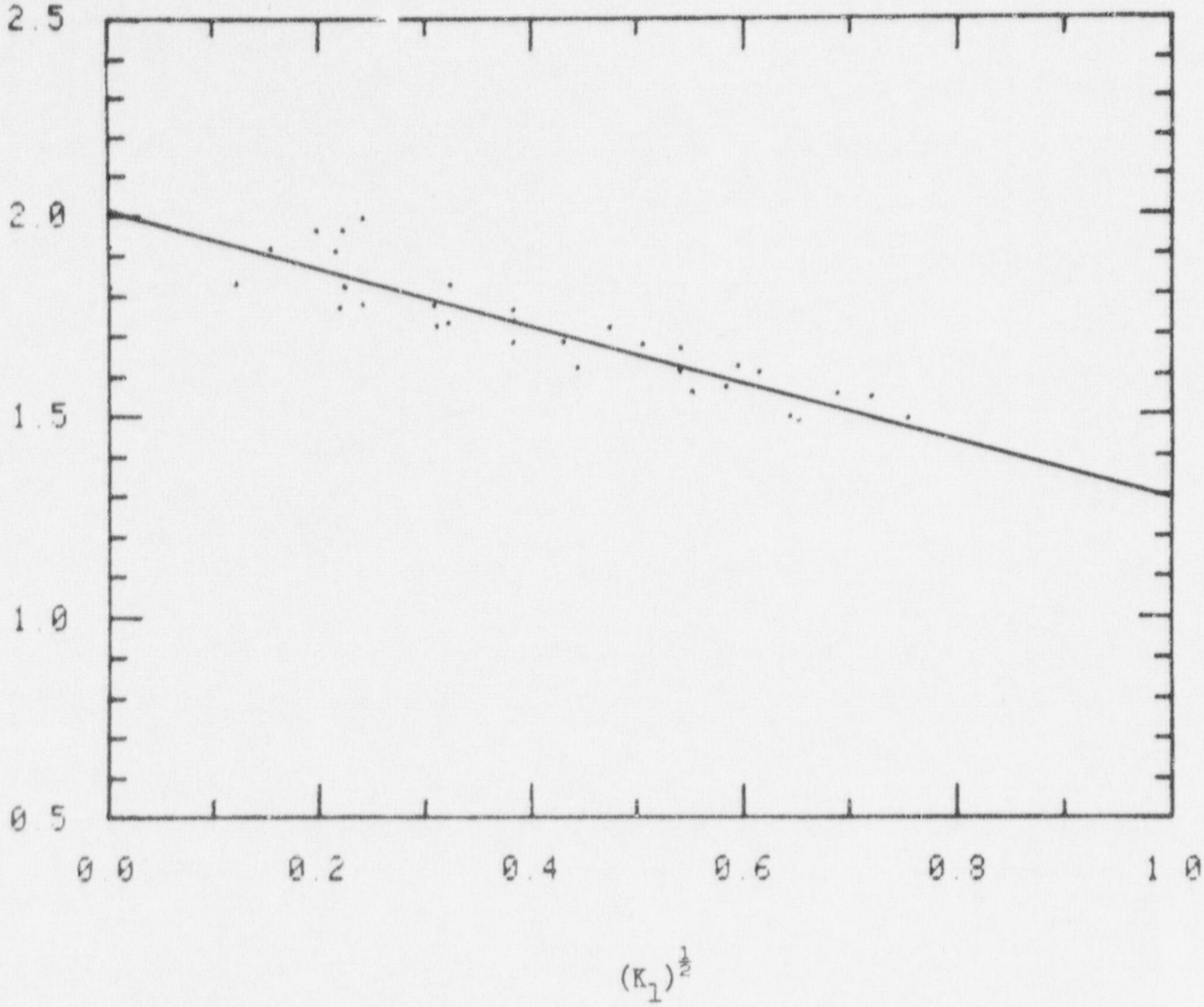
Fig. 40 CCFL results adjusted for core region injection fallback, including least squares fit data, KKU Open Hole UCSP (Test Series B) outlet height = 0.305m.



L... es Fit =

$$(K_g)^{\frac{1}{2}} + 0.798(K_l)^{\frac{1}{2}} = 1.93$$

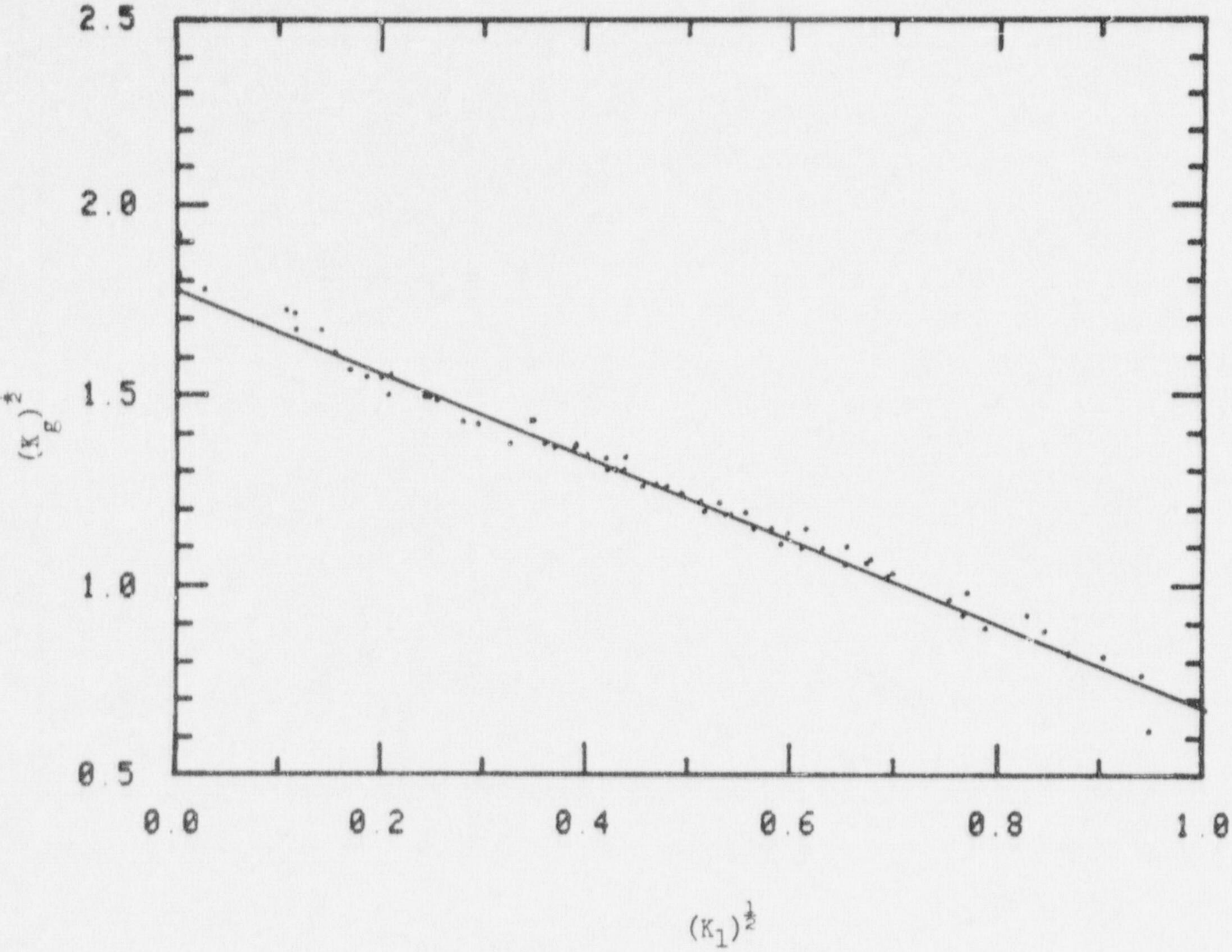
Fig. 41 CCFL results adjusted for core region injection fallback, including least squares fit data, KKU Support Column (Test Series C) outlet height = 0.305m.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 0.719(K_1)^{\frac{1}{2}} = 2.01$$

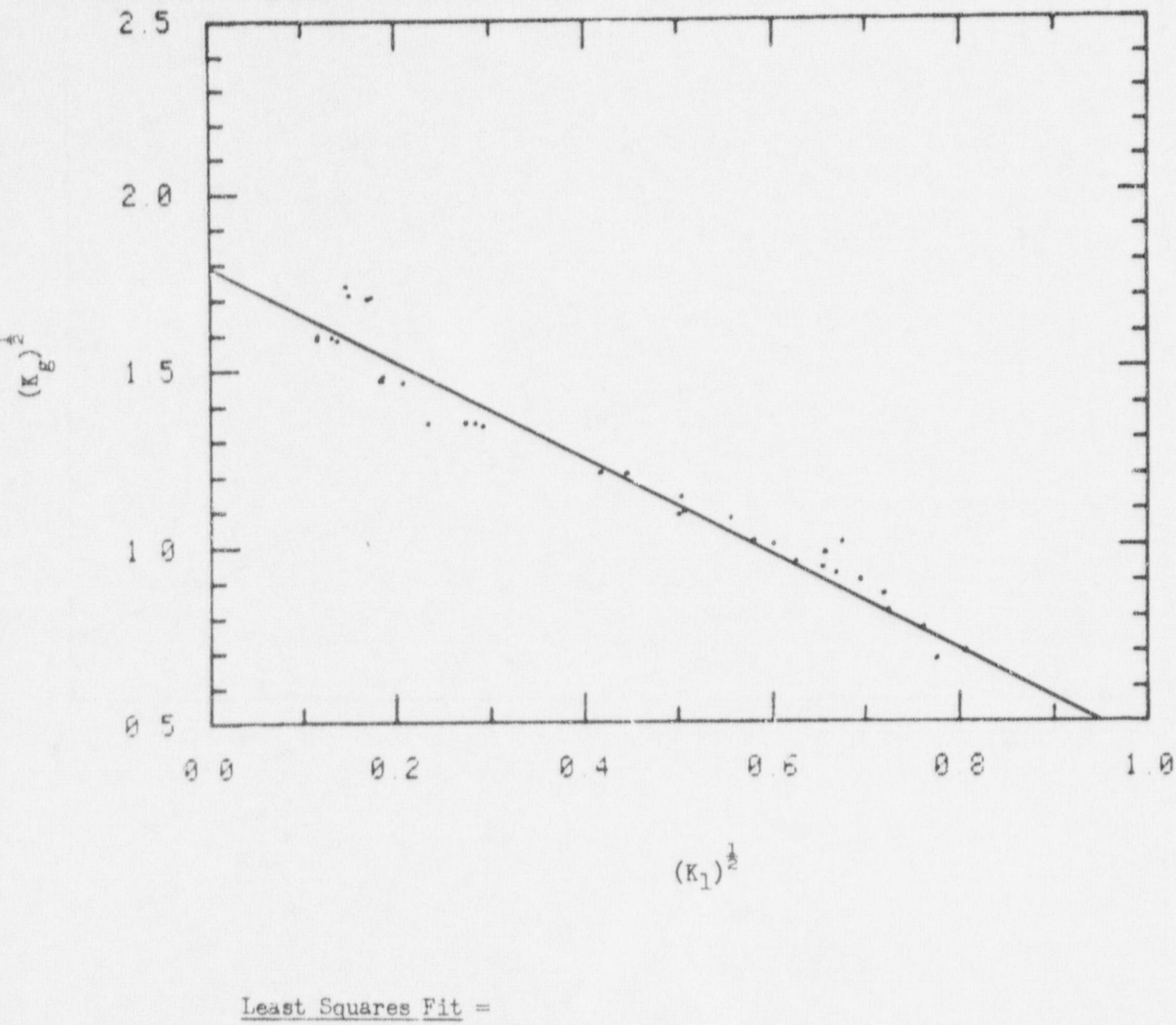
Fig. 42 CCFL results adjusted for core region injection fallback, including least squares fit data, KKU Support Column (Test Series D) outlet height = 0.813m.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 1.10(K_1)^{\frac{1}{2}} = 1.78$$

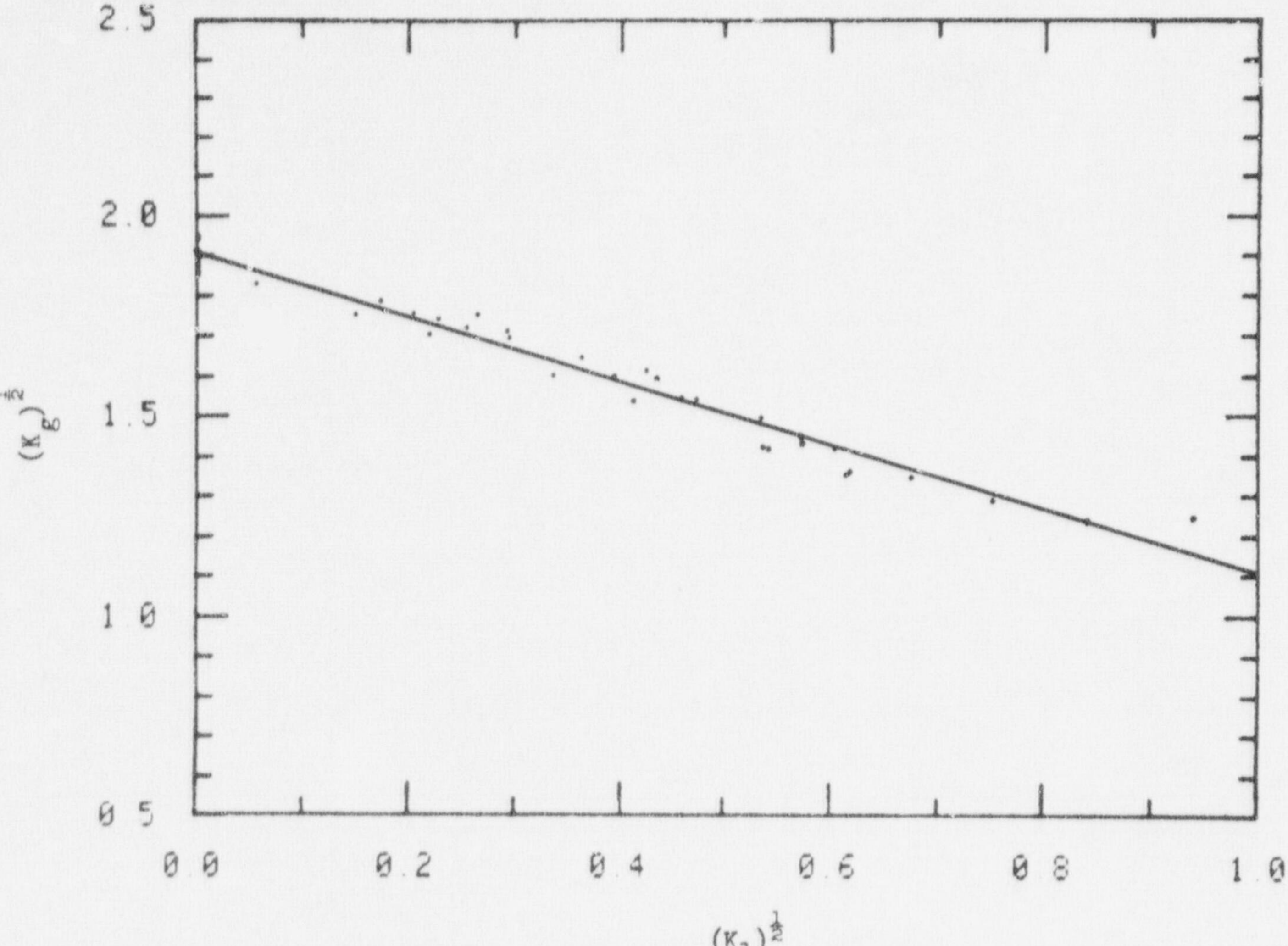
Fig. 43 CCFL results adjusted for core region injection fallback, including least squares fit data, KKU Control Rod Guide Shroud (Test Series E) outlet height = 0.813m.



<u>Least Squares Fit</u> =

$$(K_g)^{\frac{1}{2}} + 1.37(K_1)^{\frac{1}{2}} = 1.80$$

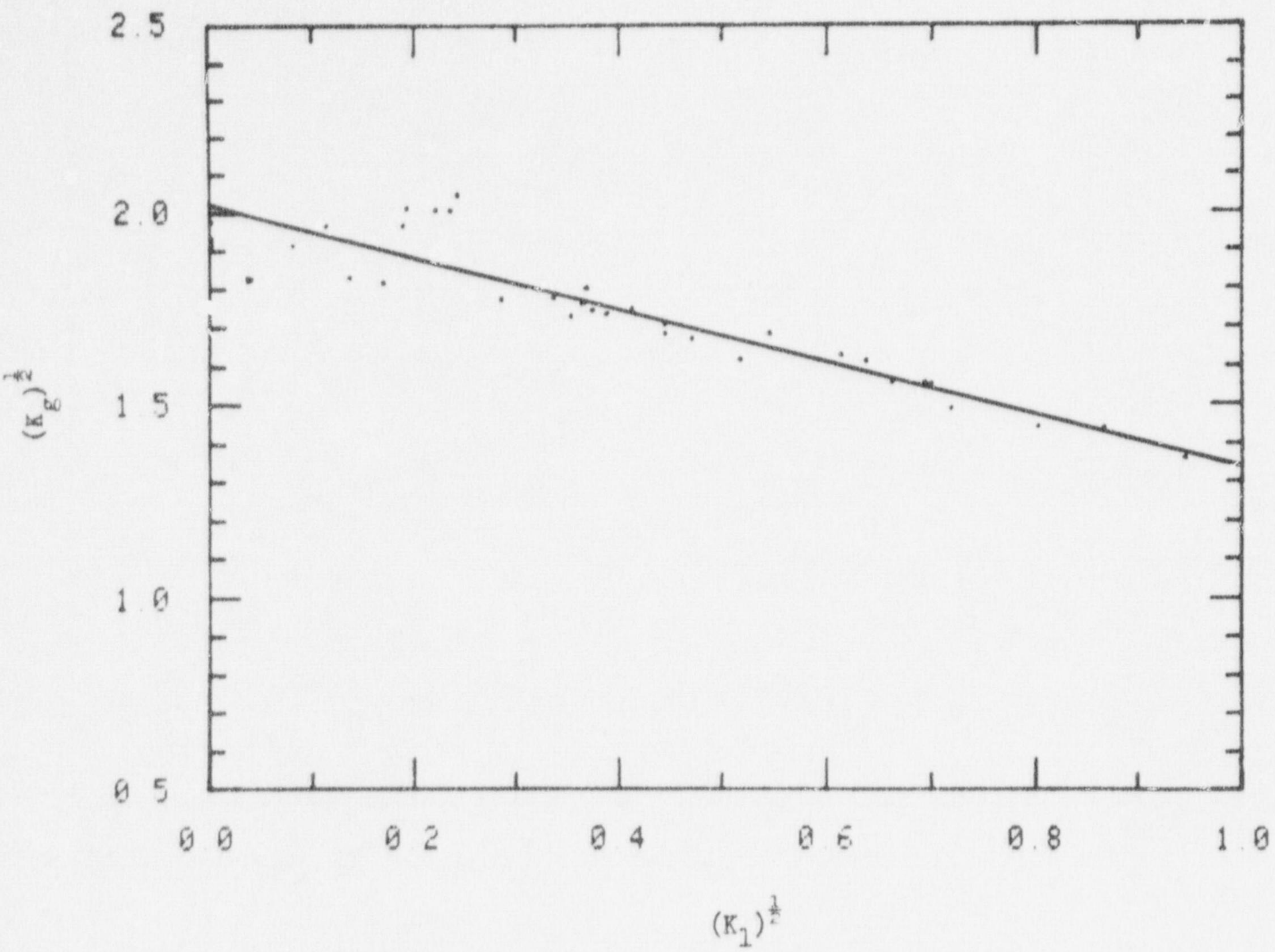
Fig. 44 CCFL results adjusted for core region injection fallback, including least square fit data, KKU Control Rod Guide Shroud (Test Series F) outlet height = 0.305m.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 0.800(K_1)^{\frac{1}{2}} = 1.90$$

Fig. 45 CCFL results adjusted for core region injection fallback, including least squares fit data, JAERI UCSP (Test Series G) outlet height = 0.305m.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 0.689(K_l)^{\frac{1}{2}} = 2.02$$

Fig. 46 CCFL results adjusted for core region injection fallback, including least squares fit data, JAERI UCSP (Test Series H) outlet height = 0.813m.

method and coefficients of the straight line fits. Those points with zero fallback or obviously below the flooding curve and have not been included in determination of the best fit straight line. Figures 47 thru 50 are reproductions of the data from the Westinghouse tests with best fit straight lines and coefficients. Note that it was not necessary to use the fallback adjustment on the Westinghouse tests because fuel bundle region injection was not used.

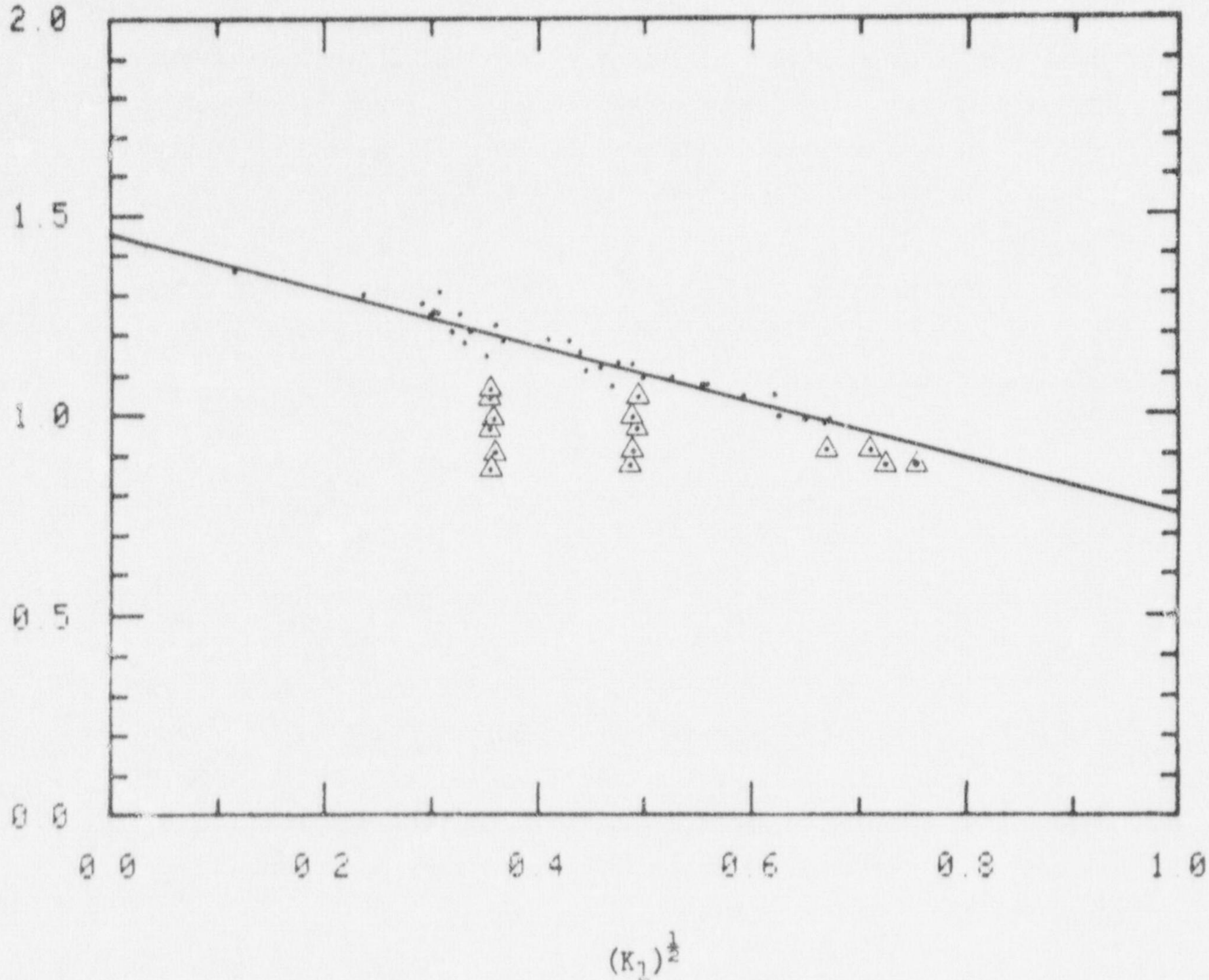
A compilation of $(K_G)^{1/2}$ $(K_L)^{1/2}$ correlations and statistics is also given in Table VII. Reference 3 contains a description of the statistical terms used in this table.

5. EFFECT OF THE UPPER PLENUM OUTLET HEIGHT

Test Series A, D, E, and H in which the simulated hot leg outlet from the upper plenum was located 0.813 m above the USCP were repeated with the outlet located 0.305 m above the USCP (Series B, C, F, and G). Comparison of the adjusted CCFL data from these series shown in Figures 35 thru 42 leads to the conclusion that the greater upper plenum liquid content occurring in the 0.813 m outlet height tests results in a small but definite increase in countercurrent liquid penetration.

6. COMPARISON OF KKU AND WESTINGHOUSE TEST RESULTS

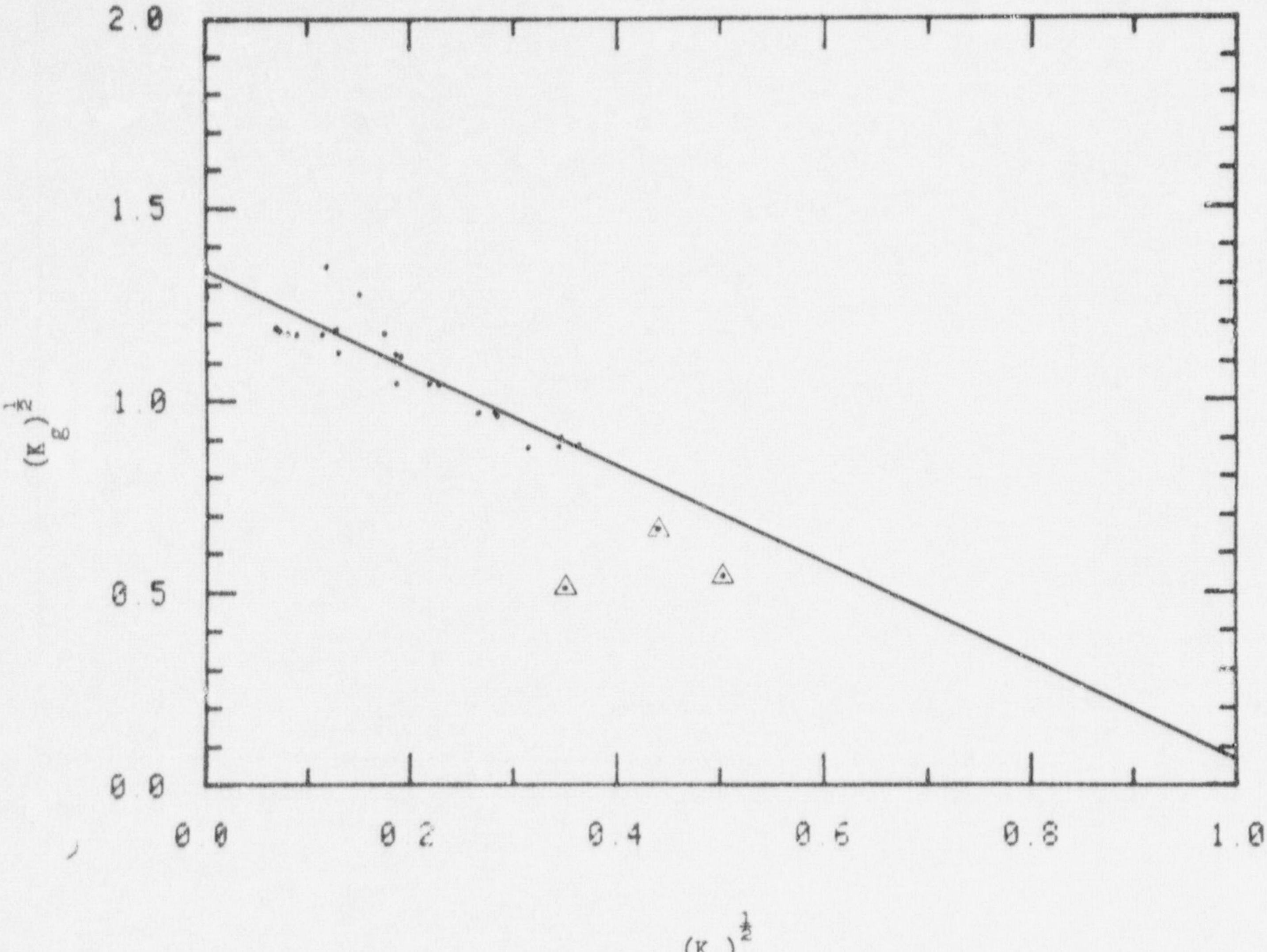
Countercurrent flooding data gathered for the KKU and Westinghouse type upper core region/upper plenum designs exhibit significantly different behavior. The KKU tests, in general, permitted a greater degree of liquid penetration of upper plenum stored liquid to the fuel bundle region at a given gas upward velocity. The differences appear to be due to the combined effects of (1) flow blockage or channeling caused by the thin plate positioned at the exit of the



Least Squares Fit: (Points designated by triangles excluded) =

$$(K_g)^{\frac{1}{2}} + 0.720(K_l)^{\frac{1}{2}} = 1.46$$

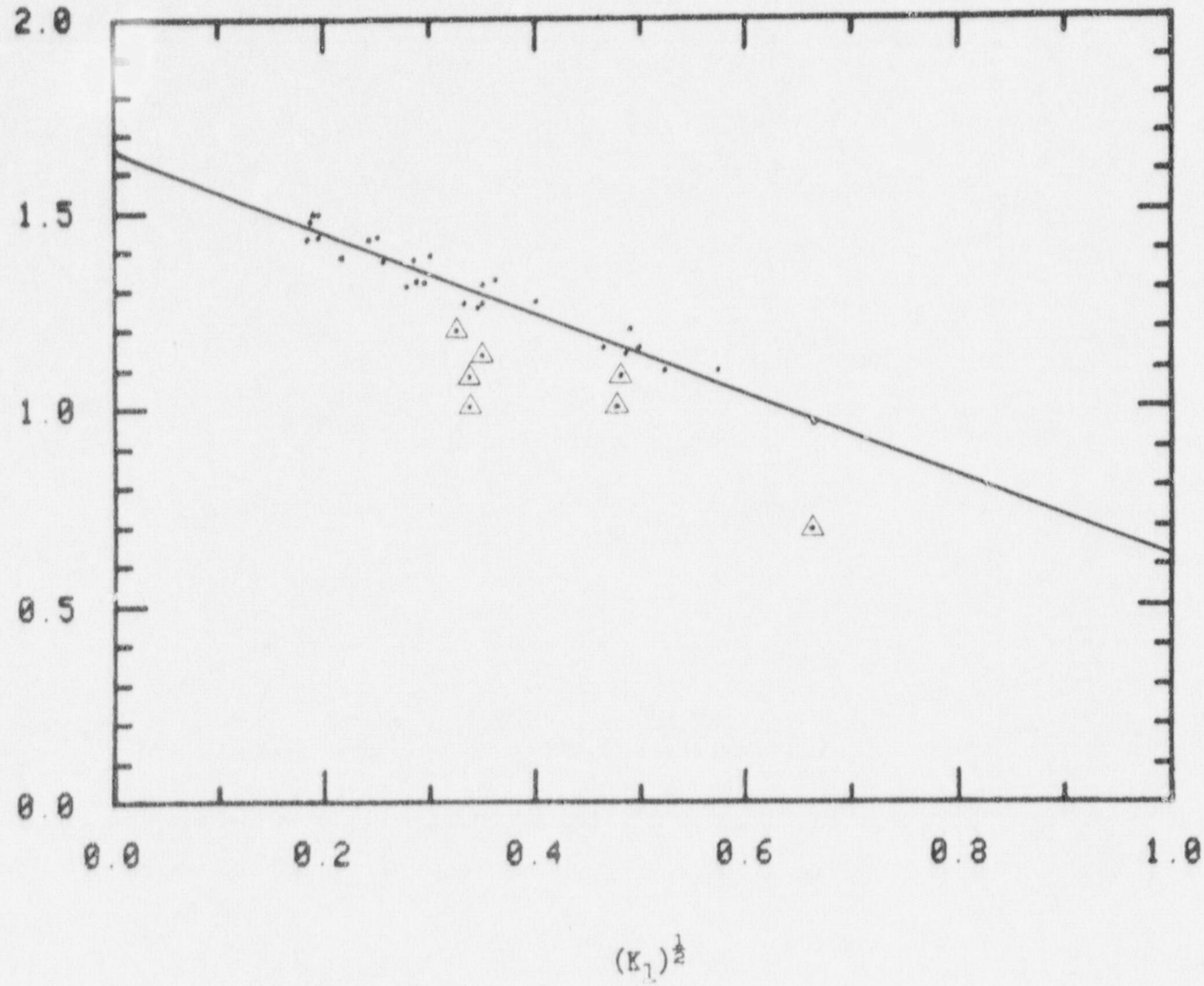
Fig. 47 CCFL results for Westinghouse 15x15 (TROJAN) Open Hole UCSP (Test Series I) including least squares fit data.



Least Squares Fit: (Points designated by triangles excluded) =

$$(K_g)^{\frac{1}{2}} + 1.26(K_l)^{\frac{1}{2}} = 1.33$$

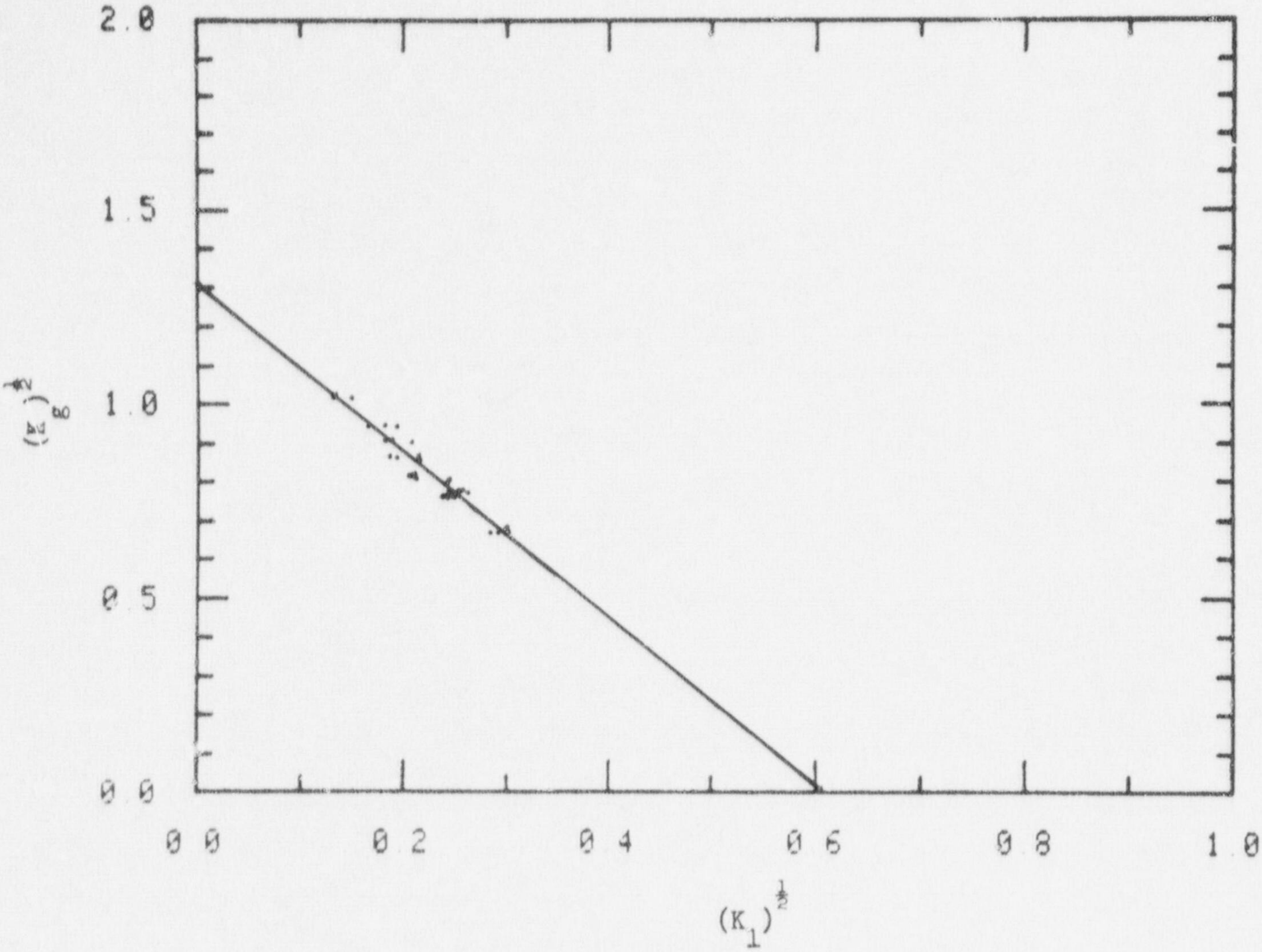
Fig. 48 CCFL results for Westinghouse 15x15 (TROJAN) Support Column (Test Series J) including least squares fit data.



Least Squares Fit: (Points designated by triangles excluded) =

$$(K_g)^{\frac{1}{2}} + 1.03(K_l)^{\frac{1}{2}} = 1.65$$

Fig. 49 CCFL results for Westinghouse 15x15 (TROJAN) Control Rod Guide Shroud (Test Series K) including least squares fit data.



Least Squares Fit =

$$(K_g)^{\frac{1}{2}} + 2.163(K_l)^{\frac{1}{2}} = 1.31$$

Fig. 50 CCFL results for Westinghouse 15x15 (TROJAN) Stub Mixer (Test Series L) including least squares fit data.

TABLE VII

COUNTERCURRENT FLOODING CORRELATIONS AND STATISTICS

(General Form of Correlation ; $(K_G)^{\frac{1}{2}} + A(K_L)^{\frac{1}{2}} = B$)

Test Series A (KKU Open Hole UCSP, 0.813 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 0.719(K_L)^{\frac{1}{2}} = 2.04$
Estimated standard deviation of coefficients	S.D.(A) = 0.0584 S.D.(B) = 0.0259
Coefficient of determination	0.830
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0792

Test Series B (KKU Open Hole UCSP, 0.305 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 0.784(K_L)^{\frac{1}{2}} = 1.98$
Estimated standard deviation of coefficients	S.D.(A) = 0.0541 S.D.(B) = 0.0267
Coefficient of determination	0.905
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0387

Test Series C (KKU Support Column, 0.305 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 0.798(K_L)^{\frac{1}{2}} = 1.93$
Estimated standard deviation of coefficients	S.D.(A) = 0.0279 S.D.(B) = 0.0137
Coefficient of determination	0.980
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0216

Test Series D (KKU Support Column, 0.813 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 0.718(K_L)^{\frac{1}{2}} = 2.01$
Estimated standard deviation of coefficients	S.D.(A) = 0.0613 S.D.(B) = 0.0280
Coefficient of determination	0.825
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0615

TABLE VII (CONT.)

Test Series E (KKU Control Rod Guide, 0.813 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{1/2} + 1.10(K_L)^{1/2} = 1.78$
Estimated standard deviation of coefficients	S.D.(A) = 0.0163 S.D.(B) = 0.00866
Coefficient of determination	0.987
Estimated standard deviation of $(K_G)^{1/2}$ on $(K_L)^{1/2}$	0.00300

Test Series F (KKU Control Rod Guide, 0.305 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{1/2} + 1.37(K_L)^{1/2} = 1.80$
Estimated standard deviation of coefficients	S.D.(A) = 0.0465 S.D.(B) = 0.0238
Coefficient of determination	0.958
Estimated standard deviation of $(K_G)^{1/2}$ on $(K_L)^{1/2}$	0.0740

Test Series G (JAERI UCSP, 0.305 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{1/2} + 0.800(K_L)^{1/2} = 1.90$
Estimated standard deviation of coefficients	S.D.(A) = 0.0336 S.D.(B) = 0.0163
Coefficient of determination	0.954
Estimated standard deviation of $(K_G)^{1/2}$ on $(K_L)^{1/2}$	0.0381

Test Series H (JAERI UCSP, 0.813 m U.P. Outlet)

Equation of best fit st. line	$(K_G)^{1/2} + 0.689(K_L)^{1/2} = 2.02$
Estimated standard deviation of coefficients	S.D.(A) = 0.0542 S.D.(B) = 0.0265
Coefficient of determination	0.838
Estimated standard deviation of $(K_G)^{1/2}$ on $(K_L)^{1/2}$	0.0729

TABLE VII (CONT.)

Test Series I (Westinghouse Open Hole UCSP)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 0.720(K_L)^{\frac{1}{2}} = 1.46$
Estimated standard deviation of coefficients	S.D.(A) = 0.0319 S.D.(B) = 0.0145
Coefficient of determination	0.946
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0243

Test Series J (Westinghouse Support Column)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 1.26(K_L)^{\frac{1}{2}} = 1.33$
Estimated standard deviation of coefficients	S.D.(A) = 0.129 S.D.(B) = 0.0285
Coefficient of determination	0.813
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0574

Test Series K (Westinghouse Control Rod Guide Shroud)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 1.03(K_L)^{\frac{1}{2}} = 1.65$
Estimated standard deviation of coefficients	S.D.(A) = 0.0536 S.D.(B) = 0.0198
Coefficient of determination	0.934
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0367

Test Series L (Westinghouse Stub Flow Mixer)

Equation of best fit st. line	$(K_G)^{\frac{1}{2}} + 2.16(K_L)^{\frac{1}{2}} = 1.31$
Estimated standard deviation of coefficients	S.D.(A) = 0.102 S.D.(B) = 0.0227
Coefficient of determination	0.942
Estimated standard deviation of $(K_G)^{\frac{1}{2}}$ on $(K_L)^{\frac{1}{2}}$	0.0265

westinghouse end box, and (2) general differences in design of upper plenum internals. The overall impression received is that upper plenum to core region countercurrent liquid penetration is extremely geometry dependent.

7. FROTH DENSITY RESULTS

The density of the upper plenum froth was measured by two methods. In test groups W-1, W-2 and the supplemental tests performed with the JAERI CCRTF configuration, gamma densitometer measurements were made at a location 0.08 m above the UCSP. In group W-4, the measurement was made 0.05 m above the top of the stub flow mixer. The results are included in Tables A-9, A-10, A-11, and A-13 in Appendix A. The alternate density estimate was derived from measurements of the amount of liquid draining back to the bottom of the test vessel upon cessation of air and water inlet flows. The results of these tests are shown in Table VIII.

This table also contains the identification of tests performed with similar air and water flow rates, and the densities measured by the gamma densitometer for these tests.

The comparison of the results generated by each density measurement method shows that the gamma densitometer predicted higher froth densities. Two potential reasons for this have been identified. First, the gamma densitometer scans the bottom region of the froth mixture, where the froth might be expected to be more dense due to the presence of the water injection and the accumulation of water flowing down along the vessel upper plenum wall. Second, the direct-fallback measurements are expected to be low since the method employed for these tests allowed the loss of some upper plenum water into the air injection diffusers (see Figure 1). The magnitude of this effect is

TABLE VIII

UPPER PLENUM LIQUID CONTENT TEST RESULTS

TEST SERIES	AIR INJECTION RATE ($m^3/s \times 10^2$)	WATER INJECTION RATE ($m^3/s \times 10^3$)	UPPER PLENUM LIQUID CONTENT ($m^3 \times 10^2$)
W-1	5.19	1.26	1.12
	5.19	1.26	1.43
	5.19	1.26	1.32
	6.14	1.26	1.66
	7.08	1.26	1.88
	8.02	1.26	1.79
	8.02	1.26	1.97
	8.97	1.26	1.73
	8.97	1.26	1.88
	9.91	1.26	1.79
	9.91	1.26	1.84
W-2	9.91	.315	.95
	9.91	.631	1.04
	9.91	1.26	1.07
	9.91	1.89	1.18
	7.55	.315	1.18
	7.55	.631	1.29
	7.55	1.26	1.36
	7.55	1.89	1.45
	4.72	.315	0.82
	4.72	.631	1.38
	4.72	1.26	1.50
	4.72	1.89	1.59
W-4	2.83	1.26	1.70
	3.78	1.26	1.70
	4.72	1.26	1.50
	5.66	1.26	1.50

thought to be small, but cannot be estimated accurately due to the difficulty experienced in measuring the amount of water in the air lines. This inaccuracy is estimated as less than ten percent of the measured density, based on attempts to measure the liquid gathered when the air lines were drained after several fallback measurement tests.

Some systematic variation with air flowrate was observed in the density measurement made with the gamma densitometer in the three Westinghouse tests. These trends are shown on in Figures 52 and 53. The unusual behavior shown on Figure 51 is believed to be caused by calibration error rather than an abrupt change in flow structure. Although the trend of these data is expected - low air flows lead to denser froths - the significant wall effects in the one bundle sized vessel minimize usefulness of the froth density data in predicting large scale upper plenum behavior. Observation of the froth suggests the presence of a thick film of water running down the upper plenum vessel walls. The densitometer is sensitive to this film which masks the density of the two-phase mixture in the center of the upper plenum. The figures, therefore, are presented only as qualitative evidence of the trend of such behavior.

8. CINEMATOGRAPHY

Motion Pictures were made of representative flow patterns and flow rates for all test series. In general, the pictures are sufficient to illustrate the general flow pattern in the upper plenum but are not detailed enough to show small scale, droplet behavior. The upper end box and core region flow patterns are not shown.

9. SIGNIFICANCE OF PRIOR CCFL STUDIES

The general problem of countercurrent flooding has received considerable attention due to two primary factors. First, in simple geometries (i.e., round tubes), where a liquid film falls relative to

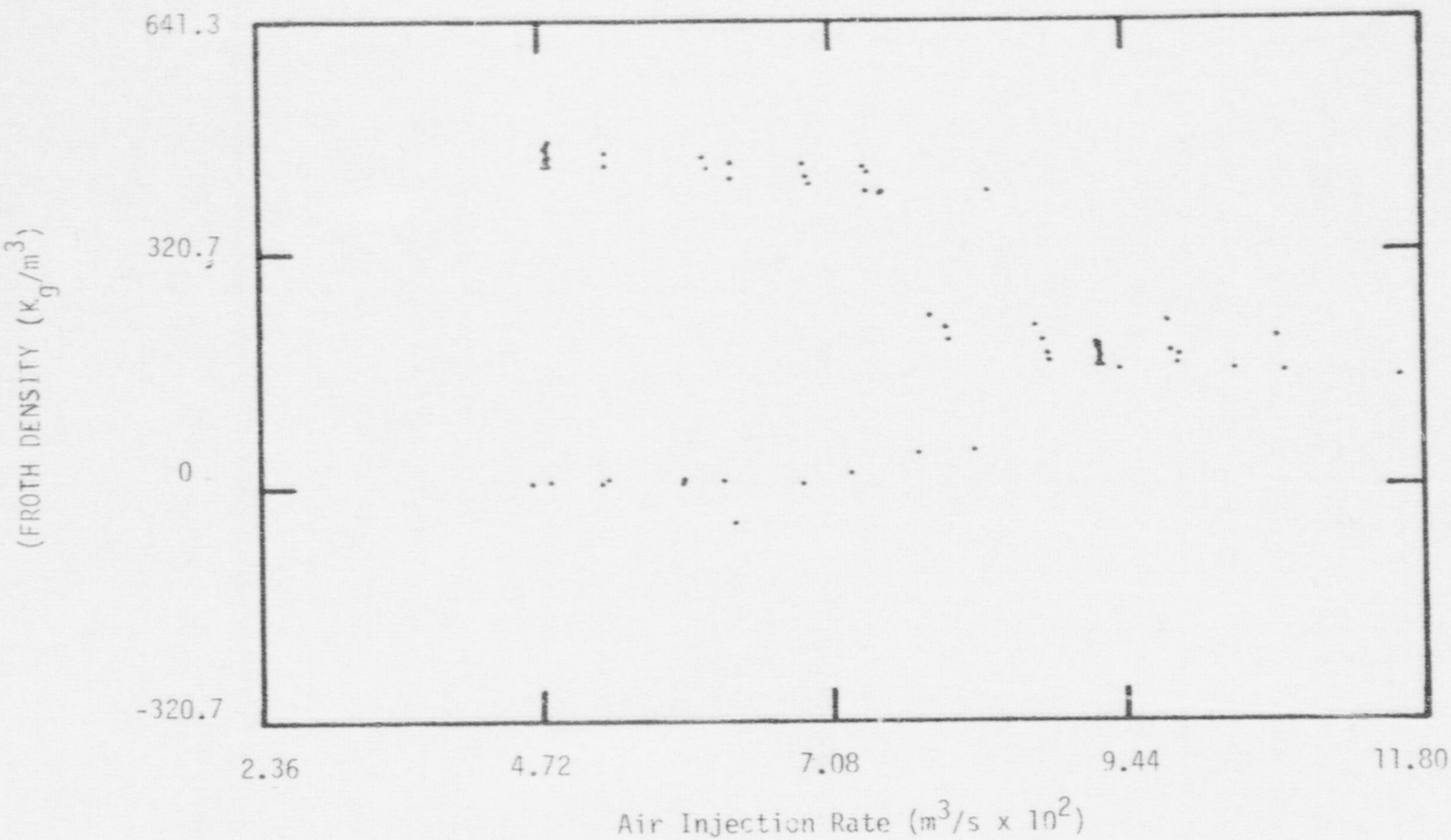


Fig. 51 Froth density versus air injection rate for Westinghouse UCSP model test.

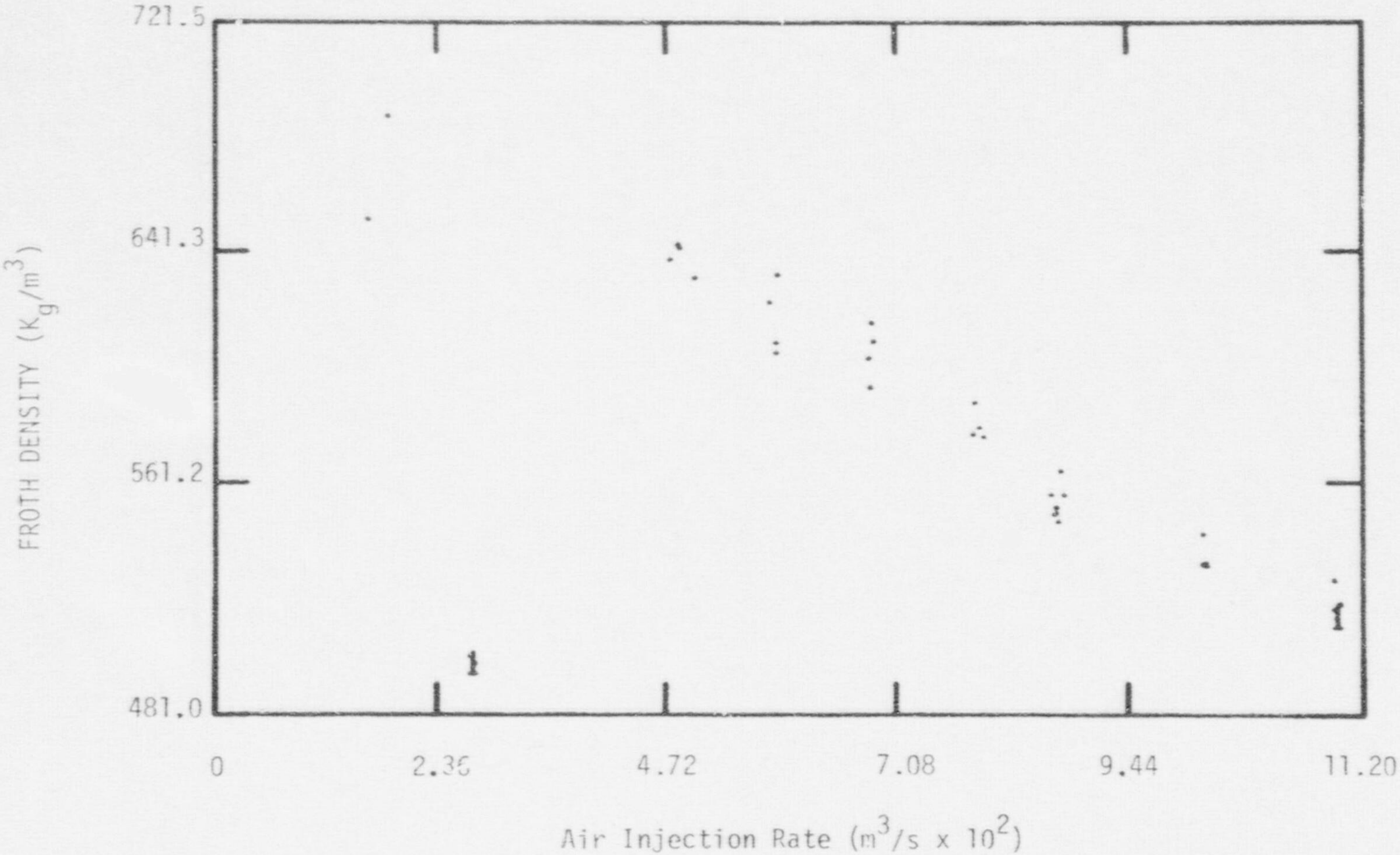


Fig. 52 Froth density versus air injection rate for Westinghouse support column model test.

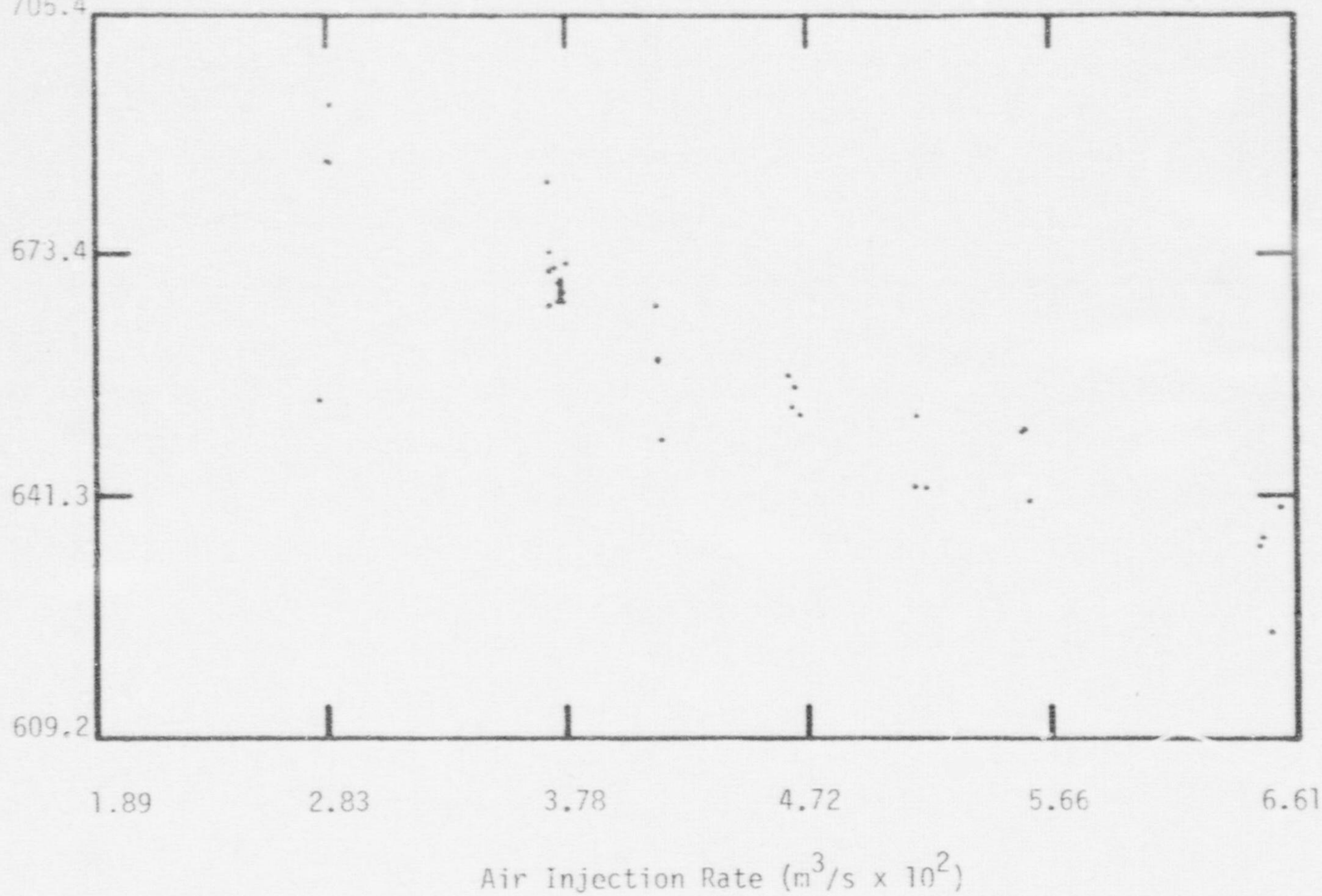


Fig. 53 Froth density versus air injection rate for Westinghouse flow mixer model test.

the up-flowing gas, it presents a basic situation in which interfacial stability and drag phenomena may be studied and modeled. Second, it is an important effect in some chemical processing equipment; distillation columns, gas absorption columns, etc. The attention focused on CCFL for these reasons has resulted in a number of studies aimed at the development of empirical relationships for flooding behavior. The description of this behavior from a theoretical viewpoint has not yet been successful. Early CCFL studies are described in Reference 4. Few studies to date have employed geometries more complicated than single tubes or annuli. This lack of PWR-typical geometry in previous studies is particularly important, since the results from this program indicate that test system geometry can have a significant effect on flooding behavior. Two experimental studies which have been performed in more complicated geometries are the BWR component flooding studies performed by General Electric, Co., (References 5 & 6), and the parallel tube and orifice studies by Hagi, Wallis, and Richter (Reference 7). The results of the study by Hagi are particularly important since they demonstrated that the flooding behavior for a system of two parallel tubes (or orifices) differs from what would be predicted from single tube data. Their study and analytical techniques, however, have not been generalized to more than two parallel flow paths.

Other dissimilarities between this study and classical CCFL experiments involve the methods used to inject the gas and liquid into the flooding region. In the classical studies, entrance and exit regions are designed to minimize disturbance of the gas flow in the flooding region. Also, liquid is introduced into the wall film in a manner which produces minimal disruption to the down-flowing film. These idealized flow conditions are not possible in the complicated geometries typical of nuclear reactors. The flow path for the air in this experiment was non-linear, and the water entered the flooding region as a turbulent two-phase mixture.

In general, the geometry dependent behavior observed in this experiment does not compare well with any of the empirical relationships developed in simpler geometries. The KKU models flooding curves are somewhat higher than the classical results, while the Westinghouse type models exhibited considerably varying behavior somewhat near or below the empirical predictions. The empiricisms are not reproduced here since their use is not straightforward in a complicated geometry— the Wallis type correlation (Reference 5) requires a characteristic length, which is somewhat ambiguous in this geometry.

10. SIMULATION OF THE AIR-WATER TEST APPARATUS VIA THE "TRAC" COMPUTER CODE

One of the objectives of the overall Nuclear Regulatory Commission (NRC) 3-D Program is the verification of the TRAC computer analysis program. TRAC is an advanced nuclear reactor analysis code intended for use in modeling reactor behavior during transient or accident conditions (Reference 8). It is intended to be capable of modeling reflood behavior, so it was anticipated that the simulation of a CCFL experiment would provide a useful tool for preliminary checkout of the code. A detailed report of the results of this study will be published elsewhere. A brief summary of the code data comparisons is included here to provide insight into the capability of TRAC to simulate this system, and to point out some of the features of the analytical results that are important to understanding the experimental behavior.

The TRAC results are summarized in Table IX which also compares them to the experimental data. In general, the TRAC results agree reasonably well with the data for both the CCFL and froth density comparisons. The model used in the calculations is described in Appendix D.

TABLE IX

"TRAC" CALCULATION RESULTS

TEST NUMBER	AIR FLOWRATE (m^3/s)	LOWER WATER INJECTION RATE ($m^3/s \times 10^3$)	UPPER WATER INJECTION RATE ($m^3/s \times 10^3$)	EXPERIMENTAL FALLBACK RATE ($m^3/s \times 10^3$)	TRAC CALCULATED FALLBACK RATE ($m^3/s \times 10^3$)	EXPERIMENTAL FROTH DENSITY	TRAC CALCULATED FROTH DENSITY
Y02	0.152	0.0	0.932	0.471	0.379	366	390
Y06	0.169	0.0	0.915	0.332	0.331	301	266
Y10	0.187	0.0	0.909	0.273	0.312	315	270
Y25	0.147	0.188	0.777	0.707	0.578	375	260
Y34	0.187	0.150	0.767	0.370	0.384	272	260
Y49	0.146	0.465	0.443	0.726	0.832	351	260
Y58	0.187	0.467	0.447	0.196	0.718	260	280

The TRAC calculations have displayed behavior which has aided the understanding of the experimental results. One such feature is amount of time required to reach a steady state fallback condition. The calculations indicated that approximately twenty seconds is needed before the fallback rate stabilitzes. Since a similar startup time was allowed before the data was gathered for each test point, it is assumed that a quasi-steady state existed during the tests. Another calculated phenomenon of interest is the behavior of the core injected water. The startup of the calculations showed immediate dumping of core injected water into the bottom of the vessel. This has reinforced the opinion that core entrainment was not successfully duplicated with the present mixer design. Also, the code-data agreement seems much better when core entrainment is not employed, suggesting that overall modeling could possibly be improved with a better entrainment mixing scheme. This code-experiment comparison will be expanded in the future, and will include calculations simulating other test configurations.

V. CONCLUSIONS AND RECOMMENDATIONS

This experimental program has resulted in an increased knowledge of flow behavior for PWR vessels during reflood flow conditions. Some specific conclusions drawn from the experimental results are listed below. In addition, recommendations are made for future test programs of this nature that could enhance the data quantity for such tests.

1. CONCLUSIONS

The most important result of this test series is the evidence that significant countercurrent liquid penetration from the upper plenum to the core and significant upper plenum liquid storage may occur in a PWR during reflood. This result suggests that steam

binding may be less severe in PWR reflood than calculated under licensing type assumptions. In addition, the geometry dependence of the CCFL behavior has been demonstrated, indicating that use of empirical models based upon CCFL experiments in nontypical geometries is not correct for reactor reflood analysis.

Another result of importance is the qualitative description of the upper plenum gas-liquid mixture during reflood. The existence of a distinct turbulent froth, which persists over the range of air flows representative of reflood conditions, has been demonstrated. This flow structure must be considered when upper plenum instrumentation is designed for reflood experiments.

The problems associated with simulation of core-entrained water at the top of the core have been mentioned previously. These problems appear to be inherent in experimental designs that do not include a heated core. We conclude that adequate mixer designs for upper plenum simulation experiments require further analysis and development.

Upper plenum outlet height was demonstrated to have an effect on CCFL behavior. This suggests that CCFL may be influenced by the upper plenum water inventory. Presently accepted empiricisms used to describe CCFL behavior do not include this effect, thus suggesting that improvement is required in these models to describe PWR-typical behavior.

The disagreement between the results generated by the two different froth density measurements suggests that a single density measurement with a gamma densitometer, combined with a known froth height, may not be sufficient to estimate upper plenum liquid content. A vertical array of densitometers may be required to accurately determine the froth density variation with elevation, and thereby estimate the amount of water stored in the froth above the UCSP.

The empirical models developed for CCFL behavior in the various different reactor geometries are limited in their utility since high temperature steam-water data would be needed to duplicate PWR conditions. These correlations reflect the geometry influences of the different designs, but further steam-water data are needed to verify their applicability to PWR reflood flow behavior.

2. RECOMMENDATIONS

The results of thse experiments strongly indicate a geometry influence upon CCFL which (to date) cannot be predicted in advance. The CCFL behavior of other reactor designs during reflood flow conditions therefore can be determined only by individual tests of the different designs. In anticipation of future CCFL testing of this nature, the following recommendations are offered:

1. The modeling of core entrainment is extremely difficult in this type of experiment. The need for realistic air (or steam) flows requires at least a short section of simulated core, but an unheated core readily allows fallback of the supposedly entrained water. The need exists for further study of entrainment effects and effective methods of simulating entrainment.

2. The film of water on the vessel walls is an effect peculiar to small scale tests. Multibundle tests would minimize this effect and provide a much improved simulation of realistic upper plenum behavior.

3. Air-water tests cannot simulate phase nonequilibrium. Thus, correct simulation of upper head injection (Westinghouse or BWR) or hot leg injection (German design) plants with air-water is not possible. In addition, superheated steam is expected to exit the core during some periods of reflood. The effect of this nonequilibrium upon CCFL is not known,

but could be significant. Steam-water testing would allow investigation of these effects and also the use of a heated core to produce typical core region entrainment characteristics. Further analytical studies via "TRAC", Reference 8, could generate comparisons of steam-water versus air-water behavior in identical geometries, and could also provide insight into the effect of phase nonequilibrium.

4. The cinephotographic test records proved inadequate to record the details of the upper plenum flow. Future tests should allow for preliminary studies aimed at maximizing the usefulness of the photographic data. These studies could include investigation of the effects of alternate illumination methods (back lighting, lighting from the side or above, etc.) and investigation of the suitability of optical probes for the viewing of local flow behavior at various vessel locations.

The incorporation of these recommendations into future CCFL tests modeling realistic PWR upper plenum geometries would enhance the quality of data generated by these studies. This would provide additional data which could prove to be of great utility in the analysis and understanding of PWR upper plenum behavior during reflood.

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APPENDIX A

DATA

APPENDIX A

DATA

Tables A-I to A-XIII record the data gathered for the entire test program. Test points in which instrument or control failures invalidated the results have been eliminated from this listing. In addition to the recorded data, the calculated square roots of the gas and liquid Kutateladze numbers, based on the end box tie plate flow area, are also included. The sensor locations and designations are given in Figure A-I.

Fig. A-I Air-water test system - schematic.

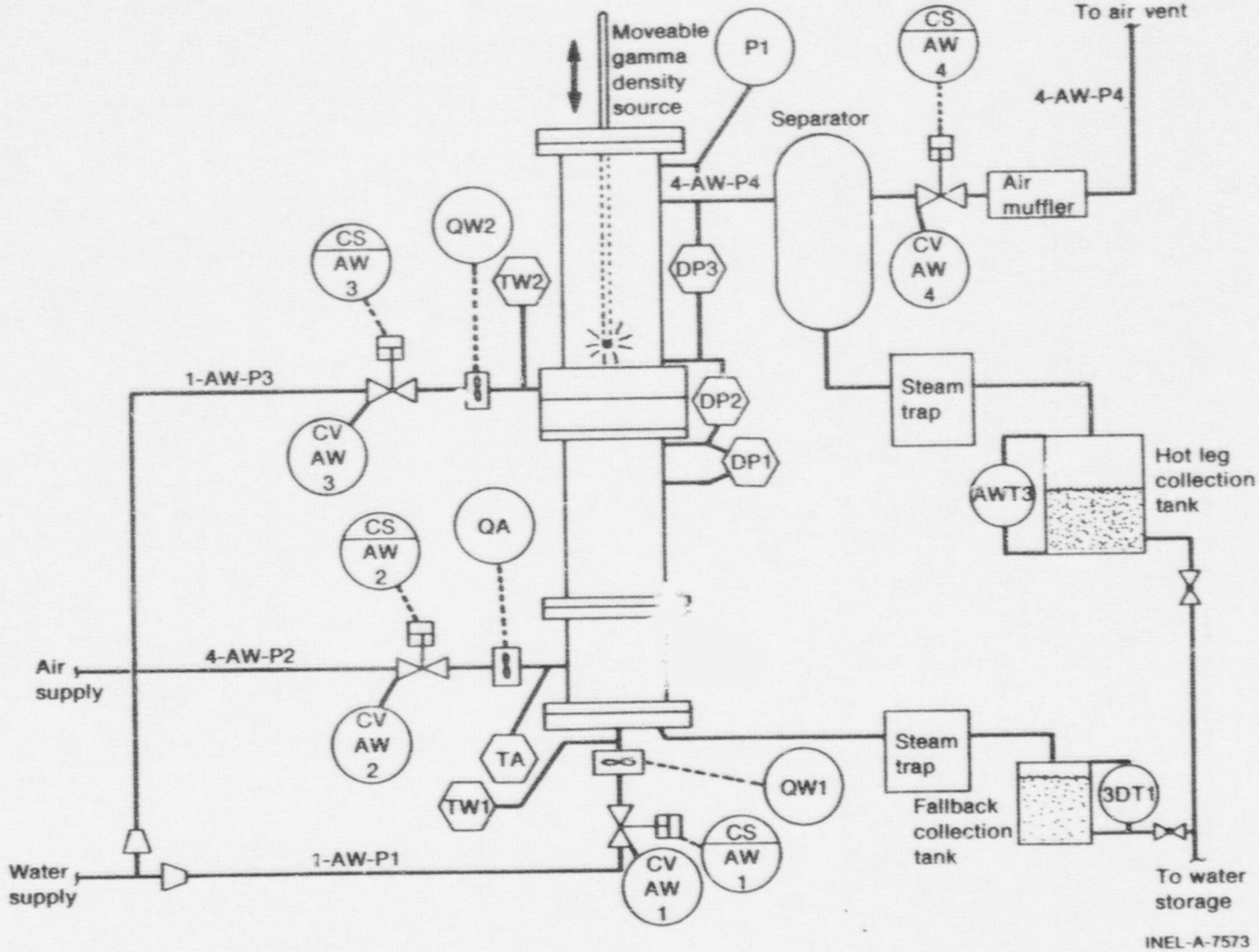

TABLE A-I

KKU OPEN HOLE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	A30	A31	A33	A34	A35	A36	A37
QA	CUBIC METERS/SECOND	.178E+00	.198E+00	.209E+00	.219E+00	.228E+00	.238E+00	.122E+00
QW1	CUBIC METERS/SECOND	.454E-03	.531E-03	.585E-03	.633E-03	.679E-03	.736E-03	.223E-03
QW2	CUBIC METERS/SECOND	.415E-03	.326E-03	.278E-03	.226E-03	.179E-03	.440E-03	.101E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	50.140	50.319	51.415	51.595	50.354	50.374	50.044
TH1	DEGREES KELVIN	292.090	293.466	294.253	293.491	294.070	294.754	294.753
TH2	DEGREES KELVIN	293.557	295.303	296.318	295.277	295.743	295.906	296.861
TA	DEGREES KELVIN	282.734	284.481	292.881	298.350	306.666	252.493	289.546
TWA	DEGREES KELVIN	291.181	292.743	293.320	293.038	294.172	294.273	295.765
PA	KILOPASCALS	51.443	51.569	52.668	52.840	51.593	51.569	51.936
DP2	KILOPASCALS	.723	.703	.672	.680	.651	.605	.702
DP3	KILOPASCALS	.480	.389	.363	.333	.322	.276	1.119
DP1	KILOPASCALS	.286	.340	.405	.401	.458	.496	.261
FROTH HEIGHT	METERS	1.219	1.397	1.422	1.448	1.448	1.473	.838
FALLBACK	CUBIC METERS/SECOND	.158E-03	.707E-04	.309E-04	.139E-04	.164E-04	.208E-04	.102E-02
CARRYOUT	CUBIC METERS/SECOND	.599E-03	.724E-03	.654E-03	.724E-03	.833E-03	.707E-03	.199E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.860	1.961	2.002	2.041	2.065	2.133	1.535
LIQUID KUTATELADZE NUMBER(SQ RT)		.273	.183	.121	.081	.088	.099	.695

CHANNEL	UNITS	A38	A39	A40	A41	A42	A43	A44
QA	CUBIC METERS/SECOND	.133E+00	.143E+00	.151E+00	.162E+00	.172E+00	.182E+00	.190E+00
QW1	CUBIC METERS/SECOND	.259E-03	.301E-03	.330E-03	.377E-03	.411E-03	.453E-03	.482E-03
QW2	CUBIC METERS/SECOND	.984E-03	.951E-03	.909E-03	.871E-03	.849E-03	.800E-03	.753E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	49.892	50.464	50.485	50.181	50.652	49.622	50.069
TH1	DEGREES KELVIN	294.214	294.573	294.803	299.187	298.501	298.159	297.919
TH2	DEGREES KELVIN	296.555	297.027	297.239	301.047	300.278	299.863	299.437
TA	DEGREES KELVIN	286.751	286.367	286.023	295.808	295.119	297.012	287.758
TWA	DEGREES KELVIN	295.225	295.580	295.744	298.851	297.713	297.151	296.978
PA	KILOPASCALS	51.889	52.237	52.259	52.013	51.719	50.550	50.784
DP2	KILOPASCALS	.712	.714	.742	.751	.761	.780	.787
DP3	KILOPASCALS	1.204	1.114	.972	.845	.982	.832	.737
DP1	KILOPASCALS	.276	.212	.247	.231	.268	.244	.271
FROTH HEIGHT	METERS	1.041	1.092	1.143	1.168	1.194	1.219	1.245
FALLBACK	CUBIC METERS/SECOND	.820E-03	.707E-03	.606E-03	.425E-03	.278E-03	.201E-03	.136E-03
CARRYOUT	CUBIC METERS/SECOND	.281E-03	.400E-03	.418E-03	.727E-03	.836E-03	.908E-03	.999E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.603	1.665	1.714	1.760	1.808	1.853	1.911
LIQUID KUTATELADZE NUMBER(SQ RT)		.622	.578	.535	.448	.362	.308	.254

TABLE A-I (CONT.)

KKU OPEN HOLE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	A45	A46	A47	A48	A49	A50	A51
QA	CUBIC METERS/SECOND	.200E+00	.210E+00	.123E+00	.115E+00	.134E+00	.143E+00	.154E+00
QH1	CUBIC METERS/SECOND	.539E-03	.582E-03	.225E-03	.190E-03	.261E-03	.299E-03	.332E-03
QH2	CUBIC METERS/SECOND	.713E-03	.656E-03	.146E-02	.147E-02	.143E-02	.139E-02	.136E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	50.543	50.395	49.974	50.372	50.369	50.308	50.002
TH1	DEGREES KELVIN	298.163	298.214	297.043	297.083	297.109	297.341	297.761
TH2	DEGREES KELVIN	299.782	299.749	298.984	298.888	298.708	298.973	299.240
TA	DEGREES KELVIN	291.776	301.656	288.684	288.321	288.387	289.526	290.489
THA	DEGREES KELVIN	297.655	297.530	296.924	297.804	297.582	297.801	298.185
PA	KILOPASCALS	51.183	51.077	51.529	52.276	51.881	51.605	51.097
DP2	KILOPASCALS	.799	.789	.702	.703	.737	.731	.744
DP3	KILOPASCALS	.633	.566	1.695	1.649	1.653	1.553	1.459
DP1	KILOPASCALS	.316	.330	.233	.227	.194	50.486	.237
FROTH HEIGHT	METERS	1.372	1.473	1.067	.565	1.092	1.143	1.168
FALLBACK	CUBIC METERS/SECOND	.544E-04	.416E-04	.121E-02	.153E-02	.102E-02	.896E-03	.826E-03
CARRYOUT	CUBIC METERS/SECOND	.999E-03	.107E-02	.363E-03	.409E-03	.599E-03	.690E-03	.102E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.955	1.984	1.540	1.491	1.609	1.661	1.717
LIQUID KUTATELADZE NUMBER(SQ RT)		.160	.140	.754	.849	.695	.650	.625

CHANNEL	UNITS	A52	A53	A54	A55	A57	A58	A59
QA	CUBIC METERS/SECOND	.162E+00	.171E+00	.181E+00	.190E+00	.210E+00	.218E+00	.106E+00
QH1	CUBIC METERS/SECOND	.370E-03	.404E-03	.445E-03	.485E-03	.581E-03	.632E-03	.170E-03
QH2	CUBIC METERS/SECOND	.130E-02	.131E-02	.122E-02	.119E-02	.108E-02	.104E-02	.204E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	50.778	49.953	49.746	52.190	49.435	50.554	50.740
TH1	DEGREES KELVIN	296.070	295.862	296.087	296.145	296.182	296.330	291.744
TH2	DEGREES KELVIN	298.336	298.150	298.366	298.480	298.413	298.623	293.235
TA	DEGREES KELVIN	287.749	290.222	289.724	292.204	292.460	297.007	288.174
THA	DEGREES KELVIN	297.027	296.908	297.047	297.246	297.167	297.466	255.372
PA	KILOPASCALS	51.871	51.115	50.759	53.234	50.217	51.487	52.776
DP2	KILOPASCALS	.811	.841	.841	.847	.862	.839	.730
DP3	KILOPASCALS	1.372	1.460	1.304	1.238	.863	.963	1.810
DP1	KILOPASCALS	.233	.210	.206	.217	.149	.271	.591
FROTH HEIGHT	METERS	1.219	1.219	1.245	1.270	1.270	1.295	.838
FALLBACK	CUBIC METERS/SECOND	.543E-03	.457E-03	.327E-03	.250E-03	.132E-03	.124E-03	.156E-02
CARRYOUT	CUBIC METERS/SECOND	.999E-03	.124E-02	.134E-02	.131E-02	.144E-02	.145E-02	.290E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.766	1.811	1.864	1.913	1.998	2.032	1.437
LIQUID KUTATELADZE NUMBER(SQ RT)		.506	.464	.393	.344	.249	.242	.859

TABLE A-I (CONT.)

KKU OPEN HOLE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	A60	A61	A62	A63	A64	A65	A66
QA	CUBIC METERS/SECOND	.115E+00	.124E+00	.134E+00	.143E+00	.153E+00	.154E+00	.161E+00
QW1	CUBIC METERS/SECOND	.200E-03	.220E-03	.263E-03	.302E-03	.333E-03	.338E-03	.369E-03
QW2	CUBIC METERS/SECOND	.200E-02	.196E-02	.192E-02	.189E-02	.187E-02	.183E-02	.180E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	124.275
P1	KILOPASCALS	50.892	49.198	50.726	50.846	50.227	51.047	50.494
TW1	DEGREES KELVIN	292.605	293.345	273.274	294.382	294.499	299.148	298.693
TW2	DEGREES KELVIN	294.032	294.855	295.559	295.879	296.213	300.780	300.194
TA	DEGREES KELVIN	288.948	288.996	289.052	287.233	285.544	285.736	285.997
TWA	DEGREES KELVIN	293.249	294.096	294.721	294.917	295.142	299.300	298.707
PA	KILOPASCALS	52.807	50.619	51.868	51.217	50.923	48.045	47.556
DP2	KILOPASCALS	.629	.688	.752	.697	.715	.840	.809
DP3	KILOPASCALS	2.498	2.328	2.129	2.135	2.140	1.719	1.878
DP1	KILOPASCALS	.607	.572	.565	.550	.418	.505	.419
FROTH HEIGHT	METERS	1.067	1.118	1.143	1.168	1.219	1.168	1.219
FALLBACK	CUBIC METERS/SECOND	.148E-02	.132E-02	.109E-02	.102E-02	.908E-03	.669E-03	.512E-03
CARRYOUT	CUBIC METERS/SECOND	.547E-03	.779E-03	.833E-03	.924E-03	.119E-02	.127E-02	.154E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.494	1.541	1.607	1.658	1.718	1.700	1.738
LIQUID KUTATELADZE NUMBER(SQ RT)		.837	.789	.718	.695	.655	.562	.491

CHANNEL	UNITS	A67	A68	A69	A70
QA	CUBIC METERS/SECOND	.172E+00	.181E+00	.190E+00	.202E+00
QW1	CUBIC METERS/SECOND	.407E-03	.444E-03	.480E-03	.538E-03
QW2	CUBIC METERS/SECOND	.177E-02	.174E-02	.171E-02	.165E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000
P1	KILOPASCALS	50.407	52.684	50.726	50.422
TW1	DEGREES KELVIN	298.068	297.757	297.835	297.958
TW2	DEGREES KELVIN	299.950	299.551	295.716	299.868
TA	DEGREES KELVIN	287.098	288.218	288.645	289.259
TWA	DEGREES KELVIN	298.393	297.953	298.200	298.357
PA	KILOPASCALS	47.457	49.747	47.657	47.298
DP2	KILOPASCALS	.783	.768	.792	.767
DP3	KILOPASCALS	1.963	1.926	1.894	1.831
DP1	KILOPASCALS	.348	.257	.184	.129
FROTH HEIGHT	METERS	1.270	1.346	1.321	1.346
FALLBACK	CUBIC METERS/SECOND	.381E-03	.310E-03	.278E-03	.213E-03
CARRYOUT	CUBIC METERS/SECOND	.154E-02	.177E-02	.175E-02	.177E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.794	1.847	1.886	1.938
LIQUID KUTATELADZE NUMBER(SQ RT)		.424	.383	.362	.317

TABLE A-II

KKU OPEN HOLE UCSP TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	B01	B02	B03	B04	B05	B06	B07
QA	CUBIC METERS/SECOND	.123E+00	.133E+00	.142E+00	.151E+00	.159E+00	.169E+00	.178E+00
QW1	CUBIC METERS/SECOND	.212E-03	.267E-03	.301E-03	.333E-03	.368E-03	.409E-03	.440E-03
QW2	CUBIC METERS/SECOND	.586E-03	.561E-03	.514E-03	.468E-03	.442E-03	.417E-03	.381E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.016	51.795	50.430	49.340	49.802	52.061	52.759
TW1	DEGREES KELVIN	296.522	296.910	297.278	297.649	298.088	296.719	297.155
TW2	DEGREES KELVIN	297.562	297.958	298.336	298.722	299.189	297.968	298.309
TA	DEGREES KELVIN	288.505	288.890	289.299	290.397	290.886	288.664	287.594
THA	DEGREES KELVIN	297.513	297.208	297.357	297.663	298.374	296.088	296.208
PA	KILOPASCALS	53.774	54.622	53.248	52.196	52.764	53.230	53.260
DP2	KILOPASCALS	.134	.195	.156	.175	.232	.347	.312
DP3	KILOPASCALS	2.164	2.121	2.097	2.099	2.132	.228	2.212
DP1	KILOPASCALS	.064	.075	.074	.071	.073	.060	.074
FROTH HEIGHT	METERS	.356	.406	.432	.508	.635	.737	.813
FALLBACK	CUBIC METERS/SECOND	.817E-03	.757E-03	.707E-03	.675E-03	.506E-03	.283E-03	.185E-03
CARRYOUT	CUBIC METERS/SECOND	.871E-04	.101E-03	.145E-03	.158E-03	.353E-03	.652E-03	.652E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.547	1.612	1.662	1.710	1.757	1.813	1.859
LIQUID KUTATELADZE NUMBER(SQ RT)		.621	.598	.578	.564	.489	.365	.295

CHANNEL	UNITS	B08	B09	B10	B11	B12	B13	B14
QA	CUBIC METERS/SECOND	.190E+00	.198E+00	.112E+00	.122E+00	.132E+00	.141E+00	.150E+00
QW1	CUBIC METERS/SECOND	.484E-03	.536E-03	.194E-03	.227E-03	.260E-03	.299E-03	.331E-03
QW2	CUBIC METERS/SECOND	.334E-03	.312E-03	.971E-03	.945E-03	.906E-03	.874E-03	.837E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.387	50.765	50.128	51.799	52.828	52.268	52.212
TW1	DEGREES KELVIN	297.352	297.602	297.852	297.024	296.314	296.620	296.688
TW2	DEGREES KELVIN	298.416	298.689	299.158	298.079	297.535	297.812	297.731
TA	DEGREES KELVIN	287.814	303.451	292.072	291.302	285.824	285.237	286.373
THA	DEGREES KELVIN	296.020	296.887	297.508	297.649	296.687	296.408	297.209
PA	KILOPASCALS	53.327	51.361	50.529	52.843	56.669	56.165	55.927
DP2	KILOPASCALS	.332	.362	.287	.320	.327	.282	.356
DP3	KILOPASCALS	2.206	2.084	2.084	2.161	2.324	2.320	2.270
DP1	KILOPASCALS	.074	.071	.070	.072	.077	.078	.238
FROTH HEIGHT	METERS	.864	.838	.432	.508	.610	.686	.686
FALLBACK	CUBIC METERS/SECOND	.131E-03	.111E-03	.915E-03	.779E-03	.626E-03	.610E-03	.594E-03
CARRYOUT	CUBIC METERS/SECOND	.669E-03	.185E-03	.631E-08	.462E-03	.562E-03	.670E-03	.616E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.918	1.924	1.461	1.534	1.623	1.677	1.723
LIQUID KUTATELADZE NUMBER(SQ RT)		.248	.229	.657	.606	.544	.537	.529

TABLE A-II (CONT.)

KKU OPEN HOLE UCSP TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	B15	B16	B17	B18	B19	B20	B22
QA	CUBIC METERS/SECOND	.160E+00	.169E+00	.105E+00	.939E-01	.113E+00	.123E+00	.943E-01
QW1	CUBIC METERS/SECOND	.370E-03	.406E-03	.149E-03	.939E-04	.192E-03	.222E-03	.883E-04
QW2	CUBIC METERS/SECOND	.798E-03	.782E-03	.140E-02	.144E-02	.137E-02	.134E-02	.197E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.770	51.068	51.725	50.689	51.119	52.218	52.595
TW1	DEGREES KELVIN	297.095	297.150	297.388	297.228	297.607	298.056	292.602
TW2	DEGREES KELVIN	298.189	298.209	298.499	298.357	298.730	299.246	294.208
TA	DEGREES KELVIN	287.525	289.418	290.707	290.652	289.850	290.789	283.910
TWA	DEGREES KELVIN	297.290	297.373	298.140	297.993	297.800	298.594	294.859
PA	KILOPASCALS	55.907	54.071	56.606	54.076	53.830	54.842	63.220
DP2	KILOPASCALS	.315	.347	.422	.168	.415	.417	.247
DP3	KILOPASCALS	2.311	2.271	2.333	2.171	2.258	2.330	1.877
DP1	KILOPASCALS	-.686	-.880	-.780	-.295	-.008	-.003	-.729
FROTH HEIGHT	METERS	.686	.787	.406	.305	.660	.660	.406
FALLBACK	CUBIC METERS/SECOND	.435E-03	.332E-03	.111E-02	.155E-02	.980E-03	.805E-03	.196E-02
CARRYOUT	CUBIC METERS/SECOND	.815E-03	.924E-03	.597E-03	.524E-04	.670E-03	.669E-03	.908E-04
GAS KUTATELADZE NUMBER (SQ ROOT)		1.777	1.814	1.441	1.354	1.481	1.546	1.404
LIQUID KUTATELADZE NUMBER(SQ RT)		.453	.396	.724	.854	.680	.616	.962

CHANNEL	UNITS	B23	B24	B25	B26	B27	B28	B29
QA	CUBIC METERS/SECOND	.103E+00	.113E+00	.122E+00	.131E+00	.141E+00	.132E+00	.151E+00
QW1	CUBIC METERS/SECOND	.166E-03	.198E-03	.2[illegible]0E-03	.265E-03	.300E-03	.265E-03	.327E-03
QW2	CUBIC METERS/SECOND	.190E-02	.189E-02	.184E-02	.180E-02	.182E-02	.130E-02	.128E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.895	51.628	51.974	49.925	53.342	51.754	50.492
TW1	DEGREES KELVIN	293.496	293.314	293.553	293.325	294.080	294.076	291.406
TW2	DEGREES KELVIN	294.799	294.551	294.775	294.479	295.272	295.232	291.446
TA	DEGREES KELVIN	284.153	283.851	283.706	283.362	284.562	287.254	312.344
TWA	DEGREES KELVIN	294.724	294.405	294.495	294.414	294.659	294.856	292.831
PA	KILOPASCALS	62.120	61.700	62.251	59.678	63.243	61.407	52.483
DP2	KILOPASCALS	.498	.522	.528	.526	.517	.412	.407
DP3	KILOPASCALS	2.298	2.254	2.273	2.200	2.517	2.163	.113
DP1	KILOPASCALS	-.276	15.217	-.033	-.017	-.592	-.040	.993
FROTH HEIGHT	METERS	.762	.813	.813	.838	.864	.737	.762
FALLBACK	CUBIC METERS/SECOND	.120E-02	.965E-03	.806E-03	.784E-03	.708E-03	.588E-03	.577E-03
CARRYOUT	CUBIC METERS/SECOND	.797E-03	.109E-02	.119E-02	.132E-02	.136E-02	.905E-03	.978E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.464	1.530	1.594	1.643	1.717	1.646	1.678
LIQUID KUTATELADZE NUMBER(SQ RT)		.752	.675	.617	.608	.578	.527	.522

TABLE A-II (CONT.)

KKU OPEN HOLE UCSF TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	B31	B32	B33	B35	B36	B37
QA	CUBIC METERS/SECOND	.185E+00	.195E+00	.186E+00	.158E+00	.177E+00	.198E+00
QH1	CUBIC METERS/SECOND	.474E-03	.531E-03	.480E-03	.367E-03	.444E-03	.536E-03
QH2	CUBIC METERS/SECOND	.113E-02	.109E-02	.701E-03	.170E-02	.163E-02	.155E-02
GUI	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.945	52.567	52.367	49.779	51.924	51.992
TH1	DEGREES KELVIN	291.507	292.121	292.612	293.324	293.776	293.957
TH2	DEGREES KELVIN	291.449	292.051	292.452	293.205	293.654	293.944
TA	DEGREES KELVIN	315.893	293.614	310.393	291.363	292.039	291.781
THA	DEGREES KELVIN	293.088	293.158	293.294	293.810	294.147	294.273
PA	KILOPASCALS	53.771	53.484	53.113	50.285	52.756	52.888
DP2	KILOPASCALS	.515	.508	.420	.546	.542	.588
DP3	KILOPASCALS	.059	-.037	-.001	-.115	-.188	.628
DP1	KILOPASCALS	.326	.310	.291	.333	.371	.283
FROTH HEIGHT	METERS	.762	1.016	.838	.864	.965	.991
FALLBACK	CUBIC METERS/SECOND	.425E-03	.191E-03	.196E-03	.534E-03	.300E-03	.153E-03
CARRYOUT	CUBIC METERS/SECOND	.392E-03	.114E-02	.897E-03	.156E-02	.176E-02	.192E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.853	1.933	1.863	1.736	1.845	1.950
LIQUID KUTATELADZE NUMBER(SQ RT)		.448	.300	.304	.502	.376	.268

TABLE A-III

KRU SUPPORT COLUMN TEST HEIGHT= 0.305 METERS

CHANNEL	UNITS	C03	C04	C05	C06	C07	C08	C09
QA	CUBIC METERS/SECOND	.140E+00	.151E+00	.179E+00	.187E+00	.197E+00	.113E+00	.104E+00
QW1	CUBIC METERS/SECOND	.300E-03	.329E-03	.413E-03	.479E-03	.534E-03	.194E-03	.153E-03
QW2	CUBIC METERS/SECOND	.530E-03	.507E-03	.430E-03	.355E-03	.307E-03	.999E-03	.103E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.881	52.137	53.317	53.186	51.474	52.931	55.159
TW1	DEGREES KELVIN	299.932	300.381	300.595	299.947	300.203	299.541	299.961
TW2	DEGREES KELVIN	299.920	300.378	300.596	299.925	300.119	299.665	299.918
TA	DEGREES KELVIN	286.531	286.471	287.103	288.238	299.556	290.233	290.299
TWA	DEGREES KELVIN	297.709	298.322	297.870	297.292	297.471	298.617	299.370
PA	KILOPASCALS	56.843	53.741	59.584	57.316	59.526	57.137	59.714
DP2	KILOPASCALS	.217	.372	.341	.373	.341	.361	.411
DP3	KILOPASCALS	-.114	.124	-.078	-.040	.023	-.053	-.081
DP1	KILOPASCALS	.235	.245	.236	.220	.236	.263	.214
FROTH HEIGHT	METERS	.483	.559	.635	.711	.737	.457	.406
FALLBACK	CUBIC METERS/SECOND	.610E-03	.425E-03	.234E-03	.177E-03	.544E-04	.860E-03	.958E-03
CARRYOUT	CUBIC METERS/SECOND	.178E-03	.372E-03	.572E-03	.673E-03	.690E-03	.280E-03	.631E-07
GAS KUTATELADZE NUMBER (SQ ROOT)		1.668	1.718	1.901	1.929	1.983	1.498	1.442
LIQUID KUTATELADZE NUMBER(SQ RT)		.536	.448	.332	.289	.160	.637	.672

CHANNEL	UNITS	C10	C11	C13	C14	C15	C16	C17
QA	CUBIC METERS/SECOND	.123E+00	.132E+00	.168E+00	.187E+00	.197E+00	.945E-01	.104E+00
QW1	CUBIC METERS/SECOND	.223E-03	.261E-03	.401E-03	.479E-03	.535E-03	.123E-03	.154E-03
QW2	CUBIC METERS/SECOND	.964E-03	.929E-03	.773E-03	.701E-03	.652E-03	.149E-02	.145E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.962	52.798	52.281	52.606	53.658	54.114	53.398
TW1	DEGREES KELVIN	300.116	300.316	300.501	300.048	300.290	295.685	295.977
TW2	DEGREES KELVIN	300.020	300.227	300.408	299.926	300.153	295.674	295.906
TA	DEGREES KELVIN	289.237	288.574	287.573	287.917	288.400	285.438	284.872
TWA	DEGREES KELVIN	298.574	298.498	298.301	297.914	297.830	296.888	296.813
PA	KILOPASCALS	56.033	56.729	56.269	56.821	58.177	56.707	55.626
DP2	KILOPASCALS	.405	.411	.482	.432	.393	-.001	.528
DP3	KILOPASCALS	-.090	-.102	-.119	-.046	.049	-.012	.256
DP1	KILOPASCALS	.274	.275	.251	.223	.237	.004	.279
FROTH HEIGHT	METERS	.533	.584	.686	.711	.737	.457	.533
FALLBACK	CUBIC METERS/SECOND	.691E-03	.555E-03	.289E-03	.185E-03	.746E-04	.120E-02	.936E-03
CARRYOUT	CUBIC METERS/SECOND	.345E-03	.527E-03	.890E-03	.963E-03	.107E-02	.571E-03	.645E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.557	1.619	1.827	1.929	1.984	1.369	1.430
LIQUID KUTATELADZE NUMBER(SQ RT)		.571	.512	.369	.296	.188	.752	.665

TABLE A-III (CONT.)

KKU SUPPORT COLUMN TEST HEIGHT= 0.308 METERS

CHANNEL	UNITS	C18	C19	C20	C21	C22	C23	C24
QA	CUBIC METERS/SECOND	.113E+00	.123E+00	.132E+00	.152E+00	.169E+00	.187E+00	.197E+00
QH1	CUBIC METERS/SECOND	.191E-03	.226E-03	.263E-03	.331E-03	.406E-03	.479E-03	.531E-03
QH2	CUBIC METERS/SECOND	.140E-02	.137E-02	.134E-02	.127E-02	.121E-02	.112E-02	.107E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.933	51.980	52.476	53.168	52.497	52.293	52.159
TH1	DEGREES KELVIN	296.357	296.327	296.594	296.854	297.127	297.354	297.287
TH2	DEGREES KELVIN	296.223	296.180	296.407	296.668	296.911	297.121	297.037
TA	DEGREES KELVIN	285.347	286.823	286.721	286.461	286.905	288.712	287.613
THA	DEGREES KELVIN	296.159	296.338	296.043	295.857	295.996	295.773	295.882
PA	KILOPASCALS	54.740	53.420	53.805	54.579	54.020	53.788	53.801
DP2	KILOPASCALS	.518	.534	.550	.584	.583	.5[illegible]7	.474
DP3	KILOPASCALS	.259	.206	.192	.177	.239	.319	.357
DP1	KILOPASCALS	.279	.275	.243	.231	.203	.212	.201
FROTH HEIGHT	METERS	.584	.610	.635	.660	.686	.711	.787
FALLBACK	CUBIC METERS/SECOND	.817E-03	.648E-03	.642E-03	.436E-03	.327E-03	.207E-03	.170E-03
CARRYOUT	CUBIC METERS/SECOND	.709E-03	.927E-03	.763E-03	.120E-02	.125E-02	.700E-03	.145E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.487	1.544	1.606	1.727	1.814	1.907	1.960
LIQUID KUTATELADZE NUMBER(SQ RT)		.621	.553	.551	.453	.393	.312	.284

CHANNEL	UNITS	C25	C26	C27	C28	C29	C30	C31
QA	CUBIC METERS/SECOND	.949E-01	.104E+00	.113E+00	.122E+00	.131E+00	.150E+00	.169E+00
QH1	CUBIC METERS/SECOND	.104E-03	.152E-03	.182E-03	.219E-03	.258E-03	.331E-03	.404E-03
QH2	CUBIC METERS/SECOND	.197E-02	.190E-02	.188E-02	.187E-02	.179E-02	.171E-02	.166E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.899	53.080	53.704	53.249	53.292	53.020	52.415
TH1	DEGREES KELVIN	296.930	297.433	297.409	297.736	297.765	297.919	297.924
TH2	DEGREES KELVIN	296.857	297.302	297.274	297.534	297.546	297.706	297.700
TA	DEGREES KELVIN	288.950	287.988	287.675	287.406	287.318	286.977	287.593
THA	DEGREES KELVIN	297.185	296.988	296.807	296.832	296.612	296.658	296.472
PA	KILOPASCALS	55.879	55.471	55.840	54.996	54.881	54.375	54.010
DP2	KILOPASCALS	.014	.668	.644	.652	.593	.582	.637
DP3	KILOPASCALS	.094	.146	.082	.016	.290	.155	.113
DP1	KILOPASCALS	.027	.314	.291	.290	.304	.272	.239
FROTH HEIGHT	METERS	.483	.533	.559	.559	.635	.686	.711
FALLBACK	CUBIC METERS/SECOND	.122E-02	.980E-03	.871E-03	.762E-03	.654E-03	.479E-03	.338E-03
CARRYOUT	CUBIC METERS/SECOND	.945E-03	.113E-02	.125E-02	.131E-02	.107E-02	.153E-02	.171E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.366	1.430	1.489	1.547	1.603	1.712	1.813
LIQUID KUTATELADZE NUMBER(SQ RT)		.759	.680	.641	.600	.555	.475	.399

TABLE A-III (CONT.)

KKU SUPPORT COLUMN TEST HEIGHT= 0.305 METERS

CHANNEL	UNITS	C32	C33
QA	CUBIC METERS/SECOND	.187E+00	.197E+00
QW1	CUBIC METERS/SECOND	.479E-03	.532E-03
QW2	CUBIC METERS/SECOND	.160E-02	.155E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000
P1	KILOPASCALS	52.031	52.786
TW1	DEGREES KELVIN	298.102	297.974
TW2	DEGREES KELVIN	297.879	297.737
TA	DEGREES KELVIN	288.247	288.599
TWA	DEGREES KELVIN	296.521	296.733
PA	KILOPASCALS	53.542	54.474
DP2	KILOPASCALS	.620	.619
DP3	KILOPASCALS	.123	.290
DP1	KILOPASCALS	.227	.197
FROTH HEIGHT	METERS	.762	.762
FALLBACK	CUBIC METERS/SECOND	.213E-03	.158E-03
CARRYOUT	CUBIC METERS/SECOND	.165E-02	.198E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.908	1.962
LIQUID KUTATELADZE NUMBER(SQ RT)		.317	.273

TABLE A-IV

KKU SUPPORT COLUMN TEST HEIGHT = 0.305 METERS

CHANNEL	UNITS	D01	D02	D03	D04	D05	D06	D07
QA	CUBIC METERS/SECOND	.122E+00	.132E+00	.143E+00	.151E+00	.159E+00	.169E+00	.187E+00
QH1	CUBIC METERS/SECOND	.226E-03	.258E-03	.298E-03	.328E-03	.373E-03	.404E-03	.484E-03
QH2	CUBIC METERS/SECOND	.608E-03	.56[illegible]E-03	.538E-03	.497E-03	.464E-03	.422E-03	.358E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.983	52.231	52.922	51.863	51.834	52.194	52.589
TH1	DEGREES KELVIN	292.676	293.716	294.866	295.705	296.600	297.667	298.138
TH2	DEGREES KELVIN	292.479	293.443	294.551	295.379	296.262	297.287	297.656
TA	DEGREES KELVIN	283.255	282.923	284.985	286.097	287.369	288.587	286.369
THA	DEGREES KELVIN	292.561	292.621	293.625	294.195	294.925	295.604	295.429
PA	KILOPASCALS	56.096	54.577	55.599	54.628	54.684	55.096	55.364
DP2	KILOPASCALS	.467	.688	.754	.768	.806	.782	.[illegible]14
DP3	KILOPASCALS	.303	.023	-.187	-.051	-.049	-.055	-.109
DP1	KILOPASCALS	.251	.510	.795	.911	1.013	1.071	1.058
FROTH HEIGHT	METERS	.610	.787	1.143	1.143	1.270	1.346	1.372
FALLBACK	CUBIC METERS/SECOND	.871E-03	.675E-03	.610E-03	.528E-03	.449E-03	.321E-03	.180E-03
CARRYOUT	CUBIC METERS/SECOND	.631E-07	.631E-07	.218E-03	.218E-03	.334E-03	.428E-03	.618E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.554	1.615	1.681	1.723	1.770	1.819	1.921
LIQUID KUTATELADZE NUMBER(SQ RT)		.641	.564	.536	.499	.460	.389	.291

CHANNEL	UNITS	D08	D09	D10	D11	D12	D13	D14
QA	CUBIC METERS/SECOND	.112E+00	.125E+00	.132E+00	.143E+00	.152E+00	.159E+00	.168E+00
QH1	CUBIC METERS/SECOND	.192E-03	.225E-03	.264E-03	.299E-03	.337E-03	.364E-03	.413E-03
QH2	CUBIC METERS/SECOND	.998E-03	.955E-03	.922E-03	.889E-03	.855E-03	.811E-03	.795E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.896	52.041	51.712	52.743	52.104	52.803	52.760
TH1	DEGREES KELVIN	296.170	296.825	297.833	298.833	299.695	299.732	301.112
TH2	DEGREES KELVIN	296.008	296.636	297.587	298.564	299.360	299.418	300.543
TA	DEGREES KELVIN	286.268	285.309	285.510	284.993	284.987	285.116	285.594
THA	DEGREES KELVIN	295.674	295.923	296.676	297.238	297.576	297.642	298.612
PA	KILOPASCALS	55.751	55.144	54.676	55.677	55.093	55.904	55.847
DP2	KILOPASCALS	.299	.261	.229	.218	.231	.233	.271
DP3	KILOPASCALS	.745	.288	.302	.298	.290	.298	.294
DP1	KILOPASCALS	.698	.770	.768	.834	.782	.810	.870
FROTH HEIGHT	METERS	.813	.991	1.092	1.168	1.219	1.270	1.346
FALLBACK	CUBIC METERS/SECOND	.109E-02	.946E-03	.883E-03	.691E-03	.550E-03	.463E-03	.378E-03
CARRYOUT	CUBIC METERS/SECOND	.236E-04	.138E-03	.273E-03	.454E-03	.818E-03	.618E-03	.754E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.487	1.569	1.610	1.682	1.731	1.776	1.826
LIQUID KUTATELADZE NUMBER(SQ RT)		.717	.668	.646	.571	.509	.467	.423

TABLE A-IV (CONT.)

KKU SUPPORT COLUMN TEST HEIGHT = 0.305 METERS

CHANNEL	UNITS	D15	D16	D17	D18	D19	D20	D21
QA	CUBIC METERS/SECOND	.187E+00	.112E+00	.168E+00	.113E+00	.170E+00	.122E+00	.132E+00
QW1	CUBIC METERS/SECOND	.483E-03	.183E-03	.405E-03	.196E-03	.403E-03	.226E-03	.266E-03
QW2	CUBIC METERS/SECOND	.720E-03	.140E-02	.121E-02	.188E-02	.166E-02	.137E-02	.134E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.055	53.657	52.904	52.302	53.621	52.734	53.169
TH1	DEGREES KELVIN	300.690	299.371	299.491	299.230	299.669	299.28[illegible]	299.614
TH2	DEGREES KELVIN	300.298	299.262	299.186	298.955	299.364	299.010	299.321
TA	DEGREES KELVIN	285.907	288.747	290.348	294.122	295.024	294.539	294.957
THA	DEGREES KELVIN	298.089	299.087	298.574	298.951	299.178	298.943	299.151
PA	KILOPASCALS	55.150	57.682	56.249	56.605	57.336	56.401	56.724
DP2	KILOPASCALS	.348	.260	.270	.225	.272	.268	.251
DP3	KILOPASCALS	.307	.008	.032	.032	.054	.011	-.006
DP1	KILOPASCALS	.939	.752	.806	.740	.824	.764	.757
FROTH HEIGHT	METERS	1.346	.940	1.219	1.092	1.346	.965	1.016
FALLBACK	CUBIC METERS/SECOND	.248E-03	.106E-02	.449E-03	.140E-02	.555E-03	.133E-02	.107E-02
CARRYOUT	CUBIC METERS/SECOND	.945E-03	.400E-03	.113E-02	.672E-03	.151E-02	.313E-03	.400E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.921	1.494	1.820	1.490	1.826	1.544	1.606
LIQUID KUTATELADZE NUMBER(SQ RT)		.342	.706	.460	.813	.512	.792	.[illegible]10

CHANNEL	UNITS	D22	D23	D24	D25	D26	D27	D28
QA	CUBIC METERS/SECOND	.142E+00	.152E+00	.159E+00	.188E+00	.197E+00	.122E+00	.132E+00
QW1	CUBIC METERS/SECOND	.294E-03	.336E-03	.377E-03	.480E-03	.533E-03	.230E-03	.262E-03
QW2	CUBIC METERS/SECOND	.132E-02	.128E-02	.123E-02	.112E-02	.107E-02	.183E-02	.179E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.105	52.124	52.529	52.831	52.799	52.382	52.991
TH1	DEGREES KELVIN	299.932	300.073	300.305	300.521	300.376	299.323	296.77[illegible]
TH2	DEGREES KELVIN	299.626	299.805	300.010	300.226	300.046	299.086	296.[illegible]18
TA	DEGREES KELVIN	294.917	295.366	295.850	295.107	294.595	290.553	286.685
THA	DEGREES KELVIN	299.395	299.558	299.762	299.687	299.437	298.824	296.373
PA	KILOPASCALS	55.410	55.601	55.795	55.913	55.962	56.669	56.[illegible]49
DP2	KILOPASCALS	.232	.236	.268	.308	.330	.222	.251
DP3	KILOPASCALS	-.024	-.064	-.054	.036	.041	-.032	-.004
DP1	KILOPASCALS	.796	.887	.903	.844	.893	.740	.742
FROTH HEIGHT	METERS	1.067	1.118	1.168	1.295	1.397	1.168	1.219
FALLBACK	CUBIC METERS/SECOND	.915E-03	.806E-03	.664E-03	.354E-03	.275E-03	.123E-02	.101E-02
CARRYOUT	CUBIC METERS/SECOND	.581E-03	.673E-03	.791E-03	.114E-02	.121E-02	.799E-03	.105E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.664	1.719	1.760	1.912	1.961	1.550	1.819
LIQUID KUTATELADZE NUMBER(SQ RT)		.657	.617	.560	.409	.360	.762	.691

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TABLE A-IV (CONT.)

KKU SUPPORT COLUMN TEST HEIGHT = 0.305 METERS

CHANNEL	UNITS	D29	D30	D31	D32	D33	D34
QA	CUBIC METERS/SECOND	.142E+00	.152E+00	.160E+00	.187E+00	.197E+00	.202E+00
QW1	CUBIC METERS/SECOND	.301E-03	.333E-03	.367E-03	.479E-03	.535E-03	.590E-03
QW2	CUBIC METERS/SECOND	.177E-02	.171E-02	.169E-02	.160E-02	.155E-02	.150E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.762	52.684	52.666	53.415	51.051	51.521
TW1	DEGREES KELVIN	297.640	297.411	297.640	298.046	298.277	298.407
TW2	DEGREES KELVIN	297.327	297.131	297.323	297.708	297.929	298.057
TA	DEGREES KELVIN	288.072	287.521	289.748	290.034	290.068	289.420
THA	DEGREES KELVIN	297.055	296.594	296.829	297.027	297.225	297.223
PA	KILOPASCALS	55.486	56.294	56.239	56.754	54.517	55.057
DP2	KILOPASCALS	.249	.251	.269	.323	.350	.391
DP3	KILOPASCALS	-.005	-.003	.014	.069	.096	.136
DP1	KILOPASCALS	.768	.805	.815	.866	.931	.920
FROTH HEIGHT	METERS	1.270	1.321	1.346	1.422	1.422	1.473
FALLBACK	CUBIC METERS/SECOND	.842E-03	.637E-03	.544E-03	.315E-03	.259E-03	.245E-03
CARRYOUT	CUBIC METERS/SECOND	.122E-02	.145E-02	.154E-02	.173E-02	.180E-02	.187E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.676	1.733	1.774	1.919	1.963	1.990
LIQUID KUTATELADZE NUMBER(SQ RT)		.630	.548	.507	.386	.349	.340

TABLE A-V

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	E01	E02	E03	E04	E05	E06	E07
QA	CUBIC METERS/SECOND	.104E+00	.114E+00	.122E+00	.132E+00	.150E+00	.169E+00	.188E+00
QW1	CUBIC METERS/SECOND	.151E-03	.197E-03	.220E-03	.260E-03	.331E-03	.404E-03	.480E-03
QW2	CUBIC METERS/SECOND	.669E-03	.653E-03	.600E-03	.568E-03	.510E-03	.438E-03	.356E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.867	52.688	52.308	53.002	52.649	52.453	52.937
TW1	DEGREES KELVIN	297.174	297.427	297.839	298.236	298.686	299.290	299.049
TW2	DEGREES KELVIN	296.739	296.972	297.332	297.719	298.140	298.713	298.436
TA	DEGREES KELVIN	291.053	291.242	290.798	291.456	292.448	293.060	292.799
THA	DEGREES KELVIN	296.332	296.391	296.632	296.864	297.092	297.703	297.346
PA	KILOPASCALS	56.921	56.335	55.864	56.459	56.066	56.022	56.370
DP2	KILOPASCALS	.559	.577	.596	.587	.599	.626	.661
DP3	KILOPASCALS	3.045	2.892	2.893	2.792	2.674	2.522	2.374
DP1	KILOPASCALS	-.690	-.698	-.006	-.008	-.011	-.014	-.016
FROTH HEIGHT	METERS	.940	.991	1.016	1.041	1.016	.991	1.016
FALLBACK	CUBIC METERS/SECOND	.408E-03	.321E-03	.305E-03	.310E-03	.354E-03	.316E-03	.163E-03
CARRYOUT	CUBIC METERS/SECOND	.416E-03	.398E-03	.435E-03	.525E-03	.380E-03	.453E-03	.597E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.430	1.497	1.547	1.609	1.715	1.819	1.918
LIQUID KUTATELADZE NUMBER(SQ RT)		.439	.389	.379	.383	.409	.386	.278

CHANNEL	UNITS	E08	E09	E10	E11	E12	E13	E14
QA	CUBIC METERS/SECOND	.103E+00	.112E+00	.122E+00	.132E+00	.151E+00	.168E+00	.189E+00
QW1	CUBIC METERS/SECOND	.148E-03	.190E-03	.227E-03	.267E-03	.331E-03	.406E-03	.481E-03
QW2	CUBIC METERS/SECOND	.103E-02	.995E-03	.957E-03	.924E-03	.855E-03	.783E-03	.710E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.858	53.169	52.481	52.321	52.624	52.481	51.508
TW1	DEGREES KELVIN	297.862	298.016	298.331	298.546	298.983	299.565	299.537
TW2	DEGREES KELVIN	297.483	297.589	297.854	298.088	298.481	299.044	299.004
TA	DEGREES KELVIN	289.916	290.566	290.896	291.465	292.823	293.712	294.380
THA	DEGREES KELVIN	297.153	297.206	297.305	297.400	[illegible]	[illegible]	298.333
PA	KILOPASCALS	55.654	57.104	56.112	55.859	[illegible]	55.937	55.032
DP2	KILOPASCALS	.567	.576	.568	.586	.576	.603	.662
DP3	KILOPASCALS	3.324	3.167	3.049	2.968	2.764	2.661	2.500
DP1	KILOPASCALS	.327	.323	.332	.330	.329	.329	.432
FROTH HEIGHT	METERS	.965	.991	1.016	1.041	1.016	.991	1.016
FALLBACK	CUBIC METERS/SECOND	.332E-03	.327E-03	.300E-03	.316E-03	.348E-03	.321E-03	.196E-03
CARRYOUT	CUBIC METERS/SECOND	.776E-03	.776E-03	.921E-03	.795E-03	.852E-03	.890E-03	.978E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.425	1.487	1.547	1.608	1.722	1.813	1.921
LIQUID KUTATELADZE NUMBER(SQ RT)		.396	.393	.376	.386	.405	.389	.304

TABLE A-V (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	E15	E16	E17	E18	E19	E20	E21
QA	CUBIC METERS/SECOND	.945E-01	.104E+00	.114E+00	.124E+00	.142E+00	.160E+00	.950E-01
QH1	CUBIC METERS/SECOND	.101E-03	.145E-03	.201E-03	.226E-03	.303E-03	.389E-03	.120E-03
QH2	CUBIC METERS/SECOND	.148E-02	.147E-02	.142E-02	.138E-02	.131E-02	.123E-02	.192E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.018	52.012	52.753	53.351	53.135	53.917	53.476
TH1	DEGREES KELVIN	295.276	292.052	293.001	293.626	294.131	294.469	294.807
TH2	DEGREES KELVIN	295.137	291.631	292.469	293.072	293.572	293.902	294.333
TA	DEGREES KELVIN	283.464	283.991	284.306	285.390	286.421	287.265	288.001
THA	DEGREES KELVIN	294.900	291.751	292.304	292.723	293.124	293.469	294.118
PA	KILOPASCALS	55.957	54.539	54.946	55.836	55.067	55.873	55.570
DP2	KILOPASCALS	.482	.490	.490	.510	.531	.572	.509
DP3	KILOPASCALS	3.346	3.230	3.129	3.026	2.805	2.722	3.574
DP1	KILOPASCALS	.100	.119	.116	.109	.116	.159	.108
FROTH HEIGHT	METERS	1.067	1.118	1.092	1.118	1.118	1.041	1.041
FALLBACK	CUBIC METERS/SECOND	.327E-03	.310E-03	.291E-03	.286E-03	.332E-03	.360E-03	.408E-03
CARRYOUT	CUBIC METERS/SECOND	.121E-02	.127E-02	.134E-02	.131E-02	.127E-02	.127E-02	.150E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.372	1.432	1.501	1.564	1.672	1.776	1.365
LIQUID KUTATELADZE NUMBER(SQ RT)		.393	.383	.371	.368	.396	.412	.439

CHANNEL	UNITS	E23	E24	E25	E26	E27	E28	E29
QA	CUBIC METERS/SECOND	.114E+00	.123E+00	.143E+00	.162E+00	.953E-01	.901E-01	.853E-01
QH1	CUBIC METERS/SECOND	.193E-03	.218E-03	.306E-03	.398E-03	.579E-04	.618E-04	.292E-04
QH2	CUBIC METERS/SECOND	.187E-02	.183E-02	.177E-02	.169E-02	.712E-03	.712E-03	.713E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.795	54.008	52.939	51.249	53.242	53.196	53.316
TH1	DEGREES KELVIN	295.704	296.002	296.272	296.613	296.825	297.301	297.564
TH2	DEGREES KELVIN	295.193	295.510	295.757	296.068	296.694	297.019	297.415
TA	DEGREES KELVIN	288.763	289.436	289.745	289.764	285.572	286.538	287.408
THA	DEGREES KELVIN	294.900	295.133	295.362	295.625	295.076	296.075	296.150
PA	KILOPASCALS	56.147	56.270	55.049	53.327	55.481	55.769	57.814
DP2	KILOPASCALS	.521	.520	.539	.565	.474	.472	.484
DP3	KILOPASCALS	3.380	3.267	3.089	2.912	3.491	3.537	3.603
DP1	KILOPASCALS	.105	.111	.113	.157	.109	.119	.103
FROTH HEIGHT	METERS	1.092	1.016	1.016	1.067	1.016	1.016	.991
FALLBACK	CUBIC METERS/SECOND	.321E-03	.310E-03	.348E-03	.354E-03	.381E-03	.435E-03	.435E-03
CARRYOUT	CUBIC METERS/SECOND	.175E-02	.175E-02	.168E-02	.174E-02	.380E-03	.362E-03	.344E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.495	1.552	1.671	1.774	1.370	1.337	1.305
LIQUID KUTATELADZE NUMBER(SQ RT)		.389	.383	.405	.409	.424	.453	.453

TABLE A-V (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	E30	E31	E32	E33	E34	E35	E36
QA	CUBIC METERS/SECOND	.805E-01	.771E-01	.704E-01	.648E-01	.617E-01	.934E-01	.903E-01
QW1	CUBIC METERS/SECOND	.487E-04	.461E-04	.542E-04	.504E-04	.511E-04	.548E-04	.669E-04
QW2	CUBIC METERS/SECOND	.709E-03	.708E-03	.708E-03	.717E-03	.723E-03	.107E-02	.108E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.099	52.092	52.061	51.971	52.932	52.087	52.064
TH1	DEGREES KELVIN	298.008	298.548	299.013	299.560	300.140	299.949	300.462
TH2	DEGREES KELVIN	297.754	298.270	298.784	299.331	299.920	299.768	300.170
TA	DEGREES KELVIN	287.739	288.262	289.062	290.149	290.842	288.214	288.549
THA	DEGREES KELVIN	296.509	297.345	297.893	298.328	298.547	298.710	299.463
PA	KILOPASCALS	56.306	56.924	57.435	57.364	57.991	56.327	56.415
DP2	KILOPASCALS	.477	.475	.466	.454	.442	.483	.483
DP3	KILOPASCALS	3.486	3.635	3.624	3.402	2.951	3.755	3.772
DP1	KILOPASCALS	.105	.110	.108	.110	.102	.104	.102
FROTH HEIGHT	METERS	.965	.965	.914	.787	.686	1.016	1.041
FALLBACK	CUBIC METERS/SECOND	.512E-03	.561E-03	.675E-03	.808E-03	.789E-03	.375E-03	.474E-03
CARRYOUT	CUBIC METERS/SECOND	.360E-04	.181E-03	.163E-03	.726E-04	.183E-04	.669E-03	.543E-04
GAS KUTATELADZE NUMBER (SQ ROOT)		1.264	1.238	1.185	1.136	1.108	1.361	1.338
LIQUID KUTATELADZE NUMBER(SQ RT)		.491	.515	.564	.617	.610	.421	.473

CHANNEL	UNITS	E38	E39	E40	E41	E42	E43	E44
QA	CUBIC METERS/SECOND	.805E-01	.741E-01	.705E-01	.658E-01	.599E-01	.555E-01	.528E-01
QW1	CUBIC METERS/SECOND	.489E-04	.590E-04	.394E-04	.510E-04	.627E-04	.625E-04	.579E-04
QW2	CUBIC METERS/SECOND	.106E-02	.106E-02	.107E-02	.110E-02	.110E-02	.111E-02	.110E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.392	52.412	52.773	52.660	52.636	52.617	52.622
TH1	DEGREES KELVIN	300.140	300.72'	295.514	296.653	297.696	298.453	298.343
TH2	DEGREES KELVIN	299.894	300.412	295.373	296.399	297.445	298.189	298.009
TA	DEGREES KELVIN	287.741	288.779	282.062	285.028	286.844	288.245	288.091
THA	DEGREES KELVIN	299.087	299.708	294.797	295.889	296.789	297.442	297.255
PA	KILOPASCALS	56.130	51.843	57.972	57.961	58.180	58.251	58.320
DP2	KILOPASCALS	.484	.470	.431	.414	.421	.407	.411
DP3	KILOPASCALS	3.921	3.996	3.265	3.303	3.325	3.323	3.408
DP1	KILOPASCALS	.101	.108	.134	.132	.130	.125	.110
FROTH HEIGHT	METERS	1.041	1.041	1.016	.940	.914	.889	.838
FALLBACK	CUBIC METERS/SECOND	.490E-03	.713E-03	.604E-03	.726E-03	.852E-03	.965E-03	.109E-02
CARRYOUT	CUBIC METERS/SECOND	.637E-03	.507E-03	.525E-03	.380E-03	.310E-03	.372E-03	.156E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.262	1.191	1.194	1.151	1.097	1.055	1.030
LIQUID KUTATELADZE NUMBER(SQ RT)		.481	.580	.534	.585	.634	.675	.718

TABLE A-V (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	E45	E46	E47	E48	E49	E50	E51
QA	CUBIC METERS/SECOND	.948E-01	.905E-01	.855E-01	.798E-01	.743E-01	.708E-01	.658E-01
QW1	CUBIC METERS/SECOND	.685E-04	.673E-04	.758E-04	.602E-04	.731E-04	.471E-04	.542E-04
QW2	CUBIC METERS/SECOND	.150E-02	.163E-02	.164E-02	.164E-02	.164E-02	.164E-02	.164E-02
GD1	KILOGRAMS/CUBIC METER	.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	[illegible]	52.726	52.719	52.704	52.662	52.990	52.990
TH1	DEGREES KELVIN	[illegible]	298.654	298.987	299.000	299.873	299.291	299.990
TH2	DEGREES KELVIN	[illegible]	298.333	298.645	298.656	299.567	299.068	299.686
TA	DEGREES KELVIN	285.836	286.872	287.994	288.882	290.085	289.760	289.589
TWA	DEGREES KELVIN	297.893	297.829	298.214	298.251	299.166	298.643	299.259
PA	KILOPASCALS	56.578	56.632	56.974	57.274	57.887	58.166	58.508
DP2	KILOPASCALS	.441	.446	.435	.426	.414	.440	.420
DP3	KILOPASCALS	3.272	3.374	3.404	3.494	3.605	3.577	3.657
DP1	KILOPASCALS	.104	.105	.105	.104	.104	.109	.103
FROTH HEIGHT	METERS	1.041	1.041	1.016	1.016	.965	.965	.940
FALLBACK	CUBIC METERS/SECOND	.343E-03	.408E-03	.452E-03	.544E-03	.669E-03	.656E-03	.770E-03
CARRYOUT	CUBIC METERS/SECOND	.121E-02	.121E-02	.115E-02	.114E-02	.726E-04	.107E-02	.102E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.373	1.341	1.303	1.260	1.217	1.188	1.148
LIQUID KUTATELADZE NUMBER(SQ RT)		.402	.439	.462	.507	.562	.557	.601

CHANNEL	UNITS	E52	E53	E54	E55	E56	E57	E58
QA	CUBIC METERS/SECOND	.604E-01	.558E-01	.519E-01	.462E-01	.424E-01	.397E-01	.336E-01
QW1	CUBIC METERS/SECOND	.697E-04	.790E-04	.495E-04	.522E-04	.600E-04	.600E-04	.665E-04
QW2	CUBIC METERS/SECOND	.164E-02	.164E-02	.164E-02	.163E-02	.159E-02	.159E-02	.160E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.559	52.558	52.402	52.371	51.880	51.886	52.513
TH1	DEGREES KELVIN	299.704	300.347	300.379	301.116	300.527	301.257	301.466
TH2	DEGREES KELVIN	299.375	300.019	300.059	300.853	300.237	300.996	301.139
TA	DEGREES KELVIN	289.878	290.388	290.489	291.742	291.210	293.414	293.676
TWA	DEGREES KELVIN	298.945	299.554	299.573	300.243	299.667	300.372	300.257
PA	KILOPASCALS	58.355	58.589	58.482	58.648	58.321	58.265	58.885
DP2	KILOPASCALS	.412	.413	.421	.399	.398	.396	.397
DP3	KILOPASCALS	3.717	3.788	3.799	3.898	3.868	3.845	3.506
DP1	KILOPASCALS	.100	.101	.096	.097	.104	.104	.105
FROTH HEIGHT	METERS	.940	.914	.914	.889	.864	.889	.813
FALLBACK	CUBIC METERS/SECOND	.978E-03	.104E-02	.107E-02	.126E-02	.131E-02	.138E-02	.167E-02
CARRYOUT	CUBIC METERS/SECOND	.726E-03	.726E-03	.525E-03	.543E-03	.379E-03	0.	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.099	1.057	1.019	.961	.921	.889	.818
LIQUID KUTATELADZE NUMBER(SQ RT)		.679	.701	.709	.770	.785	.806	.887

TABLE A-V (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	E60	E61	E62	E63	E64	E65	E66
QA	CUBIC METERS/SECOND	.854E-01	.748E-01	.657E-01	.598E-01	.567E-01	.476E-01	.422E-01
QW1	CUBIC METERS/SECOND	.887E-04	.113E-03	.115E-03	.122E-03	.119E-03	.119E-03	.112E-03
QW2	CUBIC METERS/SECOND	.197E-02	.197E-02	.197E-02	.197E-02	.197E-02	.197E-02	.197E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.101	51.931	52.875	52.862	53.689	52.539	52.544
TW1	DEGREES KELVIN	292.887	293.463	293.998	294.227	294.788	295.417	295.783
TW2	DEGREES KELVIN	292.690	293.246	293.782	293.960	294.490	295.137	295.480
TA	DEGREES KELVIN	284.293	284.610	285.654	286.366	288.208	288.082	288.840
TWA	DEGREES KELVIN	292.451	292.940	293.418	293.587	294.162	294.745	295.137
PA	KILOPASCALS	55.707	56.053	57.832	58.169	59.468	58.794	58.816
DP2	KILOPASCALS	.454	.453	.441	.451	.429	.414	.415
DP3	KILOPASCALS	3.673	3.884	4.041	4.107	4.185	4.326	4.442
DP1	KILOPASCALS	.102	.099	.096	.098	.089	.090	.083
FROTH HEIGHT	METERS	1.092	1.067	1.041	1.016	1.016	.991	.965
FALLBACK	CUBIC METERS/SECOND	.479E-03	.669E-03	.915E-03	.965E-03	.109E-02	.138E-02	.157E-02
CARRYOUT	CUBIC METERS/SECOND	.163E-02	.141E-02	.105E-02	0.	.921E-03	.688E-03	.650E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.303	1.220	1.148	1.096	1.069	.979	.921
LIQUID KUTATELADZE NUMBER(SQ RT)		.475	.562	.657	.675	.718	.806	.861

CHANNEL	UNITS	E67	E68	E69	E70
QA	CUBIC METERS/SECOND	.383E-01	.328E-01	.288E-01	.191E-01
QW1	CUBIC METERS/SECOND	.116E-03	.116E-03	.119E-03	.117E-03
QW2	CUBIC METERS/SECOND	.197E-02	.198E-02	.197E-02	.197E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.531	52.505	52.507	52.520
TW1	DEGREES KELVIN	296.191	296.927	297.550	297.799
TW2	DEGREES KELVIN	295.903	296.657	297.263	297.592
TA	DEGREES KELVIN	289.328	290.714	291.220	291.431
TWA	DEGREES KELVIN	295.457	296.054	296.582	296.360
PA	KILOPASCALS	59.060	59.069	59.158	58.496
DP2	KILOPASCALS	.410	.396	.407	.363
DP3	KILOPASCALS	4.490	4.507	4.421	3.495
DP1	KILOPASCALS	.086	.086	.090	.091
FROTH HEIGHT	METERS	.940	.940	.864	.635
FALLBACK	CUBIC METERS/SECOND	.163E-02	.185E-02	.199E-02	.202E-02
CARRYOUT	CUBIC METERS/SECOND	.386E-03	.326E-03	0.	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		.878	.811	.760	.618
LIQUID KUTATELADZE NUMBER(SQ RT)		.878	.934	.970	.976

TABLE A-VI

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	F01	F02	F03	F04	F05	F06	F07
QA	CUBIC METERS/SECOND	.488E-01	.515E-01	.937E-01	.112E+00	.132E+00	.152E+00	.159E+00
GM1	GALLONS/MINUTE	.000	.000	.000	.000	.000	.000	.000
QM2	CUBIC METERS/SECOND	.713E-03	.714E-03	.713E-03	.639E-03	.571E-03	.499E-03	.468E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.905	52.903	52.671	53.085	52.731	52.835	52.853
TH1	DEGREES KELVIN	296.058	297.070	297.571	298.229	298.210	298.665	299.722
TH2	DEGREES KELVIN	295.687	296.655	297.192	297.779	297.747	298.165	299.218
TA	DEGREES KELVIN	284.278	284.977	285.239	286.666	288.231	297.590	300.231
THA	DEGREES KELVIN	301.773	301.485	300.256	299.781	298.809	298.746	298.889
PA	KILOPASCALS	55.200	55.126	53.794	53.770	53.199	53.496	53.474
DP2	KILOPASCALS	.393	.413	.483	.485	.436	.401	.378
DP3	KILOPASCALS	.907	.955	1.211	1.137	1.081	1.058	1.050
DP1	KILOPASCALS	.100	.091	.112	.116	.112	.135	.142
FROTH HEIGHT	METERS	.178	.203	.305	.330	.330	.330	.330
FALLBACK	CUBIC METERS/SECOND	.915E-03	.969E-03	.278E-03	.256E-03	.278E-03	.375E-03	.370E-03
CARRYOUT	CUBIC METERS/SECOND	.126E-04	0.	.543E-03	.543E-03	.525E-03	.453E-03	.471E-03
GAS KUTATELADZE	NUMBER (SQ ROOT)	.982	1.008	1.353	1.477	1.596	1.700	1.735
LIQUID KUTATELADZE	NUMBER(SQ RT)	.657	.676	.362	.348	.362	.421	.418

CHANNEL	UNITS	F08	F09	F10	F11	F12	F13	F15
QA	CUBIC METERS/SECOND	.419E-01	.467E-01	.517E-01	.567E-01	.604E-01	.666E-01	.925E-01
GM1	GALLONS/MINUTE	.000	.000	.000	.000	.000	-.000	.000
QM2	CUBIC METERS/SECOND	.105E-02	.105E-02	.105E-02	.107E-02	.106E-02	.106E-02	.106E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.127	52.123	52.118	51.996	52.513	52.542	52.384
TH1	DEGREES KELVIN	299.540	300.820	301.573	300.609	300.699	302.044	301.164
TH2	DEGREES KELVIN	299.881	301.013	301.873	301.738	302.088	301.652	300.863
TA	DEGREES KELVIN	292.505	291.330	290.613	290.056	289.169	288.802	289.608
THA	DEGREES KELVIN	299.892	300.017	300.362	300.533	300.549	300.555	300.420
PA	KILOPASCALS	54.653	55.294	55.119	54.844	55.151	54.947	53.735
DP2	KILOPASCALS	.400	.417	.422	.433	.440	.449	.465
DP3	KILOPASCALS	1.150	1.481	1.517	1.563	1.573	1.586	1.535
DP1	KILOPASCALS	.109	.113	.112	.113	.112	.111	.111
FROTH HEIGHT	METERS	.152	.229	.279	.305	.330	.356	.330
FALLBACK	CUBIC METERS/SECOND	.102E-02	.828E-03	.768E-03	.632E-03	.534E-03	.539E-03	.294E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.217E-03	.326E-03	.398E-03	.471E-03	.597E-03	.905E-03
GAS KUTATELADZE	NUMBER (SQ ROOT)	.902	.955	1.005	1.053	1.088	1.142	1.339
LIQUID KUTATELADZE	NUMBER(SQ RT)	.695	.625	.602	.546	.502	.504	.373

TABLE A-VI (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	F16	F17	F18	F19	F20	F21	F22
GA	CUBIC METERS/SECOND	.111E+00	.132E+00	.151E+00	.235E-01	.337E-01	.454E-01	.525E-01
QH1	GALLONS/MINUTE	.000	.000	.000	.000	.000	.000	.000
QH2	CUBIC METERS/SECOND	.997E-03	.929E-03	.857E-03	.149E-02	.149E-02	.149E-02	.149E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.856	52.400	52.739	52.262	52.333	51.207	51.298
TH1	DEGREES KELVIN	302.059	302.176	302.171	300.943	301.698	301.889	302.243
TH2	DEGREES KELVIN	301.600	301.695	301.690	301.916	302.261	302.433	302.840
TA	DEGREES KELVIN	290.413	292.853	293.760	294.253	293.747	294.690	293.625
THA	DEGREES KELVIN	300.651	300.594	300.643	301.071	301.160	301.602	301.552
PA	KILOPASCALS	53.983	53.007	53.462	55.835	55.861	54.478	54.495
DP2	KILOPASCALS	.481	.486	.470	.355	.371	.393	.403
DP3	KILOPASCALS	1.438	1.308	1.229	1.705	1.775	1.805	1.820
DP1	KILOPASCALS	.118	.121	.131	.117	.115	.116	.118
FROTH HEIGHT	METERS	.330	.330	.330	.229	.254	.305	.330
FALLBACK	CUBIC METERS/SECOND	.278E-03	.283E-03	.370E-03	.127E-02	.111E-02	.904E-03	.708E-03
CARRYOUT	CUBIC METERS/SECOND	.941E-03	.905E-03	.797E-03	.199E-03	.326E-03	.597E-03	.652E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.464	1.591	1.704	.677	.811	.938	1.010
LIQUID KUTATELADZE NUMBER(SQ RT)		.362	.366	.418	.775	.724	.653	.578

CHANNEL	UNITS	F23	F24	F25	F26	F27	F28	F29
GA	CUBIC METERS/SECOND	.601E-01	.752E-01	.946E-01	.112E+00	.132E+00	.152E+00	.103E-01
QH1	GALLONS/MINUTE	.000	.000	.000	.000	.000	.000	.000
QH2	CUBIC METERS/SECOND	.149E-02	.149E-02	.149E-02	.140E-02	.133E-02	.127E-02	.193E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.241	52.380	52.223	52.322	52.181	52.313	52.293
TH1	DEGREES KELVIN	301.620	301.179	301.496	301.969	302.326	302.310	292.092
TH2	DEGREES KELVIN	302.478	300.905	301.147	301.549	301.886	301.872	293.526
TA	DEGREES KELVIN	293.428	293.438	294.104	294.640	295.883	297.853	287.479
THA	DEGREES KELVIN	301.654	301.217	301.204	301.285	301.340	301.395	295.614
PA	KILOPASCALS	53.796	54.697	53.853	53.585	53.030	53.163	55.735
DP2	KILOPASCALS	.406	.425	.442	.451	.462	.476	.316
DP3	KILOPASCALS	1.835	1.817	1.747	1.638	1.503	1.407	1.223
DP1	KILOPASCALS	.117	.122	.117	.120	.115	.121	.123
FROTH HEIGHT	METERS	.330	.356	.381	.381	.356	.356	.254
FALLBACK	CUBIC METERS/SECOND	.654E-03	.375E-03	.283E-03	.261E-03	.278E-03	.316E-03	.169E-02
CARRYOUT	CUBIC METERS/SECOND	.833E-03	.103E-02	.136E-02	.132E-02	.129E-02	.127E-02	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.077	1.207	1.350	1.469	1.588	1.700	1.452
LIQUID KUTATELADZE NUMBER(SQ RT)		.555	.421	.366	.351	.362	.386	.893

TABLE A-VI (CONT.)

KKU CONTROL ROD SHROUD TEST HEIGHT= 0.305METERS

CHANNEL	UNITS	F30	F31	F32	F33	F34	F35	F36
QA	CUBIC METERS/SECOND	.901E-02	.246E-01	.295E-01	.373E-01	.432E-01	.521E-01	.614E-01
QH1	GALLONS/MINUTE	-.000	-.000	.000	-.000	-.000	-.000	-.000
QH2	CUBIC METERS/SECOND	.193E-02	.196E-02	.193E-02	.194E-02	.195E-02	.194E-02	.195E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	54.016	53.619	52.871	52.892	53.261	53.504	53.970
TH1	DEGREES KELVIN	292.171	292.278	292.764	294.155	294.989	294.839	294.175
TH2	DEGREES KELVIN	294.498	295.163	295.975	296.900	297.331	298.270	298.604
TA	DEGREES KELVIN	289.087	288.292	287.680	287.205	286.240	286.356	287.334
THA	DEGREES KELVIN	296.486	296.394	296.362	296.438	296.673	296.990	297.246
PA	KILOPASCALS	58.500	58.379	57.591	57.440	55.867	56.275	56.269
DP2	KILOPASCALS	.320	.334	.337	.347	.347	.354	.359
DP3	KILOPASCALS	1.282	1.407	1.412	1.434	1.436	1.453	1.444
DP1	KILOPASCALS	.115	.101	.113	.107	.110	.110	.109
FROTH HEIGHT	METERS	.254	.305	.305	.305	.330	.330	.356
FALLBACK	CUBIC METERS/SECOND	.164E-02	.137E-02	.123E-02	.110E-02	.948E-03	.714E-03	.544E-03
CARRYOUT	CUBIC METERS/SECOND	.631E-04	.579E-03	.597E-03	.905E-03	.978E-03	.116E-02	.136E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		.424	.701	.767	.862	.923	1.015	1.100
LIQUID KUTATELADZE NUMBER(SQ RT)		.881	.805	.762	.720	.669	.580	.507

CHANNEL	UNITS	F37	F38	F39	F40	F42
QA	CUBIC METERS/SECOND	.744E-01	.949E-01	.112E+00	.131E+00	.151E+00
QH1	GALLONS/MINUTE	-.000	-.000	.000	.000	.000
QH2	CUBIC METERS/SECOND	.207E-02	.207E-02	.198E-02	.189E-02	.181E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.198	52.346	54.870	53.382	53.593
TH1	DEGREES KELVIN	292.748	292.933	297.409	297.799	298.091
TH2	DEGREES KELVIN	295.151	296.017	297.006	297.300	297.582
TA	DEGREES KELVIN	288.090	287.042	287.193	288.136	289.449
THA	DEGREES KELVIN	299.653	300.528	299.548	299.238	298.622
PA	KILOPASCALS	54.374	51.523	53.635	52.081	53.918
DP2	KILOPASCALS	.377	.394	.410	.415	.433
DP3	KILOPASCALS	1.370	1.324	1.262	1.155	1.057
DP1	KILOPASCALS	.112	.108	.116	.108	.126
FROTH HEIGHT	METERS	.356	.381	.406	.381	.381
FALLBACK	CUBIC METERS/SECOND	.421E-03	.117E-03	.256E-03	.283E-03	.360E-03
CARRYOUT	CUBIC METERS/SECOND	.170E-02	.168E-02	.181E-02	.183E-02	.188E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.206	1.348	1.470	1.584	1.711
LIQUID KUTATELADZE NUMBER(SQ RT)		.446	.235	.348	.366	.412

TABLE A-VII

JAERI UCSP TEST HEIGHT=0.305 METERS

CHANNEL	UNITS	G01	G02	G03	G04	G05	G06	G07
QA	CUBIC METERS/SECOND	.104E+00	.114E+00	.132E+00	.143E+00	.152E+00	.160E+00	.169E+00
QH1	CUBIC METERS/SECOND	.152E-03	.200E-03	.271E-03	.304E-03	.347E-03	.381E-03	.418E-03
QH2	CUBIC METERS/SECOND	.715E-03	.669E-03	.605E-03	.572E-03	.529E-03	.490E-03	.452E-03
GD1	KILOGRAMS/CUBIC METER	0.090	0.000	0.000	0.000	0.0[illegible]	0.000	0.000
P1	KILOPASCALS	52.939	54.223	52.752	54.172	53.433	54.121	54.139
TH1	DEGREES KELVIN	299.386	300.143	300.584	301.017	301.493	301.935	302.556
TH2	DEGREES KELVIN	298.976	299.701	300.116	300.543	301.025	301.437	302.022
TA	DEGREES KELVIN	288.575	288.344	288.740	289.682	287.453	291.475	292.486
THA	DEGREES KELVIN	297.370	297.490	297.737	298.202	298.427	298.836	299.525
PA	KILOPASCALS	54.475	55.491	55.676	51.569	50.406	51.341	51.346
DP2	KILOPASCALS	.208	.221	.274	.394	.404	.411	.416
DP3	KILOPASCALS	.373	.391	.399	.408	.415	.428	.438
DP1	KILOPASCALS	.214	.213	.253	.340	.326	.337	.342
FROTH HEIGHT	METERS	.127	.203	.330	.381	.406	.432	.508
FALLBACK	CUBIC METERS/SECOND	.849E-03	.806E-03	.654E-03	.582E-03	.523E-03	.463E-03	.414E-03
CAR[illegible]T	CUBIC METERS/SECOND	0.	0.	.145E-03	.290E-03	.326E-03	.380E-03	.416E-03
[illegible]ATELADZE NUMBER (SQ ROOT)		1.426	1.493	1.611	1.644	1.692	1.738	1.783
[illegible]D KUTATELADZE NUMBER(SQ RT)		.633	.617	.555	.524	.497	.468	.447

CHANNEL	UNITS	G08	G09	G10	G11	G12	G13	G14
QA	CUBIC METERS/SECOND	.179E+00	.187E+00	.196E+00	.104E+00	.945E-01	.122E+00	.132E+00
QH1	CUBIC METERS/SECOND	.455E-03	.499E-03	.540E-03	.150E-03	.124E-03	.232E-03	.270E-03
QH2	CUBIC METERS/SECOND	.412E-03	.379E-03	.326E-03	.108E-02	.112E-02	.101E-02	.974E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.563	53.906	54.022	53.952	51.869	53.858	51.582
TH1	DEGREES KELVIN	303.282	302.764	303.370	302.190	302.481	302.676	303.048
TH2	DEGREES KELVIN	302.715	302.218	302.851	301.840	302.131	302.433	302.599
TA	DEGREES KELVIN	293.344	294.066	302.399	294.903	292.113	292.249	292.584
THA	DEGREES KELVIN	300.069	299.628	299.956	299.927	300.107	300.213	300.768
PA	KILOPASCALS	50.839	51.201	51.723	54.966	53.566	55.677	52.988
DP2	KILOPASCALS	.422	.432	.430	.560	.557	.529	.508
DP3	KILOPASCALS	.444	.455	.451	.537	.545	.517	.515
DP1	KILOPASCALS	.355	.383	.397	.294	.319	.284	.298
FROTH HEIGHT	METERS	.559	.559	.610	.381	.356	.432	.432
FALLBACK	CUBIC METERS/SECOND	.324E-03	.234E-03	.153E-03	.773E-03	.926E-03	.708E-03	.669E-03
CARRYOUT	CUBIC METERS/SECOND	.525E-03	.579E-03	.706E-03	.453E-03	.344E-03	.525E-03	.552E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.832	1.874	1.910	1.416	1.351	1.542	1.595
LIQUID KUTATELADZE NUMBER(SQ RT)		.391	.332	.268	.604	.661	.578	.562

TABLE A-VII (CONT.)

JAERI UCSP TEST HEIGHT=0.305 METERS

CHANNEL	UNITS	G15	G16	G17	G18	G19	G20	G21
QA	CUBIC METERS/SECOND	.153E+00	.159E+00	.179E+00	.186E+00	.198E+00	.967E-01	.104E+00
QH1	CUBIC METERS/SECOND	.338E-03	.378E-03	.455E-03	.495E-03	.553E-03	.126E-03	.151E-03
QH2	CUBIC METERS/SECOND	.899E-03	.857E-03	.788E-03	.751E-03	.694E-03	.158E-02	.151E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	51.673	53.055	53.065	51.498	51.705	50.878	52.739
TH1	DEGREES KELVIN	303.004	303.474	303.661	302.044	302.710	301.764	301.975
TH2	DEGREES KELVIN	302.522	302.957	303.112	301.495	302.152	301.232	301.463
TA	DEGREES KELVIN	292.659	292.973	292.864	294.811	296.743	294.390	291.942
THA	DEGREES KELVIN	300.189	300.597	300.958	299.313	299.832	299.576	299.676
PA	KILOPASCALS	52.782	53.782	53.876	52.257	52.946	51.981	54.394
DP2	KILOPASCALS	.481	.466	.451	.466	.461	.516	.515
DP3	KILOPASCALS	.514	.519	.521	.447	.477	.527	.518
DP1	KILOPASCALS	.285	.308	.359	.341	.348	.318	.314
FROTH HEIGHT	METERS	.483	.508	.533	.635	.737	.305	.381
FALLBACK	CUBIC METERS/SECOND	.512E-03	.501E-03	.305E-03	.174E-03	.125E-03	.936E-03	.762E-03
CARRYOUT	CUBIC METERS/SECOND	.724E-03	.743E-03	.996E-03	.109E-02	.116E-02	.724E-03	.833E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.711	1.751	1.856	1.885	1.943	1.359	1.418
LIQUID KUTATELADZE NUMBER(SQ RT)		.491	.486	.379	.287	.243	.665	.600

CHANNEL	UNITS	G22	G23	G24	G25	G26	G27	G28
QA	CUBIC METERS/SECOND	.122E+00	.132E+00	.151E+00	.159E+00	.178E+00	.187E+00	.197E+00
QH1	CUBIC METERS/SECOND	.227E-03	.268E-03	.341E-03	.377E-03	.453E-03	.488E-03	.547E-03
QH2	CUBIC METERS/SECOND	.143E-02	.140E-02	.134E-02	.129E-02	.120E-02	.118E-02	.112E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	52.601	52.808	53.773	53.800	53.441	53.589	53.378
TH1	DEGREES KELVIN	302.042	302.157	301.674	299.842	299.679	299.983	300.221
TH2	DEGREES KELVIN	301.509	301.625	301.137	299.348	299.207	299.510	299.725
TA	DEGREES KELVIN	291.400	291.401	291.493	290.257	290.010	291.405	292.384
THA	DEGREES KELVIN	299.467	299.385	299.127	297.470	297.476	297.697	297.737
PA	KILOPASCALS	54.325	54.325	53.084	53.229	52.995	53.090	53.398
DP2	KILOPASCALS	.498	.492	.491	.535	.517	.520	.519
DP3	KILOPASCALS	.507	.501	.485	.445	.433	.439	.439
DP1	KILOPASCALS	.292	.291	.271	.191	.247	.274	.298
FROTH HEIGHT	METERS	.381	.406	.432	.432	.483	.483	.508
FALLBACK	CUBIC METERS/SECOND	.588E-03	.508E-03	.435E-03	.397E-03	.261E-03	.213E-03	.155E-03
CARRYOUT	CUBIC METERS/SECOND	.109E-02	.116E-02	.130E-02	.121E-02	.114E-02	.145E-02	.150E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.537	1.600	1.703	1.750	1.849	1.893	1.942
LIQUID KUTATELADZE NUMBER(SQ RT)		.527	.490	.453	.433	.351	.317	.270

TABLE A-VIII (CONT.)

JAERI UCSP TEST HEIGHT=0.305 METERS

CHANNEL	UNITS	G29	G30	G31	G32	G33	G34	G35
QA	CUBIC METERS/SECOND	.802E-01	.853E-01	.796E-01	.932E-01	.104E+00	.123E+00	.132E+00
QW1	CUBIC METERS/SECOND	.134E-03	.119E-03	.129E-03	.120E-03	.154E-03	.231E-03	.271E-03
QW2	CUBIC METERS/SECOND	.158E-02	.205E-02	.203E-02	.203E-02	.199E-02	.192E-02	.189E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.547	52.959	53.055	52.837	52.776	53.071	53.033
TW1	DEGREES KELVIN	300.469	298.278	299.071	299.183	299.741	299.802	300.206
TW2	DEGREES KELVIN	300.048	298.110	298.714	298.842	299.308	299.356	299.734
TA	DEGREES KELVIN	292.456	287.654	289.923	289.563	289.539	290.980	291.666
TWA	DEGREES KELVIN	298.326	297.305	297.888	298.179	298.031	298.318	298.616
PA	KILOPASCALS	52.369	54.418	54.645	54.044	53.744	53.890	53.792
DP2	KILOPASCALS	.330	.700	.469	.699	.692	.673	.667
DP3	KILOPASCALS	.307	.473	.385	.517	.520	.500	.503
DP1	KILOPASCALS	.256	.256	.283	.235	.219	.200	.193
FROTH HEIGHT	METERS	.330	.406	.330	.432	.457	.483	.483
FALLBACK	CUBIC METERS/SECOND	.163E-02	.132E-02	.200E-02	.109E-02	.926E-03	.675E-03	.599E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.851E-03	0.	.107E-02	.121E-02	.150E-02	.156E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.235	1.290	1.244	1.344	1.420	1.539	1.597
LIQUID KUTATELADZE NUMBER(SQ RT)		.878	.789	.973	.717	.661	.564	.532

CHANNEL	UNITS	G36	G37	G38	G39	G40
QA	CUBIC METERS/SECOND	.153E+00	.160E+00	.180E+00	.188E+00	.198E+00
QW1	CUBIC METERS/SECOND	.340E-03	.386E-03	.451E-03	.492E-03	.545E-03
QW2	CUBIC METERS/SECOND	.180E-02	.178E-02	.171E-02	.168E-02	.163E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.431	53.410	53.494	53.330	53.582
TW1	DEGREES KELVIN	300.456	300.572	300.708	300.841	301.000
TW2	DEGREES KELVIN	299.975	300.088	300.212	300.347	300.523
TA	DEGREES KELVIN	291.630	292.023	291.878	292.060	292.449
TWA	DEGREES KELVIN	298.883	298.818	298.336	298.676	298.770
PA	KILOPASCALS	54.183	54.135	54.952	53.300	53.391
DP2	KILOPASCALS	.632	.615	.612	.594	.585
DP3	KILOPASCALS	.480	.475	.473	.467	.463
DP1	KILOPASCALS	.201	.210	.258	.282	.315
FROTH HEIGHT	METERS	.508	.584	.635	.686	.686
FALLBACK	CUBIC METERS/SECOND	.468E-03	.447E-03	.278E-03	.201E-03	.137E-03
CARRYOUT	CUBIC METERS/SECOND	.165E-02	.172E-02	.188E-02	.199E-02	.210E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.716	1.756	1.870	1.897	1.947
LIQUID KUTATELADZE NUMBER(SQ RT)		.470	.459	.362	.308	.254

TABLE A-VIII

JAERI UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	H01	H02	H03	H04	H05	H06	H07
QA	CUBIC METERS/SECOND	.170E+00	.162E+00	.15[illegible]E+00	.144E+00	.189E+00	.199E+00	.207E+00
QW1	CUBIC METERS/SECOND	.421E-03	.377E-03	.348E-03	.304E-03	.496E-03	.550E-03	.593E-03
QW2	CUBIC METERS/SECOND	.455E-03	.490E-03	.528E-03	.573E-03	.387E-03	.329E-03	.275E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.003	52.958	52.907	52.879	53.262	53.059	53.495
TH1	DEGREES KELVIN	297.064	298.455	300.084	302.005	301.275	302.025	301.841
TH2	DEGREES KELVIN	296.531	297.925	299.556	301.499	300.779	301.467	301.248
TA	DEGREES KELVIN	288.316	291.383	292.669	293.953	293.210	295.043	294.685
TWA	DEGREES KELVIN	295.066	296.577	298.227	299.970	299.043	299.444	299.404
PA	KILOPASCALS	55.291	55.098	55.081	55.137	55.328	55.111	55.542
DP2	KILOPASCALS	.974	.971	.975	.963	.980	1.009	.979
DP3	KILOPASCALS	1.502	1.598	1.657	1.678	1.425	1.341	1.296
DP1	KILOPASCALS	.340	.319	.312	.310	.376	.397	.409
FROTH HEIGHT	METERS	.838	.838	.787	.813	1.016	1.016	1.118
FALLBACK	CUBIC METERS/SECOND	.348E-03	.517E-03	.604E-03	.773E-03	.218E-03	.174E-03	.131E-03
CARRYOUT	CUBIC METERS/SECOND	.543E-03	.344E-03	.163E-03	0.	.652E-03	.652E-03	.743E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.827	1.774	1.727	1.671	1.916	1.964	2.005
LIQUID KUTATELADZE NUMBER(SQ RT)		.405	.494	.534	.604	.321	.287	.248

CHANNEL	UNITS	H08	H09	H10	H11	H12	H13	H14
QA	CUBIC METERS/SECOND	.150E+00	.161E+00	.17[illegible]00	.189E+00	.200E+00	.161E+00	.208E+00
QW1	CUBIC METERS/SECOND	.339E-03	.377E-03	.4[illegible]E-03	.493E-03	.547E-03	.377E-03	.590E-03
QW2	CUBIC METERS/SECOND	.902E-03	.856E-03	.826E-03	.753E-03	.701E-03	.130E-02	.106E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.359	53.481	53.700	52.593	52.590	52.827	53.274
TH1	DEGREES KELVIN	302.219	302.166	302.335	302.132	302.560	302.757	302.655
TH2	DEGREES KELVIN	301.779	301.673	301.841	301.634	302.037	302.274	302.150
TA	DEGREES KELVIN	293.925	294.241	293.211	293.954	294.962	308.869	296.042
TWA	DEGREES KELVIN	300.598	300.622	300.593	300.160	300.712	301.435	301.189
PA	KILOPASCALS	55.693	55.699	55.854	54.899	54.951	55.419	55.797
DP2	KILOPASCALS	.969	.973	.983	.999	.986	.998	1.030
DP3	KILOPASCALS	1.925	1.820	1.767	1.590	1.528	2.054	1.579
DP1	KILOPASCALS	.342	.338	.372	.405	.412	.336	.388
FROTH HEIGHT	METERS	.940	.965	.991	1.067	1.067	1.016	1.143
FALLBACK	CUBIC METERS/SECOND	.751E-03	.632E-03	.403E-03	.261E-03	.218E-03	.708E-03	.141E-03
CARRYOUT	CUBIC METERS/SECOND	.444E-03	.616E-03	.833E-03	.978E-03	.101E-02	.978E-03	.152E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.708	1.767	1.818	1.915	1.966	1.747	2.007
LIQUID KUTATELADZE NUMBER(SQ RT)		.596	.546	.436	.351	.321	.578	.258

TABLE A-VIII (CONT.)

JAERI UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	H15	H16	H17	H18	H19	H20	H21
QA	CUBIC METERS/SECOND	.170E+00	.216E+00	.207E+00	.144E+00	.133E+00	.123E+00	.113E+00
QH1	CUBIC METERS/SECOND	.414E-03	.647E-03	.593E-03	.310E-03	.273E-03	.233E-03	.202E-03
QH2	CUBIC METERS/SECOND	.175E-02	.154E-02	.650E-03	.136E-02	.140E-02	.143E-02	.147E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.038	52.910	50.900	52.946	53.791	52.464	53.270
TH1	DEGREES KELVIN	303.014	302.825	299.824	300.616	300.487	301.307	301.658
TH2	DEGREES KELVIN	302.516	302.331	299.287	300.169	300.031	300.895	301.268
TA	DEGREES KELVIN	307.580	297.581	287.609	288.609	289.629	289.879	289.911
THA	DEGREES KELVIN	301.933	301.585	297.042	299.051	299.028	299.836	300.236
PA	KILOPASCALS	55.839	55.588	53.351	56.045	56.865	55.036	56.100
DP2	KILOPASCALS	.979	1.039	.952	.932	.942	.934	.916
DP3	KILOPASCALS	2.220	1.747	.944	1.735	1.876	1.961	2.072
DP1	KILOPASCALS	.320	.422	.380	.290	.304	.320	.351
FROTH HEIGHT	METERS	1.219	1.143	.991	.914	.914	.914	.864
FALLBACK	CUBIC METERS/SECOND	.628E-03	.123E-03	.109E-03	.729E-03	.101E-02	.127E-02	.130E-02
CARRYOUT	CUBIC METERS/SECOND	.183E-02	.196E-02	.114E-02	.872E-03	.636E-03	.345E-03	.245E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.800	2.044	2.011	1.682	1.618	1.549	1.489
LIQUID KUTATELADZE NUMBER(SQ RT)		.545	.241	.227	.587	.691	.774	.782

CHANNEL	UNITS	H22	H23	H24	H25	H26	H27	H28
QA	CUBIC METERS/SECOND	.104E+00	.153E+00	.170E+00	.189E+00	.199E+00	.938E-01	.105E+00
QH1	CUBIC METERS/SECOND	.153E-03	.337E-03	.415E-03	.493E-03	.547E-03	.123E-03	.156E-03
QH2	CUBIC METERS/SECOND	.151E-02	.133E-02	.128E-02	.117E-02	.111E-02	.203E-02	.198E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.483	53.499	51.940	52.647	53.352	52.892	52.917
TH1	DEGREES KELVIN	301.995	302.691	302.755	303.358	303.889	303.994	304.747
TH2	DEGREES KELVIN	301.677	302.266	302.274	302.875	303.402	303.618	304.378
TA	DEGREES KELVIN	290.484	287.695	287.734	288.569	289.456	293.560	293.678
THA	DEGREES KELVIN	300.593	300.749	300.454	300.747	301.167	302.551	303.384
PA	KILOPASCALS	58.159	56.761	55.378	55.678	55.710	57.844	57.531
DP2	KILOPASCALS	.908	1.020	1.042	1.081	1.054	.892	.940
DP3	KILOPASCALS	1.967	1.643	1.516	1.315	1.250	2.232	2.342
DP1	KILOPASCALS	.356	.314	.344	.376	.370	.400	.388
FROTH HEIGHT	METERS	.838	1.041	.991	1.067	1.118	.838	.889
FALLBACK	CUBIC METERS/SECOND	.152E-02	.626E-03	.381E-03	.199E-03	.147E-03	.201E-02	.175E-02
CARRYOUT	CUBIC METERS/SECOND	.972E-04	.972E-03	.133E-02	.144E-02	.143E-02	.726E-04	.413E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.442	1.743	1.830	1.928	1.975	1.363	1.438
LIQUID KUTATELADZE NUMBER(SQ RT)		.846	.544	.424	.306	.263	.975	.909

TABLE A-VIII (CONT.)

JAERI UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	H29	H30	H31	H32	H33	H34	H35
QA	CUBIC METERS/SECOND	.123E+00	.133E+00	.153E+00	.161E+00	.189E+00	.199E+00	.134E+00
QW1	CUBIC METERS/SECOND	.233E-03	.270E-03	.332E-03	.376E-03	.492E-03	.548E-03	.261E-03
QW2	CUBIC METERS/SECOND	.192E-02	.188E-02	.179E-02	.177E-02	.168E-02	.162E-02	.598E-03
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	KILOPASCALS	53.361	52.968	52.903	52.098	53.566	51.765	52.697
TW1	DEGREES KELVIN	305.021	305.893	305.914	306.302	305.396	305.846	307.056
TW2	DEGREES KELVIN	304.582	305.416	305.438	305.818	304.942	305.369	306.580
TA	DEGREES KELVIN	292.493	291.446	290.449	291.202	289.949	290.408	290.882
TWA	DEGREES KELVIN	303.597	304.186	304.066	304.488	303.108	303.283	303.572
PA	KILOPASCALS	57.141	55.279	56.376	55.609	57.200	55.364	55.130
DP2	KILOPASCALS	.992	.976	1.029	1.025	1.097	1.093	.426
DP3	KILOPASCALS	2.249	2.185	1.880	1.895	1.567	1.521	.512
DP1	KILOPASCALS	.356	.340	.333	.351	.401	.410	.289
FROTH HEIGHT	METERS	.686	1.016	1.016	1.041	1.041	1.016	.457
FALLBACK	CUBIC METERS/SECOND	.116E-02	.113E-02	.648E-03	.586E-03	.239E-03	.141E-03	.827E-03
CARRYOUT	CUBIC METERS/SECOND	.972E-03	.890E-03	.111E-02	.153E-02	.191E-02	.195E-02	.183E-04
GAS KUTATELADZE NUMBER (SQ ROOT)		1.556	1.613	1.737	1.776	1.932	1.977	1.615
LIQUID KUTATELADZE NUMBER(SQ RT)		.740	.731	.553	.526	.336	.258	.625

CHANNEL	UNITS	H36	H38	H39
QA	CUBIC METERS/SECOND	.144E+00	.133E+00	.123E+00
QW1	CUBIC METERS/SECOND	.307E-03	.270E-03	.232E-03
QW2	CUBIC METERS/SECOND	.908E-03	.968E-03	.100E-02
GD1	KILOGRAMS/CUBIC METER	0.000	0.000	0.000
P1	KILOPASCALS	51.930	52.461	51.055
TW1	DEGREES KELVIN	307.801	308.542	309.360
TW2	DEGREES KELVIN	307.347	308.117	308.958
TA	DEGREES KELVIN	291.384	292.391	294.013
TWA	DEGREES KELVIN	305.290	306.146	306.686
PA	KILOPASCALS	56.011	57.483	55.890
DP2	KILOPASCALS	1.029	1.013	.952
DP3	KILOPASCALS	1.686	1.736	1.040
DP1	KILOPASCALS	.311	.306	.287
FROTH HEIGHT	METERS	.838	.813	.584
FALLBACK	CUBIC METERS/SECOND	.935E-03	.107E-02	.125E-02
CARRYOUT	CUBIC METERS/SECOND	.345E-03	.191E-03	.908E-04
GAS KUTATELADZE NUMBER (SQ ROOT)		1.683	1.626	1.556
LIQUID KUTATELADZE NUMBER(SQ RT)		.665	.710	.769

TABLE A-IX

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y01	Y02	Y03	Y04	Y05	Y06	Y07
QA	CUBIC METERS/SECOND	.146E+00	.152E+00	.155E+00	.160E+00	.166E+00	.165E+00	.174E+00
QW1	CUBIC METERS/SECOND	.376E-05	.511E-05	.196E-04	.331E-05	.702E-05	.259E-05	.193E-04
QW2	CUBIC METERS/SECOND	.938E-03	.932E-03	.932E-03	.932E-03	.930E-03	.915E-03	.920E-03
GD1	KILOGRAMS/CUBIC METER	336.110	366.327	369.267	334.897	340.925	301.558	309.996
P1	KILOPASCALS	52.295	52.333	52.357	52.386	52.419	53.699	53.759
TW1	DEGREES KELVIN	297.400	299.286	300.185	300.935	301.837	300.349	301.672
TW2	DEGREES KELVIN	298.537	299.424	307.775	261.723	299.546	300.661	258.375
TA	DEGREES KELVIN	289.075	290.063	290.121	290.546	290.928	292.300	293.636
TWA	DEGREES KELVIN	297.479	298.435	299.113	299.759	300.466	299.136	300.344
PA	KILOPASCALS	53.013	53.327	53.328	53.332	53.330	54.417	54.504
DP2	KILOPASCALS	.930	1.011	.988	1.019	1.038	1.029	1.045
DP3	KILOPASCALS	.093	.093	.128	.142	.142	.142	.148
DP1	KILOPASCALS	.308	.332	.311	.315	.319	.308	.301
FROTH HEIGHT	METERS	.889	.889	.889	.914	.914	.940	.965
FALLBACK	CUBIC METERS/SECOND	.453E-03	.471E-03	.441E-03	.435E-03	.375E-03	.332E-03	.294E-03
CARRYOUT	CUBIC METERS/SECOND	.391E-03	.444E-03	.543E-03	.435E-03	-.631E-03	.507E-03	.570E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.680	1.712	1.731	1.755	1.788	1.807	1.830
LIQUID KUTATELADZE NUMBER(SQ RT)		.462	.471	.456	.453	.421	.396	.373

CHANNEL	UNITS	Y08	Y09	Y10	Y11	Y12	Y13	Y14
QA	CUBIC METERS/SECOND	.179E+00	.183E+00	.187E+00	.192E+00	.197E+00	.146E+00	.152E+00
QW1	CUBIC METERS/SECOND	.257E-05	.257E-05	.261E-05	.260E-05	.261E-05	.690E-04	.742E-04
QW2	CUBIC METERS/SECOND	.910E-03	.911E-03	.909E-03	.910E-03	.910E-03	.850E-03	.849E-03
GD1	KILOGRAMS/CUBIC METER	324.114	306.046	315.908	270.621	282.200	341.149	334.440
P1	KILOPASCALS	53.146	53.204	52.974	53.618	53.621	53.165	53.208
TW1	DEGREES KELVIN	300.280	300.954	299.948	300.341	301.117	299.565	299.750
TW2	DEGREES KELVIN	186.658	70.728	164.846	294.122	288.571	299.743	299.886
TA	DEGREES KELVIN	291.929	298.322	291.847	297.898	300.441	288.272	288.572
TWA	DEGREES KELVIN	299.196	299.534	298.832	299.058	299.425	297.862	297.921
PA	KILOPASCALS	53.817	53.831	53.604	54.231	54.238	53.916	53.848
DP2	KILOPASCALS	1.012	1.037	1.036	1.031	1.009	1.025	1.033
DP3	KILOPASCALS	.150	.150	.150	.150	.150	.151	.154
DP1	KILOPASCALS	.298	.308	.303	.297	.303	.330	.327
FROTH HEIGHT	METERS	.991	.991	1.016	1.016	1.016	.864	.889
FALLBACK	CUBIC METERS/SECOND	.305E-03	.218E-03	.273E-03	.170E-03	.694E-04	.594E-03	.479E-03
CARRYOUT	CUBIC METERS/SECOND	.579E-03	.597E-03	.616E-03	.619E-03	.688E-03	.235E-03	.326E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.855	1.868	1.900	1.915	1.938	1.683	1.717
LIQUID KUTATELADZE NUMBER(SQ RT)		.379	.321	.359	.283	.181	.529	.475

TABLE A-IX (CONT.)

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y15	Y16	Y17	Y18	Y19	Y20	Y21
QA	CUBIC METERS/SECOND	.155E+00	.160E+00	.165E+00	.172E+00	.175E+00	.179E+00	.183E+00
QH1	CUBIC METERS/SECOND	.730E-04	.703E-04	.715E-04	.704E-04	.738E-04	.723E-04	.731E-04
QH2	CUBIC METERS/SECOND	.848E-03	.850E-03	.849E-03	.850E-03	.851E-03	.846E-03	.853E-03
GD1	KILOGRAMS/CUBIC METER	326.088	281.633	293.353	290.326	301.506	307.123	331.131
P1	KILOPASCALS	53.300	53.275	53.313	53.373	54.752	54.736	53.365
TH1	DEGREES KELVIN	299.919	300.303	300.560	300.428	296.144	297.016	297.776
TH2	DEGREES KELVIN	300.042	300.394	300.295	240.874	296.245	293.334	221.862
TA	DEGREES KELVIN	288.663	289.203	289.883	289.573	292.899	306.128	309.089
THA	DEGREES KELVIN	297.704	298.152	298.334	297.839	295.115	296.034	296.707
PA	KILOPASCALS	53.940	53.856	53.857	53.763	53.816	53.744	52.484
DP2	KILOPASCALS	1.015	1.010	1.017	1.026	1.028	1.027	1.010
DP3	KILOPASCALS	.154	.154	.154	.153	.211	.217	.217
DP1	KILOPASCALS	.324	.314	.308	.301	.315	.306	.298
FROTH HEIGHT	METERS	.914	.914	.940	.965	.991	.991	.991
FALLBACK	CUBIC METERS/SECOND	.526E-03	.447E-03	.414E-03	.392E-03	.298E-03	.348E-03	.300E-03
CARRYOUT	CUBIC METERS/SECOND	.235E-03	.326E-03	.380E-03	.631E-03	.555E-03	.529E-03	.726E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.733	1.758	1.788	1.825	1.828	1.828	1.840
LIQUID KUTATELADZE NUMBER(SQ RT)		.499	.459	.442	.430	.375	.405	.376

CHANNEL	UNITS	Y22	Y23	Y24	Y36	Y48	Y60	Y72
QA	CUBIC METERS/SECOND	.188E+00	.192E+00	.198E+00	.195E+00	.196E+00	.196E+00	.199E+00
QH1	CUBIC METERS/SECOND	.728E-04	.729E-04	.742E-04	.151E-03	.310E-03	.466E-03	.628E-03
QH2	CUBIC METERS/SECOND	.847E-03	.846E-03	.850E-03	.790E-03	.632E-03	.462E-03	.310E-03
GD1	KILOGRAMS/CUBIC METER	315.399	302.687	296.636	300.116	294.016	306.772	296.249
P1	KILOPASCALS	53.136	53.178	54.816	53.306	53.303	53.248	53.320
TH1	DEGREES KELVIN	298.942	300.183	299.396	297.531	298.643	299.540	300.754
TH2	DEGREES KELVIN	95.902	82.599	105.374	301.488	303.596	289.314	127.373
TA	DEGREES KELVIN	312.626	314.236	299.302	292.979	301.744	308.845	312.746
THA	DEGREES KELVIN	297.841	298.898	298.436	296.044	296.869	297.627	298.776
PA	KILOPASCALS	52.283	52.338	53.977	52.374	52.500	52.610	52.778
DP2	KILOPASCALS	1.007	1.024	1.026	1.018	1.041	1.029	1.059
DP3	KILOPASCALS	.216	.277	.280	.275	.275	.275	.282
DP1	KILOPASCALS	.305	.311	.301	.306	.377	.407	.447
FROTH HEIGHT	METERS	1.016	1.016	1.016	1.041	1.016	1.016	1.016
FALLBACK	CUBIC METERS/SECOND	.283E-03	.273E-03	.240E-03	.275E-03	.209E-03	.169E-03	.184E-03
CARRYOUT	CUBIC METERS/SECOND	.579E-03	.536E-03	.570E-03	.597E-03	.726E-03	.726E-03	.831E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.858	1.878	1.935	1.927	1.920	1.908	1.917
LIQUID KUTATELADZE NUMBER(SQ RT)		.366	.359	.336	.360	.314	.282	.295

TABLE A-IX (CONT.)

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y35	Y47	Y59	Y71	Y25	Y26	Y27
QA	CUBIC METERS/SECOND	.190E+00	.191E+00	.192E+00	.192E+00	.147E+00	.151E+00	.155E+00
QH1	CUBIC METERS/SECOND	.155E-03	.305E-03	.467E-03	.628E-03	.188E-03	.155E-03	.151E-03
QH2	CUBIC METERS/SECOND	.789E-03	.634E-03	.462E-03	.311E-03	.777E-03	.777E-03	.770E-03
GD1	KILOGRAMS/CUBIC METER	293.422	326.206	300.150	312.895	375.212	361.199	338.004
P1	KILOPASCALS	53.281	53.425	53.281	53.299	52.975	52.980	53.008
TH1	DEGREES KELVIN	299.802	300.330	301.114	301.473	297.333	298.593	299.472
TH2	DEGREES KELVIN	295.960	300.390	301.077	301.402	297.406	298.717	299.607
TA	DEGREES KELVIN	298.267	311.256	313.262	315.867	292.950	295.092	295.833
THA	DEGREES KELVIN	298.441	298.372	299.138	299.477	296.709	297.806	298.588
PA	KILOPASCALS	52.308	52.569	52.502	52.550	53.030	52.980	53.011
DP2	KILOPASCALS	1.031	1.026	1.025	1.050	1.000	1.015	1.021
DP3	KILOPASCALS	.282	.282	.282	.301	.318	.368	.375
DP1	KILOPASCALS	.317	.365	.412	.448	.331	.346	.340
FROTH HEIGHT	METERS	1.016	1.016	1.016	1.016	.940	.914	.914
FALLBACK	CUBIC METERS/SECOND	.326E-03	.267E-03	.228E-03	.240E-03	.707E-03	.700E-03	.669E-03
CARRYOUT	CUBIC METERS/SECOND	.525E-03	.556E-03	.616E-03	.620E-03	.299E-03	.243E-03	.145E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.894	1.876	1.879	1.878	1.675	1.699	1.718
LIQUID KUTATELADZE NUMBER(SQ RT)		.392	.355	.328	.336	.578	.575	.562

CHANNEL	UNITS	Y28	Y29	Y30	Y31	Y32	Y33	Y34
QA	CUBIC METERS/SECOND	.160E+00	.166E+00	.169E+00	.173E+00	.179E+00	.183E+00	.187E+00
QH1	CUBIC METERS/SECOND	.146E-03	.150E-03	.148E-03	.148E-03	.144E-03	.150E-03	.150E-03
QH2	CUBIC METERS/SECOND	.767E-03	.769E-03	.770E-03	.762E-03	.765E-03	.766E-03	.767E-03
GD1	KILOGRAMS/CUBIC METER	322.088	311.687	337.270	316.153	317.415	298.980	271.915
P1	KILOPASCALS	53.011	53.041	53.044	53.073	53.092	53.756	53.787
TH1	DEGREES KELVIN	300.527	301.631	302.768	304.016	304.663	302.918	303.545
TH2	DEGREES KELVIN	300.677	301.807	302.971	304.241	304.890	303.077	303.705
TA	DEGREES KELVIN	296.656	296.916	297.386	298.566	304.056	310.502	313.414
THA	DEGREES KELVIN	299.405	300.415	301.287	302.289	302.950	301.332	301.902
PA	KILOPASCALS	52.933	52.917	52.767	52.784	52.742	53.463	53.527
DP2	KILOPASCALS	1.002	1.023	1.007	.999	1.009	.990	.987
DP3	KILOPASCALS	.438	.437	.437	.436	.441	.439	.438
DP1	KILOPASCALS	.315	.322	.328	.317	.309	.308	.307
FROTH HEIGHT	METERS	.940	.965	.965	.965	.991	1.016	1.016
FALLBACK	CUBIC METERS/SECOND	.522E-03	.574E-03	.474E-03	.435E-03	.420E-03	.334E-03	.370E-03
CARRYOUT	CUBIC METERS/SECOND	.398E-03	.308E-03	.389E-03	.435E-03	.290E-03	.416E-03	.507E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.743	1.773	1.792	1.811	1.829	1.844	1.859
LIQUID KUTATELADZE NUMBER(SQ RT)		.497	.521	.473	.453	.445	.397	.418

TABLE A-IX (CONT.)

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y37	Y38	Y39	Y40	Y41	Y42	Y43
QA	CUBIC METERS/SECOND	.146E+00	.152E+00	.155E+00	.160E+00	.166E+00	.169E+00	.174E+00
QH1	CUBIC METERS/SECOND	.311E-03	.310E-03	.310E-03	.309E-03	.309E-03	.310E-03	.309E-03
QH2	CUBIC METERS/SECOND	.615E-03	.615E-03	.615E-03	.615E-03	.615E-03	.615E-03	.614E-03
GD1	KILOGRAMS/CUBIC METER	333.114	329.369	329.853	312.450	327.715	302.139	288.198
P1	KILOPASCALS	52.793	52.821	52.866	52.913	52.961	52.979	53.041
TH1	DEGREES KELVIN	303.674	304.093	304.512	304.861	305.217	305.607	305.353
TH2	DEGREES KELVIN	303.720	304.132	304.585	304.956	305.324	305.738	305.479
TA	DEGREES KELVIN	293.186	293.277	294.172	296.216	302.194	304.943	308.254
THA	DEGREES KELVIN	301.746	302.114	302.465	302.718	302.831	303.132	302.732
PA	KILOPASCALS	53.027	53.212	53.169	53.195	53.104	53.165	53.177
DP2	KILOPASCALS	.986	.997	.999	1.004	1.009	1.011	.997
DP3	KILOPASCALS	.443	.455	.459	.459	.459	.459	.459
DP1	KILOPASCALS	.348	.348	.341	.335	.347	.349	.350
FROTH HEIGHT	METERS	.864	.889	.940	.940	.965	.991	.991
FALLBACK	CUBIC METERS/SECOND	.782E-03	.738E-03	.599E-03	.550E-03	.468E-03	.468E-03	.453E-03
CARRYOUT	CUBIC METERS/SECOND	.631E-03	.127E-03	.230E-03	.351E-03	.384E-03	.429E-03	.397E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.672	1.709	1.720	1.744	1.767	1.782	1.803
LIQUID KUTATELADZE NUMBER(SQ RT)		.608	.590	.532	.510	.470	.470	.462

CHANNEL	UNITS	Y46	Y58	Y70	Y45	Y57	Y69	Y44
QA	CUBIC METERS/SECOND	.186E+00	.187E+00	.187E+00	.183E+00	.183E+00	.184E+00	.178E+00
QH1	CUBIC METERS/SECOND	.310E-03	.467E-03	.636E-03	.310E-03	.466E-03	.639E-03	.310E-03
QH2	CUBIC METERS/SECOND	.619E-03	.447E-03	.293E-03	.617E-03	.454E-03	.294E-03	.615E-03
GD1	KILOGRAMS/CUBIC METER	278.740	260.656	269.372	297.798	304.558	272.737	320.437
P1	KILOPASCALS	53.162	53.126	53.117	53.839	53.826	52.807	53.051
TH1	DEGREES KELVIN	302.478	303.130	303.679	302.867	303.351	304.006	303.344
TH2	DEGREES KELVIN	302.512	303.130	303.643	302.908	303.383	303.974	303.390
TA	DEGREES KELVIN	302.245	303.836	304.772	302.271	304.068	305.239	295.218
THA	DEGREES KELVIN	[illegible]	300.243	300.561	300.343	300.122	300.987	300.879
PA	KILOPASCALS	53.192	53.196	53.262	53.906	53.911	53.079	53.182
DP2	KILOPASCALS	1.011	.996	1.032	1.010	1.002	1.027	1.035
DP3	KILOPASCALS	.429	.429	.429	.429	.440	.440	.440
DP1	KILOPASCALS	.375	.414	.441	.362	.382	.451	.339
FROTH HEIGHT	METERS	1.016	.991	.965	1.016	.991	.991	.965
FALLBACK	CUBIC METERS/SECOND	.223E-03	.196E-03	.201E-03	.267E-03	.245E-03	.234E-03	.310E-03
CARRYOUT	CUBIC METERS/SECOND	.726E-03	.688E-03	.579E-03	.650E-03	.507E-03	.637E-03	.562E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.874	1.873	1.876	1.858	1.855	1.857	1.845
LIQUID KUTATELADZE NUMBER(SQ RT)		.325	.304	.308	.355	.340	.332	.383

TABLE A-IX (CONT.)

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y49	Y50	Y51	Y52	Y53	Y54	Y55
QA	CUBIC METERS/SECOND	.146E+00	.150E+00	.155E+00	.160E+00	.165E+00	.169E+00	.174E+00
QH1	CUBIC METERS/SECOND	.465E-03	.466E-03	.466E-03	.466E-03	.464E-03	.466E-03	.466E-03
QH2	CUBIC METERS/SECOND	.443E-03	.443E-03	.443E-03	.444E-03	.445E-03	.443E-03	.442E-03
GD1	KILOGRAMS/CUBIC METER	351.066	324.171	322.617	449.118	171.620	311.464	291.369
P1	KILOPASCALS	53.792	53.835	53.874	53.920	53.975	54.006	54.074
TH1	DEGREES KELVIN	304.871	305.270	305.644	305.944	306.120	305.913	306.330
TH2	DEGREES KELVIN	304.922	305.331	305.717	306.013	306.198	306.010	306.396
TA	DEGREES KELVIN	293.934	294.400	298.232	299.037	305.137	305.879	306.355
THA	DEGREES KELVIN	302.636	302.858	303.089	303.211	303.020	302.837	302.721
PA	KILOPASCALS	54.000	54.071	54.058	53.917	54.261	54.293	54.347
DP2	KILOPASCALS	1.001	1.000	.997	1.020	1.020	1.044	1.016
DP3	KILOPASCALS	.459	.459	.459	.459	.458	.458	.458
DP1	KILOPASCALS	.375	.374	.361	.369	.383	.387	.397
FROTH HEIGHT	METERS	.864	.889	.914	.940	.965	.965	.991
FALLBACK	CUBIC METERS/SECOND	.726E-03	.662E-03	.582E-03	.517E-03	.430E-03	.381E-03	.310E-03
CARRYOUT	CUBIC METERS/SECOND	.134E-03	.141E-03	.295E-03	.308E-03	.353E-03	.453E-03	.562E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.674	1.699	1.718	1.741	1.762	1.784	1.807
LIQUID KUTATELADZE NUMBER(SQ RT)		.585	.559	.524	.494	.451	.424	.383

CHANNEL	UNITS	Y61	Y62	Y63	Y64	Y65	Y66	Y67
QA	CUBIC METERS/SECOND	.146E+00	.152E+00	.155E+00	.160E+00	.165E+00	.170E+00	.174E+00
QH1	CUBIC METERS/SECOND	.636E-03	.640E-03	.631E-03	.638E-03	.638E-03	.639E-03	.631E-03
QH2	CUBIC METERS/SECOND	.287E-03	.286E-03	.288E-03	.285E-03	.284E-03	.286E-03	.285E-03
GD1	KILOGRAMS/CUBIC METER	3[illegible]5.589	368.695	343.652	330.651	309.559	319.837	352.244
P1	KILOPASCALS	53.789	53.883	53.879	53.877	53.926	53.976	52.964
TH1	DEGREES KELVIN	305.063	305.335	305.597	305.946	305.967	306.223	306.536
TH2	DEGREES KELVIN	305.092	305.367	305.642	305.991	306.261	306.513	306.877
TA	DEGREES KELVIN	294.558	295.072	296.072	298.016	303.735	310.733	311.518
THA	DEGREES KELVIN	302.650	302.851	303.011	303.311	303.481	303.463	303.780
PA	KILOPASCALS	54.317	54.472	54.331	54.324	54.434	54.435	53.394
DP2	KILOPASCALS	1.033	1.044	1.027	1.025	1.045	1.041	1.050
DP3	KILOPASCALS	.458	.532	.532	.532	.532	.532	.532
DP1	KILOPASCALS	.414	.426	.419	.420	.433	.435	.450
FROTH HEIGHT	METERS	.889	.889	.914	.914	.940	.965	.965
FALLBACK	CUBIC METERS/SECOND	.789E-03	.707E-03	.644E-03	.610E-03	.495E-03	.441E-03	.403E-03
CARRYOUT	CUBIC METERS/SECOND	.136E-03	-.631E-03	.154E-03	.318E-03	.341E-03	.371E-03	.514E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.675	1.708	1.724	1.747	1.767	1.782	1.799
LIQUID KUTATELADZE NUMBER(SQ RT)		.610	.578	.551	.537	.483	.456	.436

TABLE A-IX(CONT.)

SUPPLEMENTAL TESTS HEIGHT= 0.813 METERS

CHANNEL	UNITS	Y56	Y68
GA	CUBIC METERS/SECOND	.178E+00	.178E+00
QW1	CUBIC METERS/SECOND	.667E-03	.638E-03
QW2	CUBIC METERS/SECOND	.446E-03	.293E-03
GD1	KILOGRAMS/CUBIC METER	289.508	306.924
P1	KILOPASCALS	53.099	53.064
TW1	DEGREES KELVIN	303.986	304.609
TW2	DEGREES KELVIN	304.014	304.637
TA	DEGREES KELVIN	304.269	305.093
TWA	DEGREES KELVIN	301.117	301.451
PA	KILOPASCALS	53.302	53.271
DP2	KILOPASCALS	1.018	1.039
DP3	KILOPASCALS	.439	.439
DP1	KILOPASCALS	.399	.429
FROTH HEIGHT	METERS	.965	.991
FALLBACK	CUBIC METERS/SECOND	.305E-03	.290E-03
CARRYOUT	CUBIC METERS/SECOND	.525E-03	.579E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.831	1.830
LIQUID KUTATELADZE NUMBER(SQ RT)		.379	.370

TABLE A-X

WESTINGHOUSE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	I01	I02	I03	I04	I06	I07	I08
QW1	CUBIC METERS/SECOND	-.297E-05	-.292E-05	-.299E-05	-.297E-05	-.299E-05	-.299E-05	-.299E-05
QA	CUBIC METERS/SECOND	.469E-01	.469E-01	.468E-01	.458E-01	.512E-01	.512E-01	.513E-01
QW2	CUBIC METERS/SECOND	.190E-02	.124E-02	.617E-03	.321E-03	.190E-02	.123E-02	.614E-03
GD1	KILOGRAMS/CUBIC METER	448.581	469.612	6.299	4.395	436.545	453.737	11.207
P1	KILOPASCALS	53.437	53.413	53.416	53.404	50.381	50.309	50.343
TW1	DEGREES KELVIN	296.842	296.714	296.604	296.528	295.919	295.889	295.818
TW2	DEGREES KELVIN	298.840	299.742	300.530	301.317	302.595	303.200	304.080
TA	DEGREES KELVIN	293.665	294.544	293.655	292.201	294.988	295.797	294.416
TWA	DEGREES KELVIN	297.970	298.139	297.945	298.033	301.697	301.612	300.761
PA	KILOPASCALS	56.393	55.393	55.333	55.290	53.994	53.988	53.952
DP2	KILOPASCALS	4.969	2.690	.351	.368	5.100	3.272	.481
DP3	KILOPASCALS	.114	.079	.119	.086	.134	.131	.156
DP1	KILOPASCALS	.829	.872	.017	-.005	.825	.829	-.016
FROTH HEIGHT	METERS	.965	.737	.051	0.000	1.015	.787	.076
FALLBACK	CUBIC METERS/SECOND	.144E-02	.133E-02	.605E-03	.320E-03	.128E-02	.114E-02	.610E-03
CARRYOUT	CUBIC METERS/SECOND	.473E-03	0.	0.	0.	.463E-03	0.	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		.973	.872	.872	.860	.993	.997	.909
LIQUID KUTATELADZE NUMBER(SQ RT)		.753	.722	.497	.355	.703	.668	.489

CHANNEL	UNITS	I09	I16	I17	I18	I19	I21	I22
QW1	CUBIC METERS/SECOND	-.298E-05	-.298E-05	-.303E-05	-.309E-05	-.303E-05	-.290E-05	-.295E-05
QA	CUBIC METERS/SECOND	.512E-01	.605E-01	.604E-01	.605E-01	.605E-01	.648E-01	.648E-01
QW2	CUBIC METERS/SECOND	.335E-03	.190E-02	.124E-02	.615E-03	.317E-03	.189E-02	.124E-02
GD1	KILOGRAMS/CUBIC METER	4.593	419.291	441.422	-48.624	5.875	412.045	421.238
P1	KILOPASCALS	50.321	49.525	49.522	49.496	49.492	52.515	52.596
TW1	DEGREES KELVIN	295.775	295.581	295.527	295.469	295.388	295.207	295.196
TW2	DEGREES KELVIN	304.932	305.039	305.336	306.306	307.425	301.073	301.668
TA	DEGREES KELVIN	292.920	292.985	295.397	294.294	290.892	293.593	294.652
TWA	DEGREES KELVIN	300.830	304.049	303.875	302.883	302.434	300.379	300.781
PA	KILOPASCALS	52.670	54.566	54.556	54.566	52.774	61.570	61.077
DP2	KILOPASCALS	.479	4.988	4.071	.492	.472	4.670	4.063
DP3	KILOPASCALS	.138	.136	.159	.186	.157	.153	.141
DP1	KILOPASCALS	-.022	.841	.826	.126	-.020	.919	.815
FROTH HEIGHT	METERS	.051	1.041	.914	.229	.102	1.016	.889
FALLBACK	CUBIC METERS/SECOND	.329E-03	.992E-03	.107E-02	.611E-03	.325E-03	.980E-03	.894E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.709E-03	.129E-03	.328E-04	0.	.978E-03	.342E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		.906	.992	.930	.992	.985	1.046	1.044
LIQUID KUTATELADZE NUMBER(SQ RT)		.359	.624	.648	.490	.357	.620	.592

TABLE A-X (CONT.)

WESTINGHOUSE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	I23	I24	I25	I27	I28	I29	I41
QJ1	CUBIC METERS/SECOND	-.304E-05	-.303E-05	-.292E-05	-.298E-05	-.295E-05	-.296E-05	-.302E-05
QA	CUBIC METERS/SECOND	.652E-01	.663E-01	.699E-01	.699E-01	.699E-01	.699E-01	.838E-01
QJ2	CUBIC METERS/SECOND	.783E-03	.320E-03	.190E-02	.124E-02	.621E-03	.315E-03	.189E-02
GJ1	KILOGRAMS/CUBIC METER	439.645	3.953	402.037	427.138	435.652	18.331	170.293
P1	KILOPASCALS	52.601	52.596	48.160	48.126	48.110	48.059	52.557
TJ1	DEGREES KELVIN	295.191	295.180	295.256	295.208	295.177	295.155	299.126
TJ2	DEGREES KELVIN	302.790	303.748	303.303	303.533	304.214	304.868	304.672
TA	DEGREES KELVIN	294.183	293.406	291.423	292.672	292.511	291.511	293.101
TJA	DEGREES KELVIN	301.176	300.126	302.193	302.600	302.277	300.963	303.757
PA	KILOPASCALS	59.572	56.876	55.437	55.497	54.807	52.570	59.935
DP2	KILOPASCALS	2.355	.400	4.784	4.178	2.069	.473	4.315
DP3	KILOPASCALS	.153	.114	.161	.162	.153	.163	.184
DP1	KILOPASCALS	.830	.052	.816	.821	.810	.031	.797
FROTH HEIGHT	METERS	.610	0.000	1.092	.991	.787	.203	1.016
FALLBACK	CUBIC METERS/SECOND	.623E-03	.320E-03	.779E-03	.791E-03	.562E-03	.320E-03	.428E-03
CARRYOUT	CUBIC METERS/SECOND	0.	0.	.104E-02	.444E-03	0.	0.	.165E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.042	1.042	1.074	1.073	1.071	1.064	1.184
LIQUID KUTATELADZE NUMBER(SQ RT)		.494	.355	.553	.557	.463	.355	.410

CHANNEL	UNITS	I42	I43	I44	I31	I32	I33	I34
QJ1	CUBIC METERS/SECOND	-.305E-05	-.312E-05	-.315E-05	-.304E-05	-.300E-05	-.305E-05	-.316E-05
QA	CUBIC METERS/SECOND	.839E-01	.838E-01	.838E-01	.760E-01	.757E-01	.749E-01	.759E-01
QJ2	CUBIC METERS/SECOND	.124E-02	.650E-03	.315E-03	.189E-02	.129E-02	.643E-03	.319E-03
GJ1	KILOGRAMS/CUBIC METER	179.071	197.723	219.230	198.785	216.781	231.172	45.357
P1	KILOPASCALS	52.581	52.567	52.576	51.158	51.192	51.203	51.134
TJ1	DEGREES KELVIN	298.056	297.998	297.950	297.404	297.187	297.065	296.944
TJ2	DEGREES KELVIN	305.145	306.192	306.119	301.106	302.167	303.126	303.692
TA	DEGREES KELVIN	292.765	292.804	292.445	292.445	293.079	293.283	293.251
TJA	DEGREES KELVIN	304.224	304.528	303.595	300.483	301.443	301.980	301.723
PA	KILOPASCALS	59.672	58.991	58.028	58.808	58.874	58.144	56.115
DP2	KILOPASCALS	3.804	3.094	1.901	4.474	3.979	2.950	.883
DP3	KILOPASCALS	.155	.181	.173	.208	.197	.204	.200
DP1	KILOPASCALS	.931	.811	.805	.788	.797	.783	.499
FROTH HEIGHT	METERS	.940	.813	.711	1.067	.914	.787	.660
FALLBACK	CUBIC METERS/SECOND	.470E-03	.344E-03	.279E-03	.573E-03	.611E-03	.535E-03	.505E-03
CARRYOUT	CUBIC METERS/SECOND	.134E-03	.119E-03	0.	0.	0.	0.	.127E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.183	1.180	1.177	1.126	1.124	1.115	1.107
LIQUID KUTATELADZE NUMBER(SQ RT)		.427	.367	.331	.474	.489	.458	.445

TABLE A-X (CONT.)

WESTINGHOUSE UCSP TEST [illegible]3METERS

CHANNEL	UNITS	I39	I46	I48	I49	I57	I62	I64
QW1	CUBIC METERS/SECOND	-.340E-05	-.337E-05	-.335E-05	-.333E-05	-.345E-05	-.324E-05	-.305E-05
QA	CUBIC METERS/SECOND	.799E-01	.893E-01	.884E-01	.884E-01	.985E-01	.103E+00	.103E+00
QW2	CUBIC METERS/SECOND	.316E-03	.190E-02	.650E-03	.351E-03	.126E-02	.125E-02	.326E-03
GD1	KILOGRAMS/CUBIC METER	48.178	159.035	176.486	194.268	15[illegible].175	154.492	203.403
P1	KILOPASCALS	52.861	52.140	52.273	52.274	[illegible].930	52.325	52.312
TW1	DEGREES KELVIN	297.919	297.958	299.017	298.021	298.071	299.304	298.314
TW2	DEGREES KELVIN	303.397	301.879	304.679	305.761	304.741	306.797	306.672
TA	DEGREES KELVIN	292.537	292.309	293.279	293.641	294.322	292.865	292.556
TWA	DEGREES KELVIN	299.373	301.092	302.948	302.841	303.309	305.390	302.954
PA	KILOPASCALS	57.011	59.110	59.405	57.825	57.985	58.094	57.096
DP2	KILOPASCALS	.508	3.942	2.891	2.128	3.529	3.395	2.111
DP3	KILOPASCALS	.143	.137	.132	.137	.161	.167	.169
DP1	KILOPASCALS	.145	.828	.854	.850	.933	.836	.809
FROTH HEIGHT	METERS	.305	1.143	.955	.889	1.067	.965	.838
FALLBACK	CUBIC METERS/SECOND	.314E-03	.329E-03	.288E-03	.259E-03	.218E-03	.242E-03	.143E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.127E-02	0.	0.	0.	0.	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.144	1.220	1.210	1.207	1.275	1.304	1.300
LIQUID KUTATELADZE NUMBER(SQ RT)		.351	.359	.336	.319	.293	.308	.236

CHANNEL	UNITS	I51	I52	I53	I54	I72	I87	I88
QW1	CUBIC METERS/SECOND	-.303E-05	-.310E-05	-.331E-05	-.327E-05	-.332E-05	-.300E-05	-.299E-05
QA	CUBIC METERS/SECOND	.942E-01	.942E-01	.942E-01	.943E-01	.112E+00	.707E-01	.796E-01
QW2	CUBIC METERS/SECOND	.190E-02	.127E-02	.647E-03	.323E-03	.130E-02	.125E-02	.615E-03
GD1	KILOGRAMS/CUBIC METER	178.046	165.246	182.595	223.152	147.657	393.652	402.040
P1	KILOPASCALS	53.151	53.143	53.154	53.156	52.778	52.607	52.206
TW1	DEGREES KELVIN	298.317	298.280	298.251	298.205	298.290	295.058	295.072
TW2	DEGREES KELVIN	302.650	303.569	304.632	305.800	304.939	301.178	303.625
TA	DEGREES KELVIN	293.144	292.521	292.308	292.202	293.063	290.648	290.785
TWA	DEGREES KELVIN	301.827	302.510	302.826	302.579	303.186	299.962	301.534
PA	KILOPASCALS	59.763	59.579	58.855	58.375	59.249	60.647	58.901
DP2	KILOPASCALS	3.985	3.602	2.931	2.169	3.250	3.845	2.820
DP3	KILOPASCALS	.183	.174	.178	.172	.197	.118	.135
DP1	KILOPASCALS	.800	.819	.815	.799	.805	.846	.839
FROTH HEIGHT	METERS	1.016	.940	.838	.787	1.016	1.016	.838
FALLBACK	CUBIC METERS/SECOND	.233E-03	.271E-03	.238E-03	.230E-03	.334E-04	.633E-03	.493E-03
CARRYOUT	CUBIC METERS/SECOND	.177E-02	.597E-03	0.	0.	0.	0.	.652E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.253	1.253	1.250	1.248	1.358	1.092	1.152
LIQUID KUTATELADZE NUMBER(SQ RT)		.302	.326	.305	.300	.115	.498	.440

TABLE A-X (CONT.)

WESTINGHOUSE UCSP TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	I89	I11	I12	I13	I14
QW1	CUBIC METERS/SECOND	-.292E-05	-.293E-05	-.283E-05	-.287E-05	-.283E-05
QA	CUBIC METERS/SECOND	.706E-01	.569E-01	.569E-01	.569E-01	.569E-01
QW2	CUBIC METERS/SECOND	.124E-02	.190E-02	.124E-02	.620E-03	.319E-03
GD1	KILOGRAMS/CUBIC METER	399.226	433.587	448.916	9.445	3.959
P1	KILOPASCALS	52.599	52.043	52.059	52.332	52.337
TW1	DEGREES KELVIN	295.094	295.144	295.154	295.192	295.189
TW2	DEGREES KELVIN	304.654	297.966	299.795	299.650	300.531
TA	DEGREES KELVIN	292.660	293.647	294.712	293.872	292.789
TWA	DEGREES KELVIN	303.545	297.385	293.135	298.182	299.067
PA	KILOPASCALS	60.714	61.518	60.802	56.915	56.704
DP2	KILOPASCALS	4.013	4.009	3.952	.393	.391
DP3	KILOPASCALS	.139	.159	.157	.170	.149
DP1	KILOPASCALS	.834	.795	.795	-.033	-.025
FROTH HEIGHT	METERS	.591	.991	.913	.076	0.090
FALLBACK	CUBIC METERS/SECOND	.703E-03	.115E-02	.113E-02	.619E-03	.320E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.733E-03	.105E-03	0.	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.090	.981	.978	.965	.965
LIQUID KUTATELADZE NUMBER(SQ RT)		.525	.671	.666	.493	.355

TABLE A-XI

WESTINGHOUSE SUPPORT COLUMN TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	J01	J03	J04	J05	J06	J07	J08
QW1	CUBIC METERS/SECOND	-.315E-05	-.317E-05	-.335E-05	-.318E-05	-.322E-05	-.294E-05	-.296E-05
QA	CUBIC METERS/SECOND	.257E-01	.174E-01	.157E-01	.839E-01	.460E-01	.474E-01	.460E-01
QW2	CUBIC METERS/SECOND	.159E-02	.620E-03	.320E-03	.124E-02	.189E-02	.125E-02	.618E-03
GO1	KILOGRAMS/CUBIC METER	497.701	687.785	651.805	549.558	642.950	631.676	643.514
P1	KILOPASCALS	52.873	52.642	52.602	52.588	52.423	53.569	53.542
TW1	DEGREES KELVIN	296.476	296.721	296.778	293.559	293.917	293.943	294.017
TW2	DEGREES KELVIN	297.619	300.061	301.272	298.596	299.989	300.586	301.687
TA	DEGREES KELVIN	292.357	294.161	294.047	287.672	287.199	289.943	288.474
TWA	DEGREES KELVIN	296.945	299.054	299.098	297.145	299.173	299.653	300.305
PA	KILOPASCALS	62.031	61.206	58.355	57.909	59.738	61.764	61.349
DP2	KILOPASCALS	6.797	6.788	4.806	6.780	6.797	6.796	6.793
DP3	KILOPASCALS	.025	.002	.043	.097	.047	.031	.026
DP1	KILOPASCALS	-2.097	-2.064	-2.386	-2.605	-2.220	-2.227	-2.229
FROTH HEIGHT	METERS	.540	.889	.356	1.092	1.067	1.016	.838
FALLBACK	CUBIC METERS/SECOND	.490E-03	.644E-03	.311E-03	.132E-04	.302E-03	.305E-03	.335E-03
CARRYOUT	CUBIC METERS/SECOND	.149E-02	0.	0.	.814E-04	.114E-03	.924E-03	.239E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		.661	.541	.509	1.182	.881	.897	.884
LIQUID KUTATELADZE NUMBER(SQ RT)		.438	.502	.349	.072	.344	.346	.362

CHANNEL	UNITS	J09	J10	J11	J12	J13	J14	J15
QW1	CUBIC METERS/SECOND	-.292E-05	-.291E-05	-.288E-05	-.291E-05	-.293E-05	-.284E-05	-.314E-05
QA	CUBIC METERS/SECOND	.457E-01	.554E-01	.548E-01	.556E-01	.557E-01	.837E-01	.651E-01
QW2	CUBIC METERS/SECOND	.319E-03	.190E-02	.125E-02	.617E-03	.318E-03	.124E-02	.189E-02
GO1	KILOGRAMS/CUBIC METER	637.898	605.646	623.061	632.290	608.691	549.286	603.842
P1	KILOPASCALS	53.546	52.492	53.067	53.078	53.076	53.488	52.384
TW1	DEGREES KELVIN	293.920	293.373	293.328	293.283	293.238	293.138	293.132
TW2	DEGREES KELVIN	303.251	305.867	306.148	307.421	308.460	308.364	309.792
TA	DEGREES KELVIN	288.348	287.562	287.257	287.495	287.699	285.736	285.638
TWA	DEGREES KELVIN	300.175	304.911	304.955	305.443	305.618	305.797	308.451
PA	KILOPASCALS	59.592	60.283	60.786	60.492	60.170	58.783	58.417
DP2	KILOPASCALS	5.165	6.797	6.797	6.793	6.757	6.786	6.798
DP3	KILOPASCALS	.043	.081	.065	.073	.069	.128	.100
DP1	KILOPASCALS	-2.134	-2.326	-2.371	-2.356	-2.351	-2.658	-2.450
FROTH HEIGHT	METERS	.610	1.118	1.067	.991	.864	.838	1.118
FALLBACK	CUBIC METERS/SECOND	.253E-03	.180E-03	.204E-03	.204E-03	.213E-03	.126E-04	.122E-03
CARRYOUT	CUBIC METERS/SECOND	0.	.179E-02	.110E-02	.444E-03	.119E-03	.127E-02	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		.875	.968	.964	.970	.969	1.184	1.045
LIQUID KUTATELADZE NUMBER(SQ RT)		.315	.266	.283	.283	.289	.070	.219

TABLE A-XI (CONT.)

WESTINGHOUSE UPFLOW COLUMN TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	J16	J17	J18	J19	J20	J21	J22
QW1	CUBIC METERS/SECOND	-.287E-05	-.285E-05	-.289E-05	-.295E-05	-.293E-05	-.291E-05	-.293E-05
QA	CUBIC METERS/SECOND	.651E-01	.659E-01	.651E-01	.757E-01	.757E-01	.761E-01	.753E-01
QW2	CUBIC METERS/SECOND	.124E-02	.617E-03	.318E-03	.189E-02	.124E-02	.614E-03	.317E-03
GU1	KILOGRAMS/CUBIC METER	593.453	609.236	615.278	579.515	588.286	576.225	577.064
P1	KILOPASCALS	52.527	52.493	52.469	52.453	53.475	54.775	52.547
TH1	DEGREES KELVIN	293.279	293.294	293.309	293.318	295.477	295.630	295.792
TH2	DEGREES KELVIN	300.696	301.985	302.909	302.429	302.807	303.817	304.687
TA	DEGREES KELVIN	288.480	290.013	290.624	292.019	294.012	294.328	295.623
TWA	DEGREES KELVIN	295.854	300.569	300.867	301.440	301.440	301.932	301.990
PA	KILOPASCALS	59.679	59.613	59.355	58.917	59.024	61.414	58.519
DP2	KILOPASCALS	6.797	6.793	6.759	6.793	6.794	6.783	6.764
DP3	KILOPASCALS	.119	.108	.100	.151	.141	.155	.163
DP1	KILOPASCALS	-2.438	-2.449	-2.427	-2.554	-2.561	-2.592	-2.558
FROTH HEIGHT	METERS	1.067	1.016	.914	1.067	1.092	.965	.914
FALLBACK	CUBIC METERS/SECOND	.883E-04	.134E-03	.132E-03	.423E-04	.883E-04	0.	.921E-04
CARRYOUT	CUBIC METERS/SECOND	.110E-02	.522E-03	.206E-03	.189E-02	.125E-02	.597E-03	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.044	1.044	1.043	1.122	1.119	1.128	1.114
LIQUID KUTATELADZE NUMBER(SQ RT)		.186	.229	.228	.129	.186	0.000	.190

CHANNEL	UNITS	J23	J24	J25	J26	J27	J28	J29
QW1	CUBIC METERS/SECOND	-.294E-05	-.311E-05	-.294E-05	-.305E-05	-.291E-05	-.305E-05	-.296E-05
QA	CUBIC METERS/SECOND	.842E-01	.841E-01	.836E-01	.836E-01	.984E-01	.985E-01	.984E-01
QW2	CUBIC METERS/SECOND	.189E-02	.124E-02	.611E-03	.303E-03	.189E-02	.124E-02	.617E-03
GU1	KILOGRAMS/CUBIC METER	555.898	564.415	551.962	556.096	531.621	532.605	532.179
P1	KILOPASCALS	52.711	52.599	53.059	52.843	53.216	53.990	54.119
TH1	DEGREES KELVIN	296.037	296.087	296.254	296.314	297.065	297.106	297.185
TH2	DEGREES KELVIN	305.563	306.057	306.673	307.502	304.075	304.772	304.729
TA	DEGREES KELVIN	296.492	296.405	296.825	296.901	295.825	296.279	297.59[illegible]
TWA	DEGREES KELVIN	304.455	304.629	304.462	303.961	302.917	303.198	302.596
PA	KILOPASCALS	58.789	58.366	58.816	58.093	58.750	59.237	59.217
DP2	KILOPASCALS	6.793	6.787	6.770	6.734	6.774	6.765	6.741
DP3	KILOPASCALS	.166	.172	.177	.183	.209	.214	.214
DP1	KILOPASCALS	-2.655	-2.649	-2.681	-2.651	-2.772	-2.764	-2.794
FROTH HEIGHT	METERS	1.118	1.092	1.016	.965	1.143	1.092	.365
FALLBACK	CUBIC METERS/SECOND	.410E-04	.164E-04	.776E-04	.328E-04	.374E-04	0.	0.
CARRYOUT	CUBIC METERS/SECOND	.192E-02	.125E-02	.616E-03	.281E-03	.196E-02	.127E-02	.597E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.178	1.176	1.173	1.170	1.273	1.273	1.271
LIQUID KUTATELADZE NUMBER(SQ RT)		.127	.080	.174	.113	.150	0.000	0.000

TABLE A-XI (CONT.)

WESTINGHOUSE SUPPORT COLUMN TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	J30	J31	J32	J33	J34	J35
QF1	CUBIC METERS/SECOND	-.293E-05	-.297E-05	-.290E-05	-.289E-05	-.298E-05	-.289E-05
QA	CUBIC METERS/SECOND	.984E-01	.112E+00	.111E+00	.111E+00	.111E+00	.837E-01
QF2	CUBIC METERS/SECOND	.314E-03	.189E-02	.124E-02	.612E-03	.311E-03	.124E-02
GC1	KILOGRAMS/CUBIC METER	542.466	518.578	513.918	516.820	526.699	546.966
P1	KILOPASCALS	54.077	53.101	53.667	53.692	53.675	52.630
TH1	DEGREES KELVIN	297.258	297.390	297.449	297.486	297.528	297.639
TH2	DEGREES KELVIN	305.462	305.585	305.346	306.005	306.752	306.933
TA	DEGREES KELVIN	298.356	298.080	298.312	298.687	299.188	298.324
THA	DEGREES KELVIN	302.564	304.370	303.752	303.526	303.113	305.650
PA	KILOPASCALS	59.023	58.292	58.627	58.299	58.194	58.492
DP2	KILOPASCALS	6.708	6.757	6.745	6.694	6.604	6.782
DP3	KILOPASCALS	.195	.210	.215	.214	.227	.210
DP1	KILOPASCALS	-2.764	-2.828	-2.854	-2.843	-2.843	-2.690
FROTH HEIGHT	METERS	.914	1.194	1.092	1.016	.991	1.092
FALLBACK	CUBIC METERS/SECOND	0.	.353E-04	0.	0.	0.	.196E-04
CARRYOUT	CUBIC METERS/SECOND	.326E-03	.197E-02	.127E-02	.562E-03	.331E-03	.125E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.270	1.351	1.350	1.348	1.347	1.172
LIQUID KUTATELADZE NUMBER(SQ RT)		0.000	.118	0.000	0.000	0.000	.088

TABLE A-XII

WESTINGHOUSE CONTROL ROD SHROUD TEST HEIGHT= 0.81?METERS

CHANNEL	UNITS	K02	K03	K04	K05	K06	K07	K08
QA	CUBIC METERS/SECOND	.648E-01	.648E-01	.307E-01	.580E-01	.757E-01	.758E-01	.758E-01
QH2	CUBIC METERS/SECOND	.304E-03	.630E-03	.124E-02	.190E-02	.317E-03	.630E-03	.124E-02
GD1	KILOGRAMS/CUBIC METER	-.031	-.035	-.035	-.038	-.027	-.029	-.035
P1	KILOPASCALS	53.685	53.708	53.697	53.705	53.603	53.414	53.204
TH1	DEGREES KELVIN	295.618	295.644	295.678	295.711	295.858	295.895	295.919
TH2	DEGREES KELVIN	299.005	300.076	300.958	301.805	299.782	300.728	301.417
TA	DEGREES KELVIN	294.094	294.683	296.481	297.831	296.233	296.241	296.727
THA	DEGREES KELVIN	295.748	297.489	298.763	300.547	298.371	298.814	300.218
PA	KILOPASCALS	58.625	59.436	60.306	64.189	58.500	58.868	62.472
DP2	KILOPASCALS	.133	.166	21.360	.801	.148	.226	.679
DP3	KILOPASCALS	.150	.209	.206	4.818	.193	.217	4.474
DP1	KILOPASCALS	-.028	.074	.183	.207	.006	.091	.192
FROTH HEIGHT	METERS	0.000	.127	.152	.940	0.000	.051	.889
FALLBACK	CUBIC METERS/SECOND	.310E-03	.620E-03	.119E-02	.120E-02	.310E-03	.628E-03	.744E-03
CARRYOUT	CUBIC METERS/SECOND	0.	0.	0.	.688E-03	.309E-04	.328E-04	.462E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.001	1.003	.691	.962	1.080	1.082	[illegible]
LIQUID KUTATELADZE NUMBER(SQ RT)		.338	.478	.663	.666	.338	.481	.523

CHANNEL	UNITS	K09	K10	K11	K12	K13	K14	K15
QA	CUBIC METERS/SECOND	.758E-01	.111E+00	.837E-01	.843E-01	.846E-01	.845E-01	.941E-01
QH2	CUBIC METERS/SECOND	.190E-02	.124E-02	.316E-03	.622E-03	.124E-02	.190E-02	.315E-03
GD1	KILOGRAMS/CUBIC METER	-.036	-.030	-.027	-.028	-.035	-.032	-.034
P1	KILOPASCALS	53.123	53.775	53.553	52.981	52.085	52.033	52.240
TH1	DEGREES KELVIN	295.945	296.025	296.063	296.089	296.173	296.215	[illegible]
TH2	DEGREES KELVIN	302.035	302.320	303.053	303.864	303.475	304.063	304.807
TA	DEGREES KELVIN	297.476	302.075	297.260	297.401	297.087	297.629	297.584
THA	DEGREES KELVIN	301.040	300.956	300.824	301.288	301.995	303.094	302.190
PA	KILOPASCALS	62.910	61.073	58.352	58.343	60.797	61.187	56.850
DP2	KILOPASCALS	.769	.752	.210	.246	.697	.819	.257
DP3	KILOPASCALS	4.636	3.900	.254	.258	4.482	4.586	.275
DP1	KILOPASCALS	.233	.206	-.020	.111	.189	.218	.001
FROTH HEIGHT	METERS	.914	.914	0.000	.025	.914	.940	.025
FALLBACK	CUBIC METERS/SECOND	.898E-03	.211E-03	.334E-03	.644E-03	.588E-03	.676E-03	.290E-03
CARRYOUT	CUBIC METERS/SECOND	.981E-03	.102E-02	0.	0.	.654E-03	.127E-02	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.096	1.310	1.134	1.139	1.152	1.153	1.198
LIQUID KUTATELADZE NUMBER(SQ RT)		.575	.279	.351	.487	.465	.499	.327

TABLE A-XII (CONT.)

WESTINGHOUSE CONTROL ROD SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	K16	K19	K20	K21	K22	K23	K24
QA	CUBIC METERS/SECOND	.941E-01	.112E+00	.103E+00	.103E+00	.103E+00	.103E+00	.113E+00
QW2	CUBIC METERS/SECOND	.629E-03	.124E-02	.315E-03	.628E-03	.124E-02	.189E-02	.327E-03
GD1	KILOGRAMS/CUBIC METER	-.032	-.034	-.027	-.026	-.026	-.028	-.026
P1	KILOPASCALS	52.561	53.011	53.672	53.707	53.272	53.267	53.429
TW1	DEGREES KELVIN	296.275	296.387	296.441	296.458	296.656	296.677	296.823
TW2	DEGREES KELVIN	305.576	305.524	306.297	307.068	306.429	306.932	306.260
TA	DEGREES KELVIN	297.651	297.783	298.025	298.064	298.122	298.246	297.977
TWA	DEGREES KELVIN	302.465	303.985	303.189	305.071	304.448	305.774	302.423
PA	KILOPASCALS	57.587	60.329	58.044	61.055	60.761	61.658	57.734
DP2	KILOPASCALS	.316	.740	.302	.663	51.519	.852	.248
DP3	KILOPASCALS	.268	3.811	.272	3.830	3.964	4.374	.273
DP1	KILOPASCALS	.148	.228	.077	.191	.207	.216	.153
FROTH HEIGHT	METERS	.076	.914	.025	.889	.914	.940	.025
FALLBACK	CUBIC METERS/SECOND	.653E-03	.238E-03	.326E-03	.333E-03	.302E-03	.438E-03	.333E-03
CARRYUUT	CUBIC METERS/SECOND	0.	.978E-03	0.	.163E-03	.921E-03	.147E-02	0.
GAS KUTATELADZE NUMBER (SQ ROOT)		1.201	1.319	1.253	1.266	1.267	1.271	1.311
LIQUID KUTATELADZE NUMBER(SQ RT)		.490	.296	.347	.350	.334	.401	.350

CHANNEL	UNITS	K25	K27	K28	K29	K30	K31	K33
QA	CUBIC METERS/SECOND	.113E+00	.113E+00	.122E+00	.122E+00	.122E+00	.122E+00	.131E+00
QW2	CUBIC METERS/SECOND	.606E-03	.186E-02	.315E-03	.621E-03	.124E-02	.189E-02	.630E-03
GD1	KILOGRAMS/CUBIC METER	-.031	-.031	-.020	-.030	-.033	-.025	-.026
P1	KILOPASCALS	53.411	53.038	53.311	53.327	52.751	53.819	52.904
TW1	DEGREES KELVIN	296.857	297.086	297.230	297.264	295.467	295.497	295.551
TW2	DEGREES KELVIN	307.067	307.223	307.229	308.018	299.915	300.304	301.222
TA	DEGREES KELVIN	298.321	298.064	297.399	297.415	290.869	290.695	290.358
TWA	DEGREES KELVIN	304.296	305.854	303.787	304.836	298.496	299.063	298.514
PA	KILOPASCALS	60.491	60.911	59.940	60.224	59.698	61.180	59.467
DP2	KILOPASCALS	.686	.855	.683	.667	.748	.835	.653
DP3	KILOPASCALS	3.651	4.192	3.173	3.436	3.596	3.965	3.223
DP1	KILOPASCALS	.195	.229	.210	.211	.216	.236	.194
FROTH HEIGHT	METERS	.864	.940	.864	.889	1.016	1.016	.914
FALLBACK	CUBIC METERS/SECOND	.225E-03	.357E-03	.179E-03	.221E-03	.127E-03	.247E-03	.921E-04
CARRYUUT	CUBIC METERS/SECOND	.389E-03	.150E-02	.201E-03	.420E-03	.109E-02	.174E-02	.534E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		1.324	1.326	1.376	1.378	1.384	1.389	1.434
LIQUID KUTATELADZE NUMBER(SQ RT)		.288	.363	.256	.285	.216	.301	.184

TABLE A-XII (CONT.)

WESTINGHOUSE CONTROL RO SHROUD TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	K34	K35	K36	K37	K38	K[illegible]
QA	CUBIC METERS/SECOND	.130E+00	.131E+00	.140E+00	.132E+00	.142E+00	.141E+00
QW2	CUBIC METERS/SECOND	.124E-02	.189E-02	.316E-03	.629E-03	.124E-02	.189E-02
GD1	KILOGRAMS/CUBIC METER	-.032	-.028	-.024	-.024	-.025	-.033
P1	KILOPASCALS	52.337	51.876	54.341	52.610	53.276	53.635
TW1	DEGREES KELVIN	295.579	295.592	295.601	295.611	295.633	295.627
TW2	DEGREES KELVIN	301.830	301.709	301.681	302.402	302.208	302.593
TA	DEGREES KELVIN	290.195	290.255	295.529	289.519	290.337	290.308
THA	DEGREES KELVIN	300.131	300.358	298.505	299.236	300.252	301.018
PA	KILOPASCALS	59.348	58.995	60.582	59.066	60.144	60.897
DP2	KILOPASCALS	.787	.840	.681	.624	.745	.820
DP3	KILOPASCALS	3.594	3.857	2.475	1.938	3.336	3.766
DP1	KILOPASCALS	.216	.228	.163	.175	.184	.246
FROTH HEIGHT	METERS	.991	1.016	.914	.965	.991	1.016
FALLBACK	CUBIC METERS/SECOND	.160E-03	.171E-03	.940E-04	.103E-03	.978E-04	.103E-03
CARRYOUT	CUBIC METERS/SECOND	.132E-02	.174E-02	.287E-03	.543E-03	.123E-02	.181E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.428	1.435	1.477	1.437	1.493	1.495
LIQUID KUTATELADZE NUMBER(SQ RT)		.242	.251	.186	.195	.190	.195

TABLE A-XIII

WESTINGHOUSE FLOW MIXER TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	L01	L02	L03	L04	L05	L06	L07
QA	CUBIC METERS/SECOND	.373E-01	.281E-01	.281E-01	.281E-01	.281E-01	.370E-01	.369E-01
QW2	CUBIC METERS/SECOND	.125E-02	.321E-03	.617E-03	.125E-02	.190E-02	.321E-03	.616E-03
GD1	KILOGRAMS/CUBIC METER	667.496	653.356	685.088	692.490	684.799	682.247	673.013
P1	KILOPASCALS	54.258	53.097	53.144	53.076	52.565	52.697	52.735
TW1	DEGREES KELVIN	291.668	294.251	294.183	294.177	294.166	294.129	294.140
TW2	DEGREES KELVIN	301.710	301.895	303.069	303.943	303.624	304.137	305.107
TA	DEGREES KELVIN	292.451	294.194	295.449	296.407	296.886	297.731	298.276
TWA	DEGREES KELVIN	300.641	299.040	301.364	302.831	302.811	302.132	303.744
PA	KILOPASCALS	55.387	52.881	54.325	54.694	54.494	52.978	53.438
DP2	KILOPASCALS	-1.734	-1.571	-1.715	-1.676	-1.645	-1.750	-1.790
DP3	KILOPASCALS	4.735	3.423	4.545	4.929	5.184	4.014	4.553
DP1	KILOPASCALS	-.028	-.040	-.036	-.042	-.039	-.027	-.023
FROTH HEIGHT	METERS	1.067	.762	.965	1.067	1.092	.838	.991
FALLBACK	CUBIC METERS/SECOND	.153E-03	.228E-03	.218E-03	.228E-03	.205E-03	.145E-03	.150E-03
CARRYOUT	CUBIC METERS/SECOND	.112E-02	.240E-03	.389E-03	.984E-03	.170E-02	0.	.447E-03
GAS KUTATELADZE NUMBER (SQ ROOT)		.776	.667	.670	.670	.670	.764	.764
LIQUID KUTATELADZE NUMBER(SQ RT)		.245	.239	.292	.299	.284	.239	.242

CHANNEL	UNITS	L08	L09	L10	L11	L13	L12	L16
QA	CUBIC METERS/SECOND	.369E-01	.373E-01	.412E-01	.411E-01	.410E-01	.410E-01	.462E-01
QW2	CUBIC METERS/SECOND	.125E-02	.190E-02	.320E-03	.618E-03	.189E-02	.125E-02	.125E-02
GD1	KILOGRAMS/CUBIC METER	665.935	671.361	665.935	658.898	648.247	658.489	652.314
P1	KILOPASCALS	52.839	53.188	52.930	53.024	53.004	52.081	52.153
TW1	DEGREES KELVIN	294.100	294.348	294.358	294.381	294.358	294.080	294.101
TW2	DEGREES KELVIN	306.169	307.166	307.143	308.154	308.692	306.340	306.708
TA	DEGREES KELVIN	298.582	293.556	290.714	290.195	289.700	299.933	299.292
TWA	DEGREES KELVIN	305.171	306.130	304.158	306.052	307.713	305.424	305.847
PA	KILOPASCALS	53.884	54.743	53.205	53.792	54.355	53.191	53.109
DP2	KILOPASCALS	-1.808	-1.734	-1.801	-1.872	-1.767	-1.807	-1.828
DP3	KILOPASCALS	4.835	5.145	4.134	4.472	5.052	4.846	4.810
DP1	KILOPASCALS	-.014	-.013	-.011	-.006	-.008	-.015	-.009
FROTH HEIGHT	METERS	1.016	1.057	.914	.965	1.092	1.016	1.016
FALLBACK	CUBIC METERS/SECOND	.159E-03	.167E-03	.114E-03	.109E-03	.114E-03	.153E-03	.119E-03
CARRYOUT	CUBIC METERS/SECOND	.109E-02	.179E-02	.154E-03	.484E-03	.158E-02	.107E-02	.111E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		.765	.775	.811	.813	.814	.805	.855
LIQUID KUTATELADZE NUMBER(SQ RT)		.250	.256	.212	.207	.211	.245	.216

TABLE A-XIII (CONT.)

WESTINGHOUSE FLOW MIXER TEST HEIGHT= [illegible].813METERS

CHANNEL	UNITS	L33	L20	L14	L15	L17	L18	L21
QA	CUBIC METERS/SECOND	.654E-01	.511E-01	.463E-01	.464E-01	.464E-01	.519E-01	.513E-01
QW2	CUBIC METERS/SECOND	.125E-02	.125E-02	.321E-03	.617E-03	.189E-02	.320E-03	.190E-02
GD1	KILOGRAMS/CUBIC METER	639.224	641.779	656.552	655.157	651.361	651.283	641.563
P1	KILOPASCALS	52.835	53.063	53.270	53.390	52.950	52.995	51.971
TW1	DEGREES KELVIN	294.081	294.181	294.327	294.344	294.355	294.348	294.299
TW2	DEGREES KELVIN	308.051	308.719	307.719	308.595	308.100	308.294	309.625
TA	DEGREES KELVIN	299.311	297.013	290.307	289.827	290.774	289.782	289.118
TWA	DEGREES KELVIN	307.000	307.659	304.795	306.547	306.994	305.107	307.378
PA	KILOPASCALS	53.170	53.807	53.513	54.162	54.425	53.023	53.224
DP2	KILOPASCALS	-1.887	-1.852	-1.895	-1.841	-1.775	-1.847	-1.835
DP3	KILOPASCALS	4.683	4.798	3.939	4.539	5.059	3.893	4.995
DP1	KILOPASCALS	.015	.006	-.015	-.010	-.007	.002	.006
FROTH HEIGHT	METERS	1.016	1.015	.762	.965	1.092	.889	1.092
FALLBACK	CUBIC METERS/SECOND	.572E-04	.110E-03	.953E-04	.117E-03	.883E-04	.896E-04	.945E-04
CARRYOUT	CUBIC METERS/SECOND	.122E-02	.114E-02	.505E-04	.507E-03	.167E-02	.618E-04	.170E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		1.015	.900	.861	.864	.865	.906	.939
LIQUID KUTATELADZE NUMBER(SQ RT)		.150	.208	.193	.215	.186	.187	.182

CHANNEL	UNITS	L22	L23	L24	L26	L31	L32	L34
QA	CUBIC METERS/SECOND	.368E-01	.555E-01	.555E-01	.554E-01	.649E-01	.649E-01	.643E-01
QW2	CUBIC METERS/SECOND	.125E-02	.320E-03	.622E-03	.190E-02	.320E-03	.618E-03	.190E-02
GD1	KILOGRAMS/CUBIC METER	670.420	649.135	649.574	639.840	634.014	635.076	622.511
P1	KILOPASCALS	52.579	52.932	52.920	53.022	53.730	53.500	53.251
TW1	DEGREES KELVIN	294.331	294.355	294.357	294.368	294.491	294.475	294.391
TW2	DEGREES KELVIN	308.370	308.544	310.234	309.350	303.563	304.383	304.904
TA	DEGREES KELVIN	289.039	288.830	288.472	289.249	289.348	288.526	298.886
TWA	DEGREES KELVIN	306.970	305.155	307.254	308.044	303.203	302.[illegible]42	303.768
PA	KILOPASCALS	53.737	52.924	53.299	54.023	53.280	53.451	53.747
DP2	KILOPASCALS	-1.776	-1.823	-1.932	-1.852	-1.886	-1.943	-1.908
DP3	KILOPASCALS	4.963	3.914	4.416	4.969	3.967	4.319	4.845
DP1	KILOPASCALS	.019	.005	.009	.023	.022	.025	.043
FROTH HEIGHT	METERS	1.016	.864	.965	1.092	.940	.991	1.092
FALLBACK	CUBIC METERS/SECOND	.163E-03	.959E-04	.707E-04	.833E-04	.454E-04	.448E-04	.435E-04
CARRYOUT	CUBIC METERS/SECOND	.110E-02	.763E-04	.538E-03	.179E-02	.268E-03	.570E-03	.175E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		.770	.943	.944	.945	1.019	1.020	1.022
LIQUID KUTATELADZE NUMBER(SQ RT)		.253	.194	.166	.181	.133	.133	.131

TABLE A-XIII (CONT.)

WESTINGHOUSE FLOW MIXER TEST HEIGHT= 0.813METERS

CHANNEL	UNITS	L35
QA	CUBIC METERS/SECOND	.368E-01
QW2	CUBIC METERS/SECOND	.125E-02
GD1	KILOGRAMS/CUBIC METER	670.939
P1	KILOPASCALS	52.620
TW1	DEGREES KELVIN	294.355
TW2	DEGREES KELVIN	305.152
TA	DEGREES KELVIN	289.985
TWA	DEGREES KELVIN	304.125
PA	KILOPASCALS	54.282
DP2	KILOPASCALS	-1.736
DP3	KILOPASCALS	4.970
DP1	KILOPASCALS	-.022
FROTH HEIGHT	METERS	1.016
FALLBACK	CUBIC METERS/SECOND	.177E-03
CARRYOUT	CUBIC METERS/SECOND	.107E-02
GAS KUTATELADZE NUMBER (SQ ROOT)		.771
LIQUID KUTATELADZE NUMBER(SQ RT)		.263

2. DENSITOMETER CALIBRATION DATA

The low energy (Cd^{109} gamma source) gamma densitometer was used in Westinghouse test Series I, J, and L, and the supplemental test series. Special test points were run at various times during each series to provide information required to calibrate the data system to allow for varying (decreasing) source strength and possible variation in source location and plastic vessel wall thickness. In addition, tests employing upper plenum internal structures (W-2 and W-4) could potentially subject the measuring beam to decimation through the plastic internal. The densitometer calibration data for each test in which it was used is given in Table A-XIV.

TABLE A-XIV

DENSITOMETER CALIBRATION DATA

TEST SERIES	COUNTS/SECOND		COMMENTS
	(Vessel Empty)	(Vessel Full)	
Supplemental Tests (Series Y)	26451.	25.03	at start of test series
	26088.	25.05	after test Y18
	26356.	24.42	before test Y19
	26148.	25.31	after test Y72
	26196.	25.74	before test Y25
	25755.	24.87	at end of test series
Westinghouse Open Hole UCSP Tests (Series I)	21650.	39.62	at start of test series
	21462.	39.20	after test I-30
	21501.	43.67	after test I-34
Westinghouse Support Column Test (Series J)	13199.	47.10	at start of test series
	13086.	47.73	after test J-4
	12937.	43.43	after test J-9
	12906.	---	at end of test series
Westinghouse Flow Mixer Test (Series L)	21710.	46.92	at start of test series
	21760	47.06	at end of test series

APPENDIX B

ANALYSIS OF EXPERIMENTAL ERROR

APPENDIX B

ANALYSIS OF EXPERIMENTAL ERROR

(Provided by S. Y. Liou, Dept. of Nuclear Engineering, University of California, Berkeley, California)

The maximum likely uncertainty of a dependent variable calculated from experimental data may be expressed as:

$$\frac{\Delta R}{R} = \left[\sum_{k=1}^{N}\left(\frac{\partial}{\partial N_k}\ \ln R\right)^2 (\ N_k)^2\right]^{1/2}$$

where ΔR is the uncertainty in a calculated variable of magnitude R, N_k is the value of the k^{th} measured variable, and ΔN_k is the magnitude of the uncertainty assigned to this measurement.

Based upon sensor accuracy specifications, as given in Table B-I, the following uncertainties have been assigned:

1. temperature measurements = $\pm$ 2.77°K
2. pressure measurements = $\pm$ 1.38 KPa
3. air flow rate = $\pm$ 0.004 m^3/sec
4. water injection rate (core and upper plenum) = $\pm$ 2.3×10^{-5} m^3/sec
5. water outflow measurement (level change in collection tank) = $\pm$ 0.4×10^{-5} m^3/sec

In addition, error may arise in the visual interpretation of the slope of the recorded collection tank level. This has been estimated as $\pm 2\%$ of the reading, However, this estimate could be low for the tests with a low fallback rate. Also, an exact water mass balance is not achieved in the tests. In general,

TABLE B-I

EXPERIMENT MEASUREMENT SPECIFICATIONS

TYPE OF MEASUREMENT	INSTRUMENT NUMBER	LOCATION	RANGE	ACCURACY
MASS FLOW RATE	QW1	Inlet water (below core)	0.0-0.00227 m^3/sec	±5%
	QW2	Inlet water (to upper plenum)	0.0-0.00227 m^3/sec	±5%
	QA	Inlet air	0.047 -0.472 m^3/sec	±5%
PRESSURE	P1	Upper plenum	0-0.2078 mPa	±1.38 kPa
	PA	Inlet air	0-0.2078 mPa	±1.38 kPa
FLUID TEMPERATURE	TA	Inlet air	288.7-322°K	±2.77°K
	TW1	Inlet water	"	"
	TW2	Inlet water (upper plenum)	"	"
	TWA	Upper plenum	"	"
PRESSURE (DIFFERENTIAL)	3DT1	Measuring tank (from bottom of vessel)	0-24.88 kPa	±1% F.S.
	AWT3	Measuring tank (from separator)	0-24.88 kPa	±1% F.S.
	DP1	Across grid plate	0-4.98 kPa	±.0249 kPa
	DP2	Across upper core support plate	"	"
	DP3	Top of UCSP to top of U.P.	"	"
FROTH DENSITY (GAMMA DENSITOMETER)	GD-1	Upper plenum	0-1041 kg/m^3	±8%

the outlet water flows total to within five percent of the total inlet flows although occasionally larger descrepancies are noted.

The calculated maximum expected errors in the gas and liquid flow Kutatetadze numbers are dominated by the relative errors in the gas flow and liquid fallback measurements respectively. It is thus possible to plot these errors as functions of the gas and liquid Kutateladze numbers for each test with a different tie plate flow area (upon which these numbers are based). Since these flow areas do not differ greatly among the tests in the series, this has been done for the KKU Open Hole Test Series A as a representative example. These plots are shown in Figures B-I and B-II. As shown in the figures, the error in both gas and liquid Kutateladze numbers is generally less than 0.04 over most of the range of interest. Only for very low gas flow and liquid fallback flow rates does the error become significant.

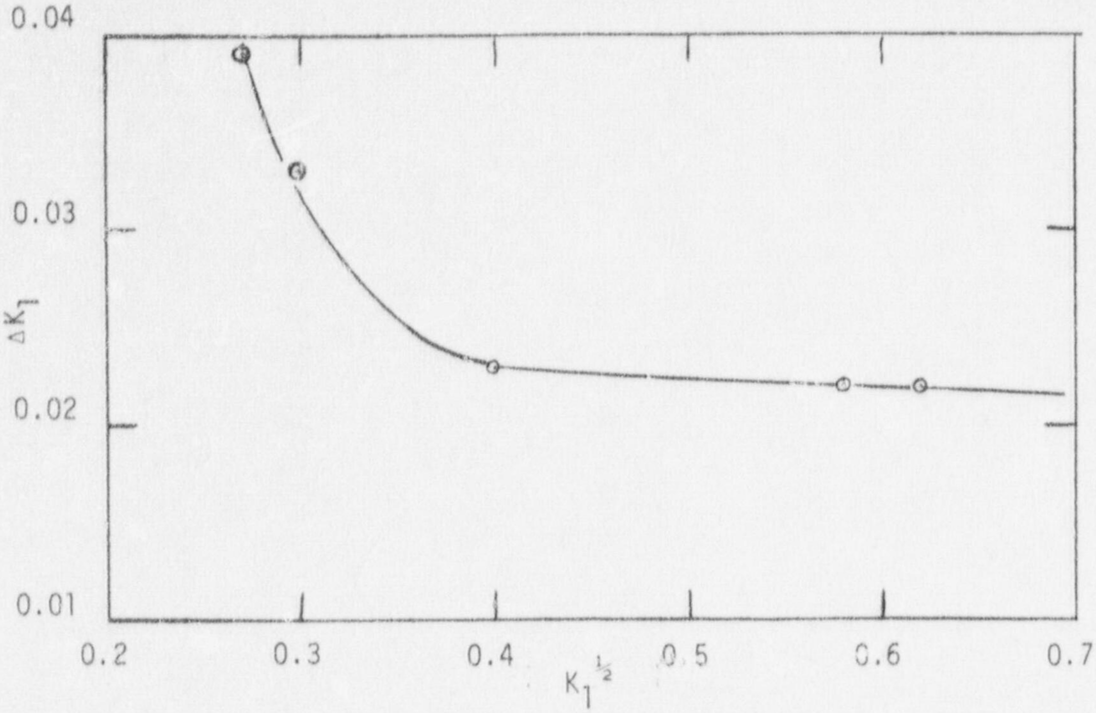

Fig. B-1 Maximum likely error in liquid Kutateladze number versus square root of liquid Kutateladze number (Test G-1).

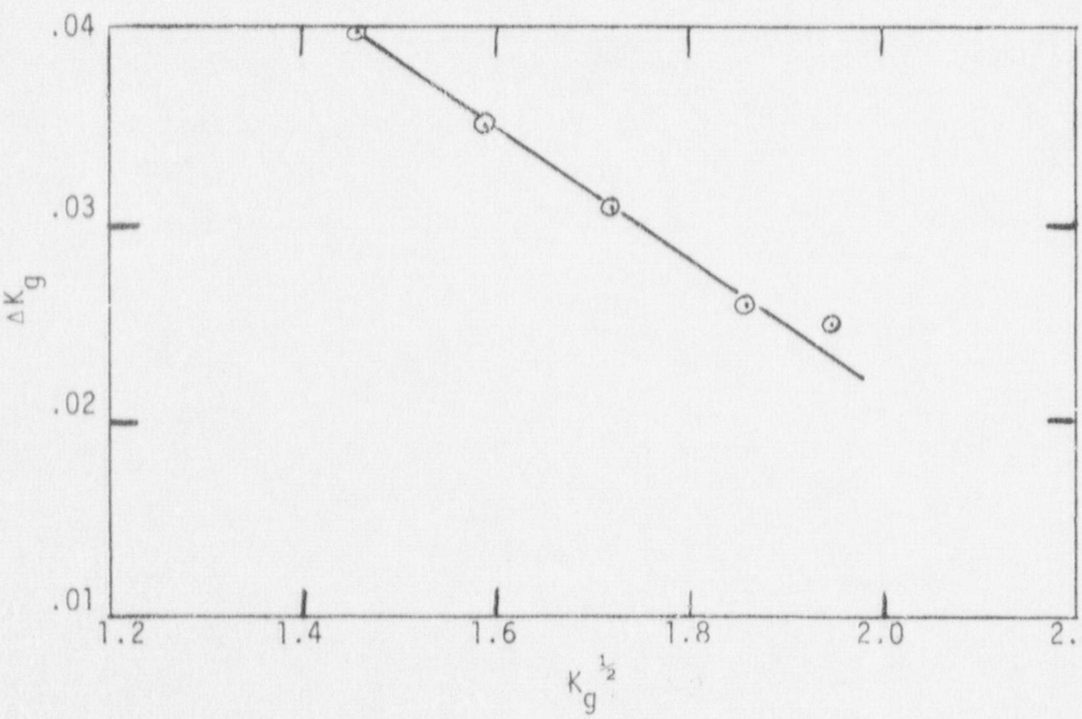

Fig. B-2 Maximum likely error in gas Kutateladze number versus square root of gas Kutateladze number (Test G-1).

APPENDIX C

DATA REDUCTION COMPUTER ROUTINE

A listing of program "CALC" and associated subroutines appears in Table C-I. The functions of these routines are:

1. Read data from the data tape.
2. Delete and edit data points if required.
3. Create a file with properly labled test points and program input data (froth height, fallback and carryout rates).
4. Adjust differential pressure readings for sensor zero point to vessel.
6. Calculate air density, and various dimensionless flow rate groups.
7. Store the results on tape suitable for plotting and listing data.

The data tape to be read is in the "INDP" format, Reference 8.

```
      PROGRAM      CALC(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
     1 TAPE1,TAPE2,TAPE3,TAPE20,TAPE11,TAPE12,TAPE13,TAPE14,TAPE4,
     2 TAPE21)
      REAL LTKFL  ,NAME
      INTEGER Q,R,S
       COMMON/ICT/ICOUNT
       COMMON/DATIN/DATA(1100),STO( 200),STO1( 200),STO2( 200),
     1STO3(200)
       COMMON NN,JJ(200),K,        A(10),D(10),XJGS(3,200),XJLS(3,200),
     C XKG(3,200),XKL(3,200),DENSL,SURTEN
       COMMON/INPUT/ICTRL(6),IDATA( 200),N,J,IREC(200),NOREC,MM
       COMMON/INOX/IND(300),INDEX(1100)
       DIMENSION NAME(200),HEIGHT(200),SMTKFL(200),LTKFL(200),
     1DENS(200),FSC(200),DP1(200),DP1ZRO(200),DP2(200),DP2ZRO(200),
     2DP3(200),DP3ZRO(200),
     C MODTST(200),MODCHL(200),XMOD(200),BYE(30),     Q(20),R(20),S(20)
       DATA OUT/"OUT"/
       DATA ICTRL(5)/"CTRL","DATA","CDAT",920,36/
       DATA CHEK/"CTRL"/
      DATA(BYE(I),I=1,30)/4,5,6,7,8,26,27,28,29,30,31,32,44,45,46,47,
     C 204,205,206,207,208,209,210,211,212,213,214,215,216,217/
      DATA(Q(I),I=1,14)/"TEST","FROT","SM T","LG T","ADJ ","AIR ",
     C"JG* ","JL* ","KG -","KL -","JG* ","JL* ","KG -","KL -"/
      DATA(R(I),I=1,14)/" TIT","H HE",2*("K FL"),"AIR ","DENS",
     C4*("- A1"),4*("- A2")/
      DATA(S(I),I=1,14)/"LE","IGHT",2*("OW"),"FLOW","ITY",8*("  ")/
       CALL OPENMS(3,IND,300,0)
       CALL OPENMS(4,INDEX,1100,0)
       DENSL=62.3
       SURTEN=.16
       NOREC = 0
       READ(5,*) NN,IK,A(1),A(2),D(1),D(2)
      IF(NN.EQ.0) GO TO 7
      I=1
6      READ(5,*) JJ(I)
      I=I+1
      IF(I-NN) 6,6,7
7     IF(IK.EQ.0) GO TO 20
      I=1
8      READ(5,*) MODTST(I),MODCHL(I),XMOD(I)
      I=I+1
      IF(I-IK) 8, 8,20
102    MM=K-NN
       WRITE(6,326)MM
  326  FORMAT(15X,9HMM EQUALS,I5)
       READ(5,23)(NAME(I),I=1,MM)
23     FORMAT(15A3)
       READ(5,*)(HEIGHT(I),I=1,MM),(SMTKFL(I),I=1,MM),(LTKFL(I),I=1,MM)
     6,(DP1ZRO(I),I=1,MM),(DP2ZRO(I),I=1,MM),(DP3ZRO(I),I=1,MM)
       GO TO 101
20    CONTINUE
C
C   ***READ CONTROL HEADER FROM TAPE.***
C
  350  READ(11) WRD1,L,(IDATA(I),I=1,L)
       IF(IDATA(2).EQ.204) GO TO 320
       IF(EOF(11)) 320,310
```

TABLE C-I

LISTING OF DATA HANDLING COMPUTER PROGRAMS

```
  310 IF(WRD1.NE.CHEK) GO TO 350
C
C    ***WRITE CONTROL HEADER TO DISK.***
C
      CALL WRITMS(3,IDATA,36,IDATA(1),0)
C
C    ***READ DATA FROM TAPE.***
C
      READ(11) WRD,K,(DATA(I),I=1,K)
      IF(EOF(11)) 320,321
  321 IF(WRD.NE.CHEK) GO TO 330
      DO 201 I=1,36
      IDATA(I) = DATA(I)
  201 CONTINUE
      GO TO 310
330    ICOUNT = IDATA(1)
      WRITE(6,733)IDATA(1)
733   FORMAT(I5)
      WRITE(6,734) (DATA(I),I=1,K)
734   FORMAT(11E10.3)
      IF(NOREC.EQ.0) GO TO 102
101   IF(NM.EQ.0) GO TO 208
C
C   ***REMOVE UNWANTED TESTS***
C
      CALL REMOVE(OUT,MM)
205   DO 207 I=1,MM
207   DATA(I)=STO(I)
208   CONTINUE
C
C     ***WRITE DATA ON  DISK***
C
       CALL WRITMS(4,DATA,MM,IDATA(1),C)
  105  NOREC = NOREC + 1
      IREC(NOREC) = IDATA(1)
  200 CONTINUE
      GO TO 350
  320 CONTINUE
      IF(IK.EQ.0) GO TO 700
C
C   ***EDIT DATA POINTS AND WRITE TO DISK***
C
      I=1
650   CALL READMS(4,DATA,MM,MODCHL(I))
      NAP=MODTST(I)
      DATA(NAP)=XMOD(I)
      CALL WRITMS(4,DATA,MM,MODCHL(I),1)
      I=I+1
      IF(I-IK) 650,650,700
700    CONTINUE
C
C   ***ADD CONTROL HEADERS FOR EXTRA CHANNELS (204-217) TO DISK***
C
      DO 400 I=2,33
400   IDATA(I)=0
      IDATA(1)=204
      IDATA(11)=730
```

TABLE C-I (CONT.)

```
            IDATA(12)=434
            IDATA(27)=1
            IDATA(28)=9
            DO 500 I=1,14
            IDATA(32)="      "
            IDATA(33)="      "
            IDATA(34)=Q(I)
            IDATA(35)=R(I)
            IDATA(36)=S(I)
            CALL WRITMS(3,IDATA,36,IDATA(1),0)
            NOREC=NOREC+1
            IREC(NOREC)=IDATA(1)
  500       IDATA(1)=IDATA(1)+1
C
C     ***WRITE TITLES, FROTH HEIGHT, AND TANK FLOW DATA TO DISK (CHNLS 204
C           -207)***
C
            IDATA(1)=204
            DO 560 I=1,4
             IF(I.EQ.4) GO TO 524
            IF(I.EQ.3) GO TO 523
            IF(I.EQ.2) GO TO 522
            DO 551 J=1,MM
  551       DATA(J)=NAME(J)
            GO TO 568
  522       DO 552 J=1,MM
  552       DATA(J)=HEIGHT(J)
            GO TO 568
  523       DO 553 J=1,MM
  553       DATA(J)=SMTKFL(J)
            GO TO 568
  524       DO 554 J=1,MM
  554       DATA(J)= LTKFL(J)
  568       CALL WRITMS(4,DATA,MM,IDATA(1),0)
  560       IDATA(1)=IDATA(1)+1
C
C     ***CALCULATE VESSEL AIR FLOW DATA AND WRITE TO TAPE IN CHNL 208***
C
             CALL READMS(4,STO,MM,6)
             CALL READMS(4,STO1,MM,26)
             CALL READMS(4,STO2,MM,4)
            DO 570 I=1,MM
  570        DATA(I)=STO(I)*(STO1(I)+12.3)/(STO2(I)+12.3)
            CALL WRITMS(4,DATA,MM,208,0)
C
C
C     ***  ADJUST DP READINGS FOR ZERO OFFSET
C
C
            CALL READMS(4,DP1,MM,27)
            DO 780 I=1,MM
   780      DATA(I)=DP1(I)-DP1ZRO(I)
            CALL WRITMS(4,DATA,MM,27,1)
            CALL READMS(4,DP2,MM,28)
            DO 781 I=1,MM
   781      DATA(I)=DP2(I)-DP2ZRO(I)
            CALL WRITMS(4,DATA,MM,28,1)
```


TABLE C-I (CONT.)

```
      CALL READMS(4,DP3,MM,29)
      DO 782 I=1,MM
  78  DATA(I)=DP3(I)-DP3ZRO(I)
      CALL WRITMS(4,DATA,MM,29,1)
C   ***CALCULATE AIR DENSITY DATA AND WRITE TO DISK IN CHNL 209***
C
       CALL READMS(4,STO,MM,46)  —— TA
       CALL READMS(4,STO1,MM,4)  —— P1
      DO 571 I=1,MM
 571  DATA(I)=144.*( STO1(I)+12.3)/(53.3*( STO(I)+460.))
      CALL WRITMS(4,DATA,MM,209,0)
C   ***CALCULATE DIMENSIONLESS GROUPS FOR CHNLS 210-217***
C
      CALL READMS(4,STO,MM,208)
      CALL READMS(4,STO1,MM,206)
      CALL READMS(4, STO2,MM,209)
       CALL CALCAW(MM)
C
C   ***WRITE DIMENSIONLESS GROUPS ON DISK***
C
      L=210
      DO 599 J=1,2
      DO 600 I=1,MM
 600  DATA(I)=XJGS(J,I)
      CALL WRITMS(4,DATA,MM,L,0)
      L=L+1
      DO 601 I=1,MM
 601  DATA(I)=XJLS(J,I)
      CALL WRITMS(4,DATA,MM,L,0)
      L=L+1
      DO 602 I=1,MM
 602  DATA(I)=XKG(J,I)
      CALL WRITMS(4,DATA,MM,L,0)
      L=L+1
      DO 603 I=1,MM
 603  DATA(I)=XKL(J,I)
      CALL WRITMS(4,DATA,MM,L,0)
 599  L=L+1
       I=1
1000   CALL READMS(3,IDATA,36,BYE(I))
       WRITE(6,1001)          (IDATA(J),J=1,36)
1001   FORMAT(5X,31I3,5A4)
       CALL READMS(4,DATA,MM,BYE(I))
      IF(BYE(I).EQ.204) GO TO 2003
      WRITE(6,1002)(DATA(J),J=1,MM)
      GO TO 2004
2003  WRITE(6,2002)(DATA(J),J=1,MM)
2004   CONTINUE
2002  FORMAT(8(1X,A4)//)
1002   FORMAT(8F12.3//)
       I=I+1
       IF(I-30) 1000,1000,1010
1010   CONTINUE
      CALL CAL7
       CALL CLOSMS(3)
       CALL CLOSMS(4)
       END
```

TABLE C-I (CONT.)

```
                 SUBROUTINE REMOVE(OUT,MM)
                  COMMON/DATIN/DATA(1100),STO( 200),STO1( 200),STO2( 200),
                1 STO3( 200)
                  COMMON NN,JJ(200),K,          A(10),D(10),XJGS(3,200),XJLS(3,200),
                C XKG(3,200),XKL(3,200),DENSL,SURTEN
                 L=1
                 I=1
        16       J=L
                 IF(JJ(I).EQ.J) GO TO 2
                 L=L+1
                 IF(J.GE.K) GO TO 7
                 GO TO 16
        2        L=L+1
                 DATA(J)=OUT
                 IF(J.GE.K) GO TO 7
                 I=I+1
        5        IF(I-NN) 16,16,7
        7        KK=1
                 II=1
                 I=1
        21       IF(DATA(I).EQ.OUT) GO TO 22
                  STO(II)=DATA(KK)
                 II=II+1
                 IF(II.GT.MM) GO TO 23
                 KK=KK+1
                 I=I+1
                 GO TO 21
        22       KK=KK+1
                 I=I+1
                 IF(I.GT.K) GO TO 23
                 GO TO 21
        23       RETURN
                 END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
    4  REMOVE         1            32

VARIABLES       SN  TYPE              RELOCATION
   312  A            REAL        ARRAY    / /        REFS       4
   324  D            REAL        ARRAY    / /        REFS       4
     0  DATA         REAL        ARRAY    DATIN      REFS       2        21        22   DEFINED     14
  5076  DENSL        REAL                 / /        REFS       4
   107  I            INTEGER                         REFS       9        16        17        21        26        29        30
                                                  DEFINED       7        16        20        26        29
   112  II           INTEGER                         REFS      22        23        24   DEFINED     19        23
   110  J            INTEGER                         REFS       9        11        14        15   DEFINED      8
     1  JJ           INTEGER     ARRAY    / /        REFS       4         9
   311  K            INTEGER              / /        REFS       4        11        15        30
   111  KK           INTEGER                         REFS      22        25        28   DEFINED     18        25        28
   106  L            INTEGER                         REFS       8        10        13   DEFINED      6        10        13
     0  MM           INTEGER                F.P.     REFS      24   DEFINED      1
```

TABLE C-I (CONT.)

```
              SUBROUTINE CALCAW(MM)
               COMMON/DATIN/DATA(1100),STO( 200),STO1( 200),STO2( 200),
             1 STO3( 200)
               COMMON NN,JJ(200),K,        A(10),D(10),XJGS(3,200),XJLS(3,200),
             C XKG(3,200),XKL(3,200),DENSL,SURTEN
               DIMENSION XJG(3,200),XJL(3,200)
               WRITE(6,1243)(STO(I),STO1(I),STO2(I),                  I=1,8),
             C A(1),A(2),D(1),D(2),SURTEN,DENSL,MM
        1243   FORMAT(8(3F12.3/),6F12.3,1I5)
              DO 10 I=1,2
              DO 10 J=1,MM
              XJG(I,J)=STO(J)/(A(I)*60.)
              XJL(I,J)=STO1(J)/(A(I)*60.)*.1337
              R=(32.2*D(I)*(DENSL- STO2(J)))**.5
              XJGS(I,J)=(XJG(I,J)*STO2(J)**.5/R)**0.5
              XJLS(I,J)=(XJL(I,J)*DENSL**.5/R)**0.5
              S=(32.2*SURTEN*(DENSL- STO2(J)))**.25
              XKG(I,J)=(XJG(I,J)*STO2(J)**.5/S)**0.5
        10    XKL(I,J)=(XJL(I,J)*DENSL**.5/S)**0.5
              RETURN
               END
```

```
        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS       DEF LINE       REFERENCES
    4  CALCAW          1            20

VARIABLES       SN  TYPE               RELOCATION
   312  A           REAL      ARRAY    / /          REFS        4       2*7      12       13
   324  D           REAL      ARRAY    / /          REFS        4       2*7      14
     0  DATA        REAL      ARRAY    DATIN        REFS        2
  5076  DENSL       REAL               / /          REFS        4         7      14       16       17       19
   226  I           INTEGER                         REFS      3*7      2*12    2*13       14     2*15     2*16     2*18
                                                     2*19  DEFINED        7      10
   227  J           INTEGER                         REFS     2*12      2*13      14     3*15     2*16       17     3*18
                                                     2*19  DEFINED       11
     1  JJ          INTEGER   ARRAY    / /          REFS        4
   311  K           INTEGER            / /          REFS        4
     0  MM          INTEGER             F.P.        REFS        7        11  DEFINED       1
     0  NN          INTEGER            / /          REFS        4
   230  R           REAL                            REFS       15        16  DEFINED      14
   231  S           REAL                            REFS       18        19  DEFINED      17
  2114  STO         REAL      ARRAY    DATIN        REFS        2         7      12
  2424  STO1        REAL      ARRAY    DATIN        REFS        2         7      13
  2734  STO2        REAL      ARRAY    DATIN        REFS        2         7      14       15       17       18
  3244  STO3        REAL      ARRAY    DATIN        REFS        2
  5077  SURTEN      REAL               / /          REFS        4         7      17
   232  XJG         REAL      ARRAY                 REFS        6        15      18  DEFINED      12
   336  XJGS        REAL      ARRAY    / /          REFS        4   DEFINED      15
  1362  XJL         REAL      ARRAY                 REFS        6        16      19  DEFINED      13
  1466  XJLS        REAL      ARRAY    / /          REFS        4   DEFINED      16
  2616  XKG         REAL      ARRAY    / /          REFS        4   DEFINED      18
  3746  XKL         REAL      ARRAY    / /          REFS        4   DEFINED      19
```

TABLE C- I (CONT.)

```
      SUBROUTINE CAL7
      COMMON/DATIN/DATA(1100),STO( 200),STO1( 200),STO2( 200),
     1 STO3( 200)
      COMMON/INPUT/ICTRL(6),IDATA( 200),N,J,IREC(200),NOREC,MM
      COMMON/ICT/ICOUNT
      COMMON/INDX/IND(200),INDEX( 500)
C
C
C     THIS SUBROUTINE WRITES DATA FROM DISK TO TAPE.
C
C
     N=MM
      ILINE = 0
      DO 900 IN=1,NOREC
      IT = IREC(IN)
C
C     READ CONTROL HEADER FROM DISK.
C
  100 CALL READMS(3,IDATA,36,IT)
      ICTRL(1)="CTRL"
      ICTRL(2)="DATA"
      ICTRL(5)=36
      IF(EOF(3)) 50,501
C
C     WRITE CONTROL HEADER TO TAPE.
C
  501 WRITE(1) ICTRL(1),ICTRL(5),(IDATA(I),I=1,36)
      NN = 0
C
C     READ NEW DATA FROM DISK.
C
      CALL READMS(4,STO,N,IDATA(1))
C
C     WRITE NEW DATA TO TAPE.
C
      WRITE(1) ICTRL(2),N,(STO(I),I=1,N)
  201 CONTINUE
      NN = NN + N
      WRITE(5,200)    IDATA(1),IDATA(34),IDATA(35),NN
      ILINE = ILINE + 1
      IF(ILINE.NE.50) GO TO 900
      IF(IT.EQ.ICOUNT) GO TO 900
      CALL PRNT
      ILINE = 0
  900 CONTINUE
  200 FORMAT(20X,I5,16X,2A4,16X,I5)
   50 ENDFILE 1
      REWIND 1
  500 RETURN
      END
```

SYMBOLIC REFERENCE MAP (R=3)

TABLE C-I (CONT.)

APPENDIX D

TRAC MODEL OF AIR WATER TEST APPARATUS

APPENDIX D

TRAC MODEL OF AIR WATER TEST APPARATUS

(Contributed by M. M. Giles)

1. TRAC MODEL DESCRIPTION

The analyses were performed using a two-dimensional TRAC model of the Air-Water Facility with the JAERI four hole upper core support plate (UCSP) as described in Section II. As shown in Figure D-1, the TRAC model consists of a vessel component with attached pipes, fills and breaks to represent the air and water injection sources and hot leg outlet. The vessel component has twelve axial levels, the interface between most levels being placed at elevations where vessel flow area changes occur. Levels 7, 8, and 11 are required to provide pipe connection points, and Level 9 is included to represent the gamma densitometer location.

Each axial level is divided in the x direction (see Figure D-1) into five cells. The spacing of these calls, which is the same on each axial level, was chosen to allow modeling of the openings in the UCSP. On the axial level representing the UCSP (Level 7), the two outside cells and the center cell are completely blocked off from all adjoining cells. The two remaining cells on that level are fully open in the axial direction, each open cell representing two of the UCSP orifices. The total axial flow area of these open cells was chosen to be the same as the total flow area of the four holes in the UCSP. The x-direction width of each open cell is the same as the width (or diameter) of the individual UCSP holes, and the

separation between these open cells is the same as the separation between holes in the UCSP. The y-direction thickness of the vessel model was chosen to meet the above area and spacing constraints.

The maximum axial cross section area of the vessel model is the same as the axial flow area of the test vessel upper plenum. Reductions in flow area at other axial levels were achieved by adjusting the TRAC fractional flow area and fractional volume parameters such that the correct axial flow areas were obtained at each level. With the exception of Level 7 which was discussed above, any flow restriction on an axial level is considered to be uniformly distributed across the vessel.

The lower core water injection is simulated by vertically upward directed pipes connected to the plane separating axial Levels 3 and 4. The upper plenum water injection is modeled by a pipe connected to a single outside cell on axial Level 8, just above the UCSP. In the actual test vessel, the upper plenum water injection takes place around the entire perimeter of the UCSP, but it is judged that the single injection point used in the TRAC model is sufficient in view of the fairly uniform distribution of mixture density observed across axial Level 8 after steady state upper plenum conditions were obtained. Lower core air injection is achieved by means of a single pipe connection to the vessel on axial Level 2. This again is unlike the actual test apparatus where air is input through two injectors, one on each side of the vessel. However, the present steady state TRAC results indicate that the axial air velocities in the core are symmetrically distributed about the center cell by the time the air reaches

axial Level 4, justifying the use of a single air injection point. Test results with one air injector blocked have also verified that the use of a single injection point is adequate.

A modified form of Version 19.3 of the TRAC Code was used for the analyses. The code was modified to use air thermodynamic and transport properties in place of the steam properties normally used for the vapor phase.

2. TRAC ANALYSIS PROCEDURE

The initial TRAC run was begun with all components filled with stationary air at a pressure of 0.134 MPa. Air injection and upper plenum water injection were then begun and the model was run to a quasi-steady state condition with constant average air flow and with water froth exiting the vessel through the hot leg outlet. About twenty seconds of model time were required for the froth to reach the hot leg axial level. The model was initialized in this manner using the actual test conditions for test Y-10. In order to save computer time, most of the other tests were run as restarts from this common initial state. On these restart runs, the air and water inlet flows were reset to represent the particular test being simulated, and the code was run for about 10 seconds of model time to allow the fallback rate into the water collector (axial Level 1) to be determined. The run was terminated when the fallback rate stabilized, approximately 30 seconds from test initiation.

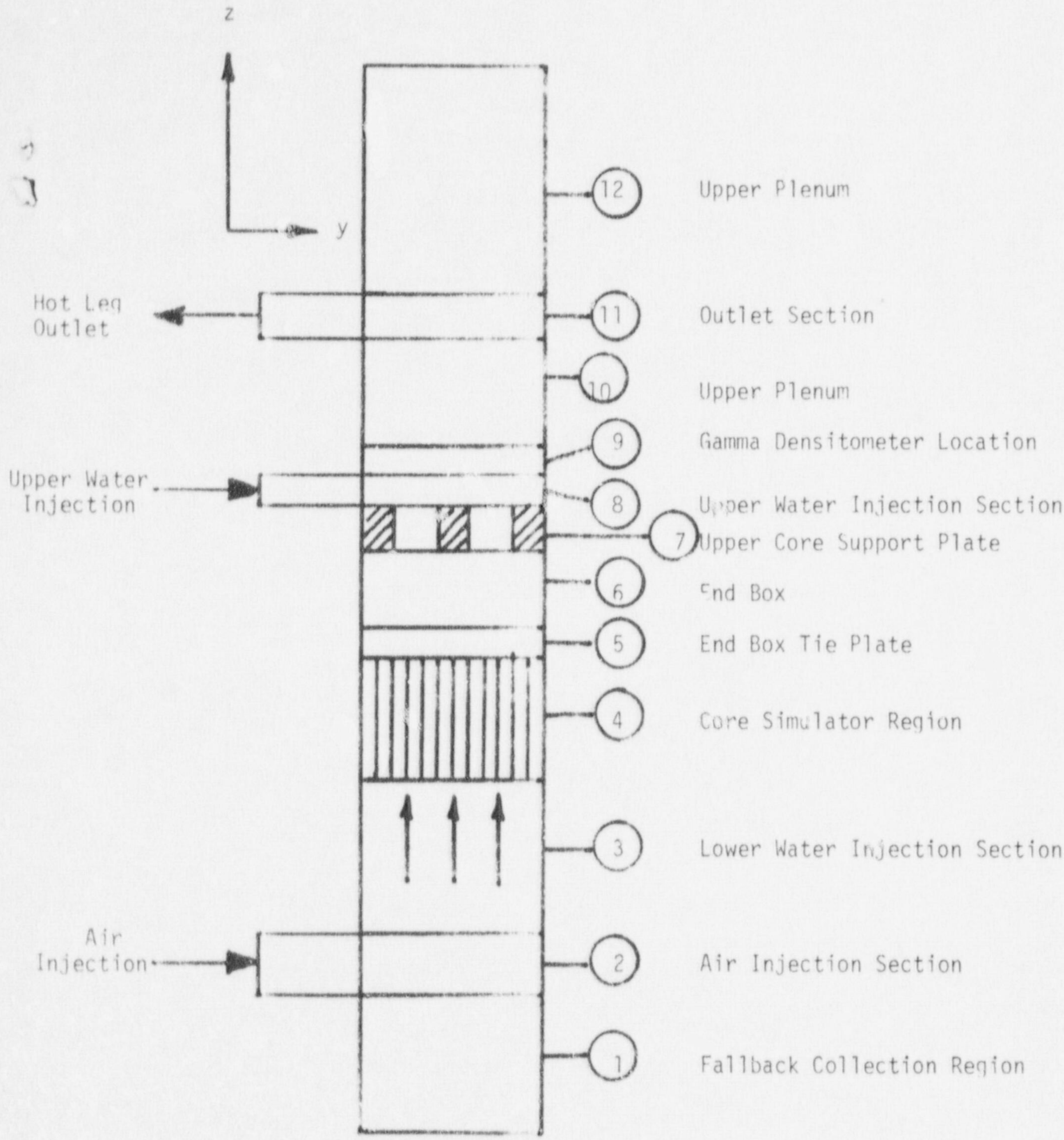

Figure D-I Air-water test vessel TRAC model components.