Westinghouse Electric Corporation
Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

AW-93-423

February 25, 1993

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: MR. R. W. BORCHARDT

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: PRESENTATION MATERIAL FROM THE FEBRUARY 25, 1993 MEETING ON THE AP600 CMT TESTS

Dear Mr. Borchardt:

The application for withholding is submitted by Westinghouse Electric Corporation ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10CFR Section 2.790, Affidavit AW-92-423 accompanies this application for withholding setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-93-423 and should be addressed to the undersigned.

Very truly yours,

N. J. Liparulo, Manager
Nuclear Safety And Regulatory Activities

/nja

cc: M. P. Siemien Office of the General Counsel, NRC
L. Barnett NRC (12H5)

0819A

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PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant specific review and approval.

In order to conform to the requirements of 10CFR 2.790 of the commission's regulation concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets and where the proprietary information has been deleted in the non-proprietary versions on the brackets remain, the information that was contained within brackets and where the proprietary information has been deleted in the non-proprietary versions only the brackets remain, the information that was contained within the brackets in the proprietary versions having been deleted. The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) contained within parentheses located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Section (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10CFR2 790(b)(1).

AW-93-423

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Hank A. Sepp, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Hank A. Sepp, Manager
Strategic Licensing Issues

Sworn to and subscribed
before me this 24 day
of February, 1993

Rose Marie Payne
Notary Public

Notarial Seal
Rose Marie Payne, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Nov. 4, 1996
Member, Pennsylvania Association of Notaries

0620A

(1) I am Manager, Strategic Licensing Issues, in the Nuclear and Advanced Technology Division, of the Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Energy Systems Business Unit.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Energy Systems Business Unit in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) Enclosed is Letter ET-NRC-93-3829, February 1993, being transmitted by Westinghouse Electric Corporation (W) letter and Application for Withholding Proprietary Information from Public Disclosure, N. J. Liparulo (W), to Mr. F. W. Borchardt, Office of NRR. The proprietary information as submitted for use by Westinghouse Electric Corporation is in response to questions concerning the AP600 plant and the associated design certification application and is expected to be applicable in other licensee submittals in response to certain NRC requirements for justification of licensing advanced nuclear power plant designs.

This information is part of that which will enable Westinghouse to:

(a) Demonstrate the design and safety of the AP600 Passive Safety Systems.

(b) Establish applicable verification testing methods.

(c) Design Advanced Nuclear Power Plants that meet NRC requirements.

(d) Establish technical and licensing approaches for the AP600 that will ultimately result in a certified design.

(e) Assist customers in obtaining NRC approval for future plants.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for advanced plant licenses.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar advanced nuclear power designs and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing analytical methods and receiving NRC approval for those methods.

Further the deponent sayeth not.

Westinghouse/NRC Meeting on AP600 Core Makeup Tank Tests

Presentation Material

February 25, 1993

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

INTRODUCTION

E. J. Piplica

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

Agenda

1.	Introduction	EJP	9:00-9:15
2.	CMT Test Philosophy		9:15-10:15
	- Data needs for analysis	LEH	
	- CMT tank design rationale	LEC	
3.	Facility Design Details	FD	10:15-11:00
	- Loop configuration/design		
4.	Instrumentation Plan	FD	11:00-12:00
	LUNCH		12:00-1:00
5.	Facility Tour	FD	1:00-2:00
6.	Test Matrix	LEC	2:00-3:00
	- Preoperational cold/hot test		
	- Test matrix tests		
7.	Westinghouse Analysis Plans		3:00-4:00
	- Plans to analyze test data	LEH	
	- Analysis results to date	JPC	
8.	Schedule	EJP	4:00-4:15
9.	Conclusions	All	4:15-4:30

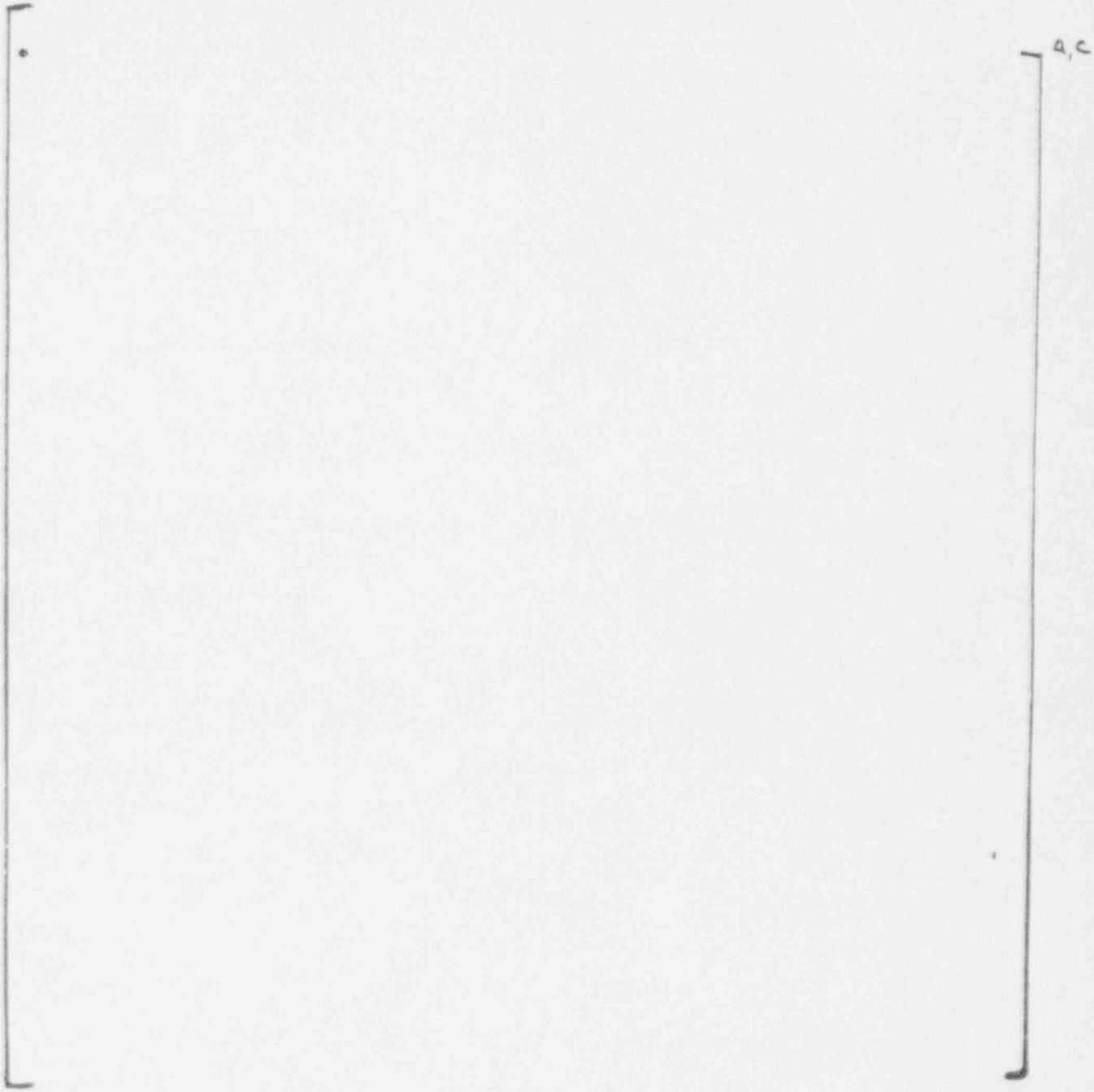
Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

CMT TEST PHILOSOPHY

Data Needs For Analysis

L. E. Hochreiter

AP600 CMT TEST



CMT Data/Phenomena To Be Simulated	WCOBRA/TRAC Model	NOTRUMP Model

a,c

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

CMT TEST PHILOSOPHY

CMT Tank Design Rationale

L. E. Conway

AP600 CORE MAKEUP TANK TEST
TEST DESIGN RATIONALE

CMT TEST TANK AND SUPPORTING EQUIPMENT ARE DESIGNED TO SIMULATE AND PERMIT OBSERVATION OF THE THERMAL HYDRAULIC PHENOMENA WHICH WILL OCCUR IN THE PLANT, INCLUDING:

- STEAM INTERACTION WITH THE CMT WATER SURFACE
- STEAM CONDENSATION ON 'COLD' CMT WALLS
- FORMATION OF A HEATED WATER SURFACE
- GRAVITY DRAINDOWN OF THE CMT
- CMT HEATUP BY NATURAL CIRCULATION
- SYSTEM DEPRESSURIZATION DURING DRAINDOWN AND FOLLOWING HEATUP
- TRANSITION FROM RECIRCULATION MODE TO DRAINDOWN MODE
- INTERMITTENT OPERATION

AP600 CORE MAKEUP TANK TEST
TEST DESIGN RATIONALE

MAJOR DESIGN FEATURES/CONSIDERATIONS

- ACTUAL PLANT ELEVATIONS/GRAVITY HEAD USED
- FULL SYSTEM PRESSURE AND TEMPERATURE
- 2 PRESSURE BALANCE LINES PROVIDED IN TEST - SIMULATE KEY LAYOUT FEATURES OF THE PZR TO CMT AND CL TO CMT BALANCE LINES
- STEAM/WATER RESERVOIR ACTS AS THE RCS - SOURCE OF STEAM/WATER TO CMT, AND ACCOMODATES CMT INJECTION
- STEAM BOILER AND STEAM ACCUMULATOR SIZED TO PROVIDE SUFFICIENT STEAM FOR SEPARATE EFFECTS TESTING:
  - WALL CONDENSATION TESTS (NO WATER)
  - DRAINDOWN AT CONSTANT PRESSURE/ TEMPERATURE

  WITH AS SPECIFIED CMT.

LAYOUT COMPARISON BETWEEN
THE AP600 CMT AND RCS, AND
THE CMT TEST TANK AND
STEAM/WATER RESERVOIR

a,c

AP600 CORE MAKEUP TANK TEST
TEST TANK DESIGN RATIONALE

- OVERALL DIMENSIONAL COMPARISON

	Test Tank	Plant CMT	Ratio
Tank Diameter			
Steam Inlet Nozzle			
Tank Cylindrical Area			
Steam Inlet Nozzle Area			
Tank Length			
Total Volume			
Surface Area			
Metal Mass			

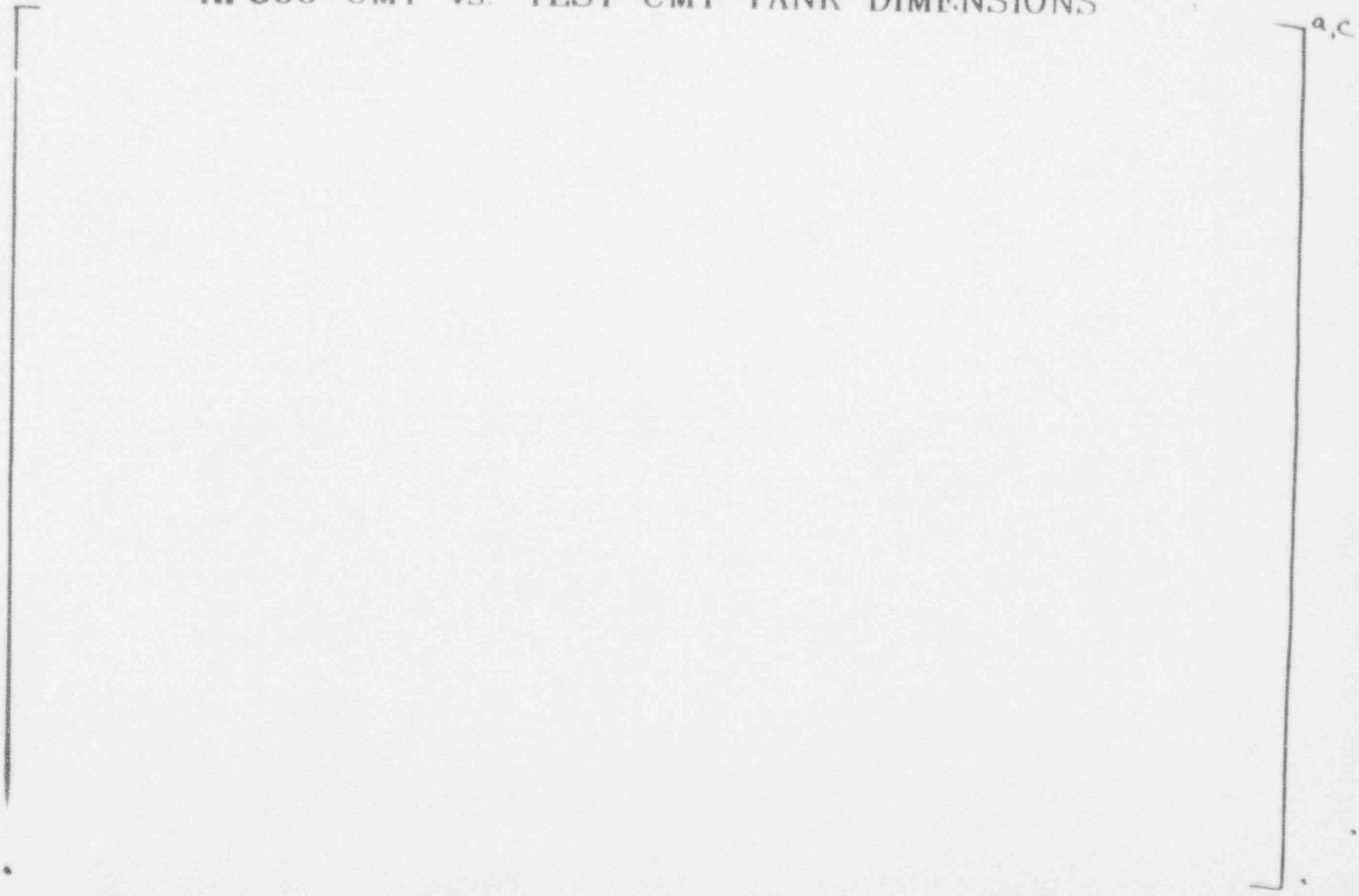
AP600 CORE MAKEUP TANK TEST
TEST TANK DESIGN RATIONALE

- STEAM JET/WATER INTERACTION
  - TEST TANK WILL BE OPERATED TO REPRODUCE STEAM JET VELOCITY, JET IMPACT AREA, AND THEREFORE JET FORCES ON WATER SURFACE
  - FOR EXAMPLE, AT THE LEVEL WHERE ADS STAGE 1 IS INITIATED (IN PLANT, CMT UPPER HEAD IS DRAINED)

	Test Tank	Actual CMT	Ratio
Tank Diameter			
Inlet Nozzle Diameter			
Tank Cylindrical Area			
Inlet Nozzle Flow Area			
Distance from top of tank to 75% water level			
No. of inlet pipe L/D's to 75% water level			
Volume			
Drain Rate			
Metal Surface Area			
Metal Mass			

07560.WPF

AP600 CMT vs. TEST CMT TANK DIMENSIONS



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February 25, 1993

FACILITY DESIGN DETAILS

Frank Delose

AP600 CORE MAKEUP TANK TEST
FACILITY DESCRIPTION

MAJOR COMPONENTS:

- CORE MAKEUP TANK (CMT)

[redacted] a,c

- STEAM/WATER RESERVOIR

[redacted] a,c

AP600 CORE MAKEUP TANK TEST
FACILITY DESCRIPTION

- STEAM ACCUMULATOR

[ ] a,c

- STEAM GENERATOR
  NATURAL GAS FIRED COIL TUBE TYPE
  2000 LBM/HR. @ 2700 PSIG (99.5% QUALITY) CAPACITY
  SKID MOUNTED WITH INTEGRAL FEEDWATER TREATMENT

PIPING/VALVES:

- STEAM LINE NO. 1

[ ] a,c

- STEAM LINE NO. 2

[ ] a,c

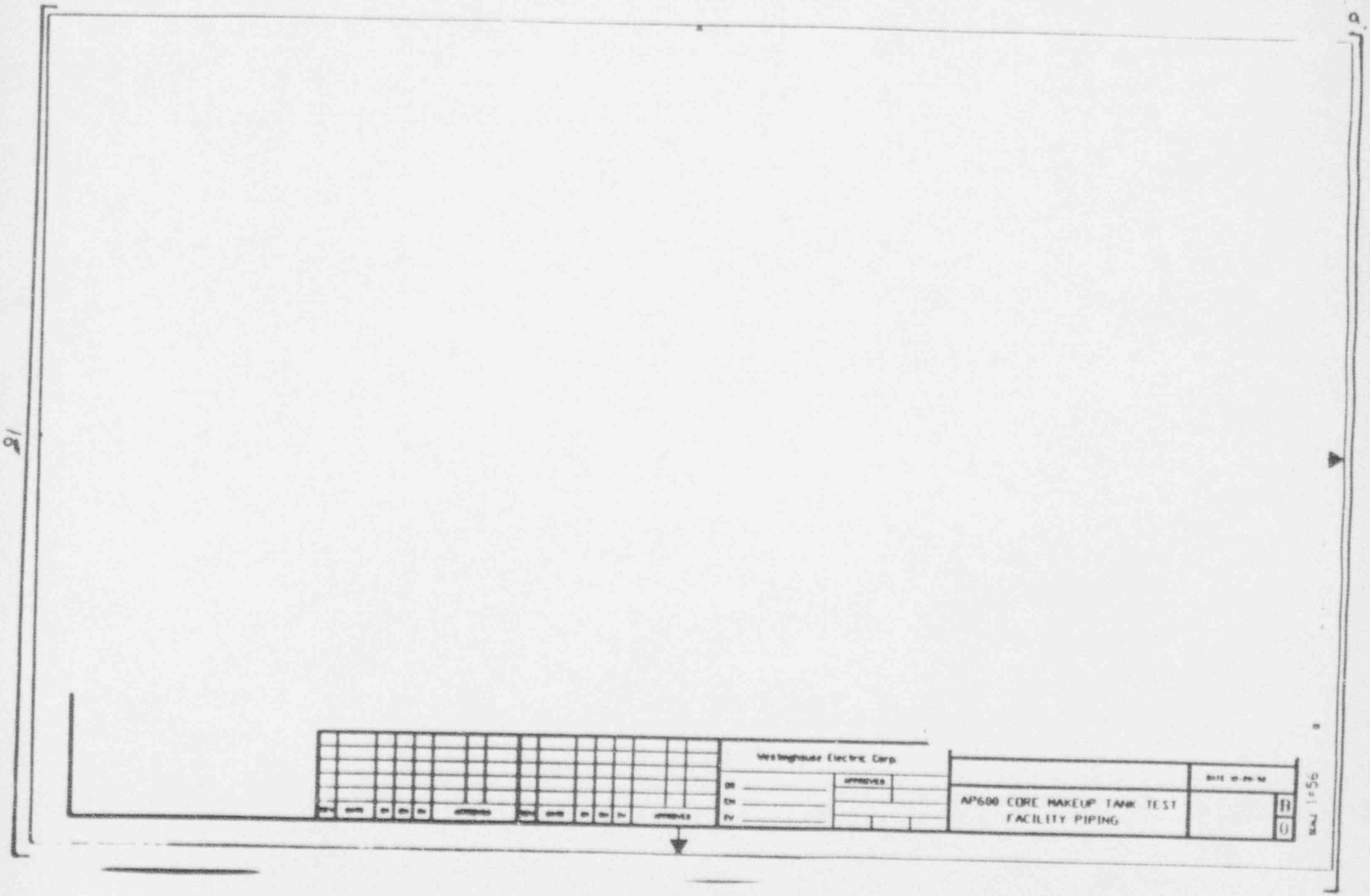
- CMT WATER DISCHARGE LINE

[ ] a,c

AP600 CORE MAKEUP TANK TEST
FACILITY DESCRIPTION

OTHER FACILITY FEATURES:

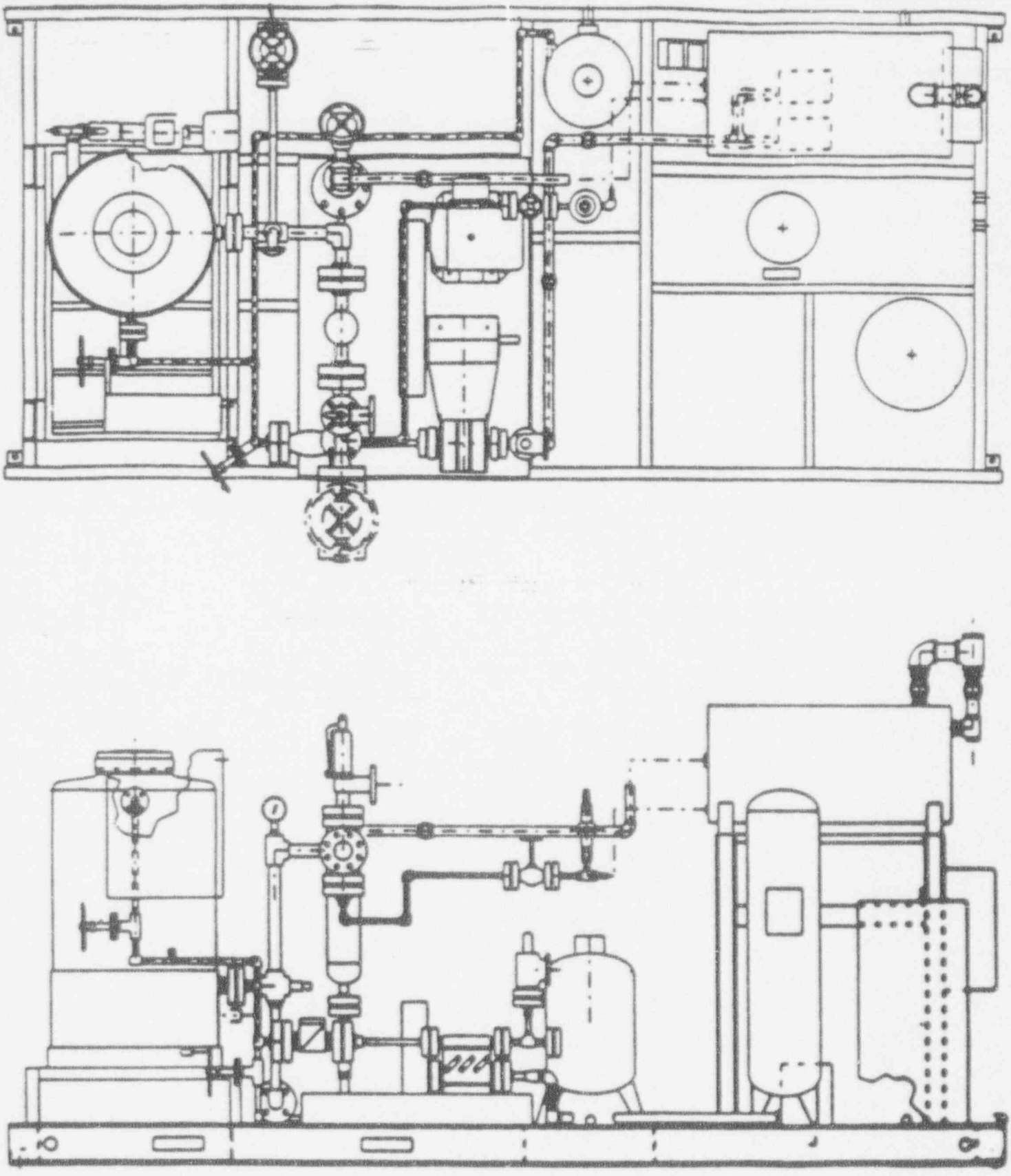
- CMT CONDENSATE DRAIN LINE WITH LEVEL CONTROL VALVE AND FLOW MEASUREMENT - USED FOR CMT WALL CONDENSATION TESTS
- STEAM/WATER RESERVOIR DRAIN WITH LEVEL CONTROL VALVE - USED FOR WATER TO STEAM TRANSITION TESTS
- STEAM ACCUMULATOR TO RESERVOIR PRESSURE CONTROL
- STEAM SPARGER PROVIDED TO HEAT RESERVOIR/WATER
- VENTS PROVIDED FOR SIMULATION OF ADS DEPRESSURIZATION
- VACUUM SYSTEM USED TO REMOVE NON-CONDENSIBLE GAS PRIOR TO TEST INITIATION


Westinghouse Electric Corp.
APPROVED
AP600 CORE MAKEUP TANK TEST FACILITY PIPING
SCALE 1=56

			INDUSTRIAL PROCESS EQUIP. CORP.
			TITLE: AP600 CMT TEST STEAM WATER RESERVOIR
			DWG. NO. C-1459 REV. 2

REVISIONS

AP600 CORE MAKEUP TANK TEST STEAM ACCUMULATOR



AP600 CORE MAKEUP TANK TEST STEAM GENERATOR

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

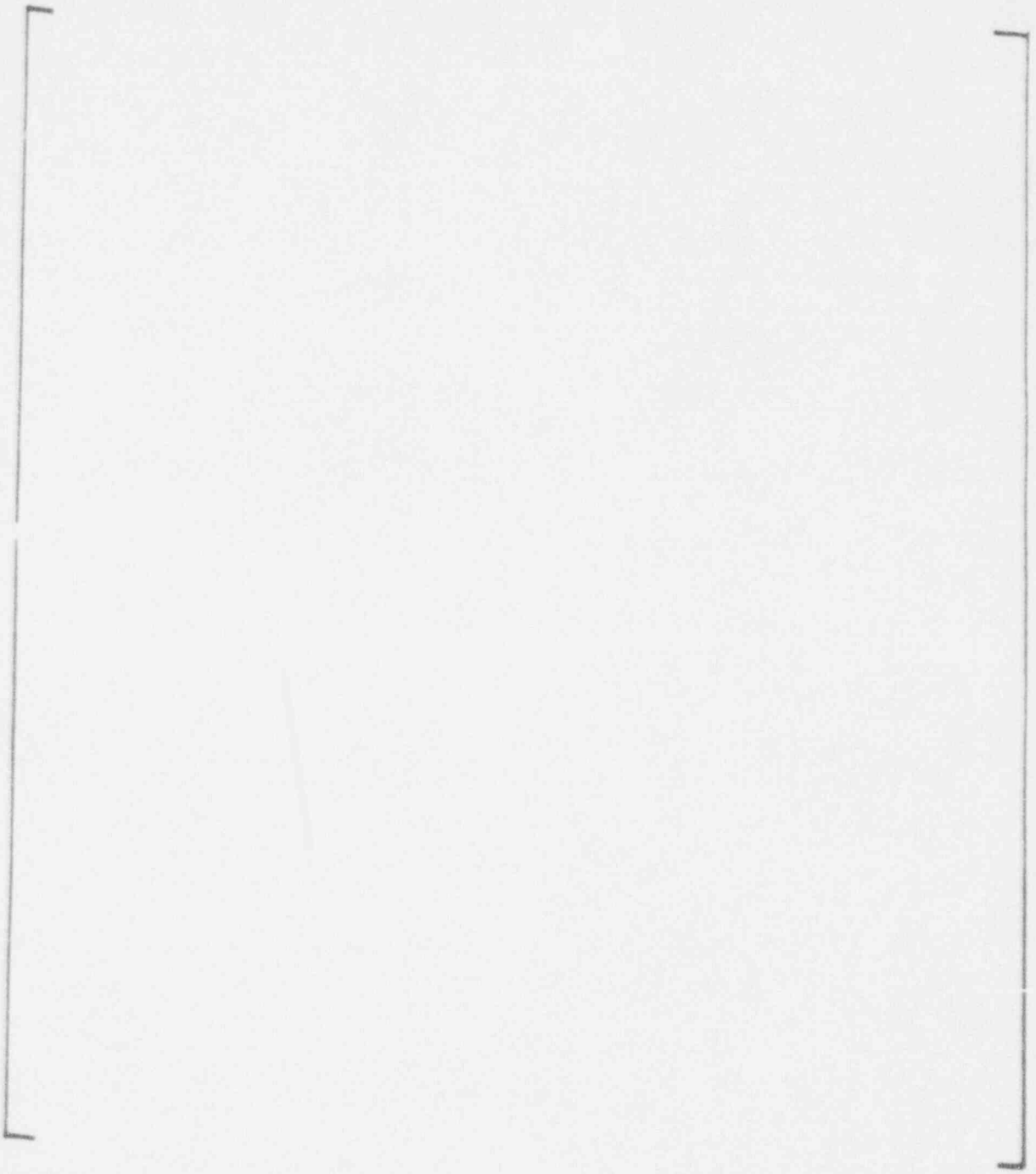
INSTRUMENTATION PLAN

Frank Delose

AP600 CORE MAKEUP TANK TEST INSTRUMENT LIST

[a,c]

AP600 CORE MAKEUP TANK TEST - CMT WALL THERMOCOUPLES



AP600 CORE MAKEUP TANK TEST - CMT INTERNAL WATER THERMOCOUPLES

T

a,c

AP600 CORE MAKEUP TANK TEST - CMT MISCELLANEOUS THERMOCOUPLES

a,c

FACILITY TOUR

Frank Delose

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

TEST MATRIX

L. E. Conway

COLD PRE-OPERATIONAL TESTS

- COMPRISED OF FILL AND DRAIN OF ALL TANKS, AND SINGLE-PHASE FLOW THROUGH ALL PIPE RUNS
- OBJECTIVES
  - CALIBRATION VERIFICATION OF LEVEL AND FLOW INSTRUMENTATION
  - ACCURATE QUANTIFICATION OF TANK VOLUMES
  - VERIFICATION OF INSTRUMENT DAS CHANNEL ASSIGNMENTS
  - ACCURATE QUANTIFICATION OF PIPING DELTA P

HOT PRE-OPERATIONAL TESTS

- PRESSURIZATION/HEATUP OF THE FACILITY, INCLUDES RAPID PRESSURIZATION OF EMPTY CMT
  - PRESSURES OF [ ]a,c AND [ ]a,c PSIA WILL BE TESTED
  - INITIAL MEASUREMENT OF STEAM CONDENSATION ON 'COLD' STEEL SURFACES
  - VERIFY STEAM SUPPLY AND CONTROL VALVE OPERABILITY
  - TC RESPONSE CHARACTERIZED
- DRAINDOWNS AT LOW FLOWRATES [ ]a,c GPM) WITH SCALED INLET NOZZLE
  - PRESSURES OF [ ]a,c AND [ ]a,c PSIA WILL BE TESTED
  - REPRODUCE AND BOUND STEAM INLET CONDITIONS THAT CAN OCCUR IN ACTUAL PLANT
  - ESTABLISH "BASE CASE" CMT INLET DIAMETER

0755D.WPF

Table 8.1: AP600 Core Makeup Tank Test Matrix

Test No.	Test Type	CMT Drain Rate	Steam Supply Pressure(s) psia	Comments
[				]a,c

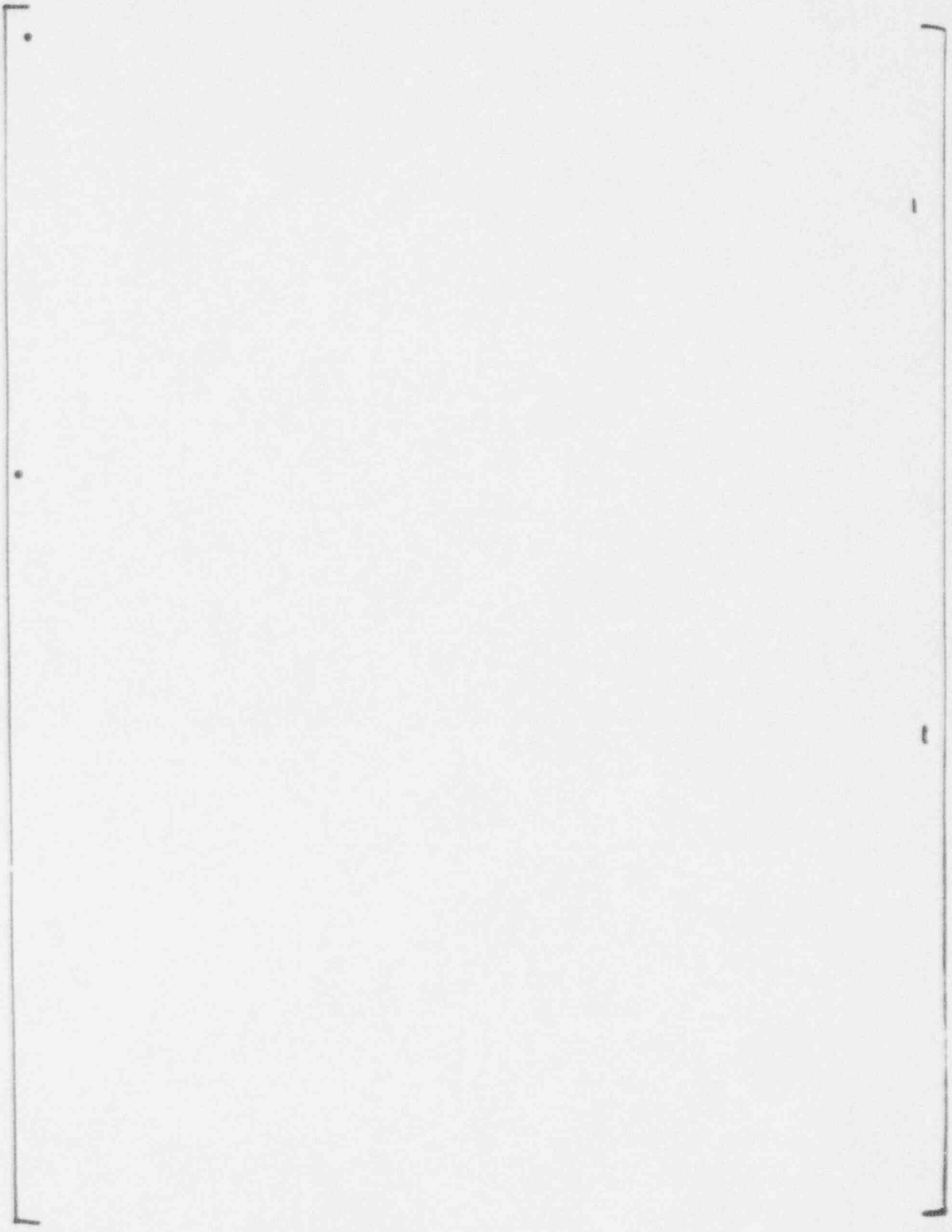
Test No.	Test Type	CMT Drain Rate	Steam Supply Pressure(s) psia	Comments
[				]

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

WESTINGHOUSE ANALYSIS PLANS

Analysis Plans for CMT Test Data

L. E. Hochreiter



[ ]9,C

1744D 1D402229 1.1

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

WESTINGHOUSE ANALYSIS PLANS

CMT Analysis Results with WCOBRA/TRAC

J. P. Cunningham

WCOBRA/TRAC Model of CMT Test Facility

Set up to help in design of test facility, e.g. find range of flows to be encountered.

Three cases are illustrated here:

1. Cold, full CMT drained to reservoir and filled with steam
   - to observe steam-water interaction and wall condensation.
2. Cold, nearly empty CMT filled with high-pressure steam (target 2250 psia)
   - to observe wall condensation with less interaction with water
3. Cold, nearly empty CMT filled with lower-pressure steam (target 100 psia)

WCOBRA/TRAC Model

CMT

- Cell heights = SSAR Model
- Standard interfacial heat transfer
- SSAR phase separation model
- SSAR wall condensation model
- [ ]^{a,c} layer wall section for each fluid cell

Steam-Water Reservoir

- [ ]^{a,c} standard Tee components
- [ ]^{a,c} cells in tank
- [ ]^{a,c} layer wall section for each fluid cell

Steam Accumulator

- Modeled as one long 1' pipe in [ ]^{a,c} cells
- [ ]^{a,c} layer wall sections

Piping

- All 1-1/2" Schedule 160
- Approximate lengths and loss factors
- [ ]^{a,c} layer wall sections

Valves

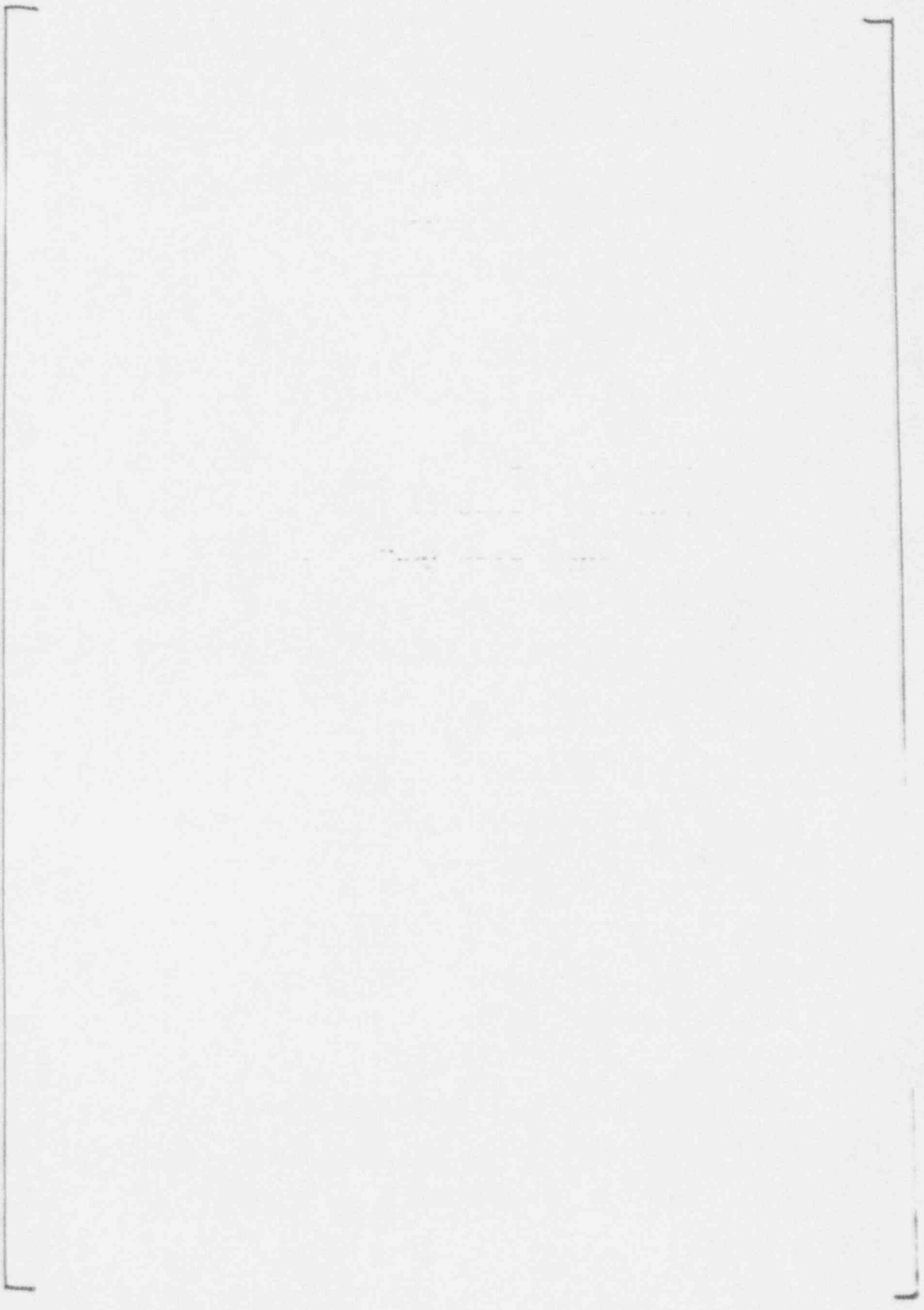
- Simple operation and pressure losses

Valve control (if required for test)

- Area proportional to error signal
- Steam supply to reservoir based on res. pressure
- CMT drain to atmosphere is based on
  - CMT collapsed liquid level

Preliminary

CMT TEST WCOBRA/TRAC MODEL



CASE 1: TEST 24

DRAIN THE FULL COLD CMT INTO THE RESERVOIR, FILLING THE CMT WITH HIGH PRESSURE STEAM FROM THE RESERVOIR AND ACCUMULATOR THROUGH STEAMLINE 1 ONLY.

INITIAL CONDITIONS:

CMT	2250 PSIA	FULL	80 F
RESERVOIR	2250 PSIA	37% FULL	653 F (SAT)
ACCUMULATOR	2500 PSIA	DRY	670 F (SAT+2 F)

TRANSIENT:

OPEN STEAMLINE 1 VALVE FULLY AT 1 TO 3 SECONDS
CMT WATER DRAINS TO RESERVOIR
STEAM FROM RESERVOIR GOES TO CMT, SOME CONDENSES

SHOWS:

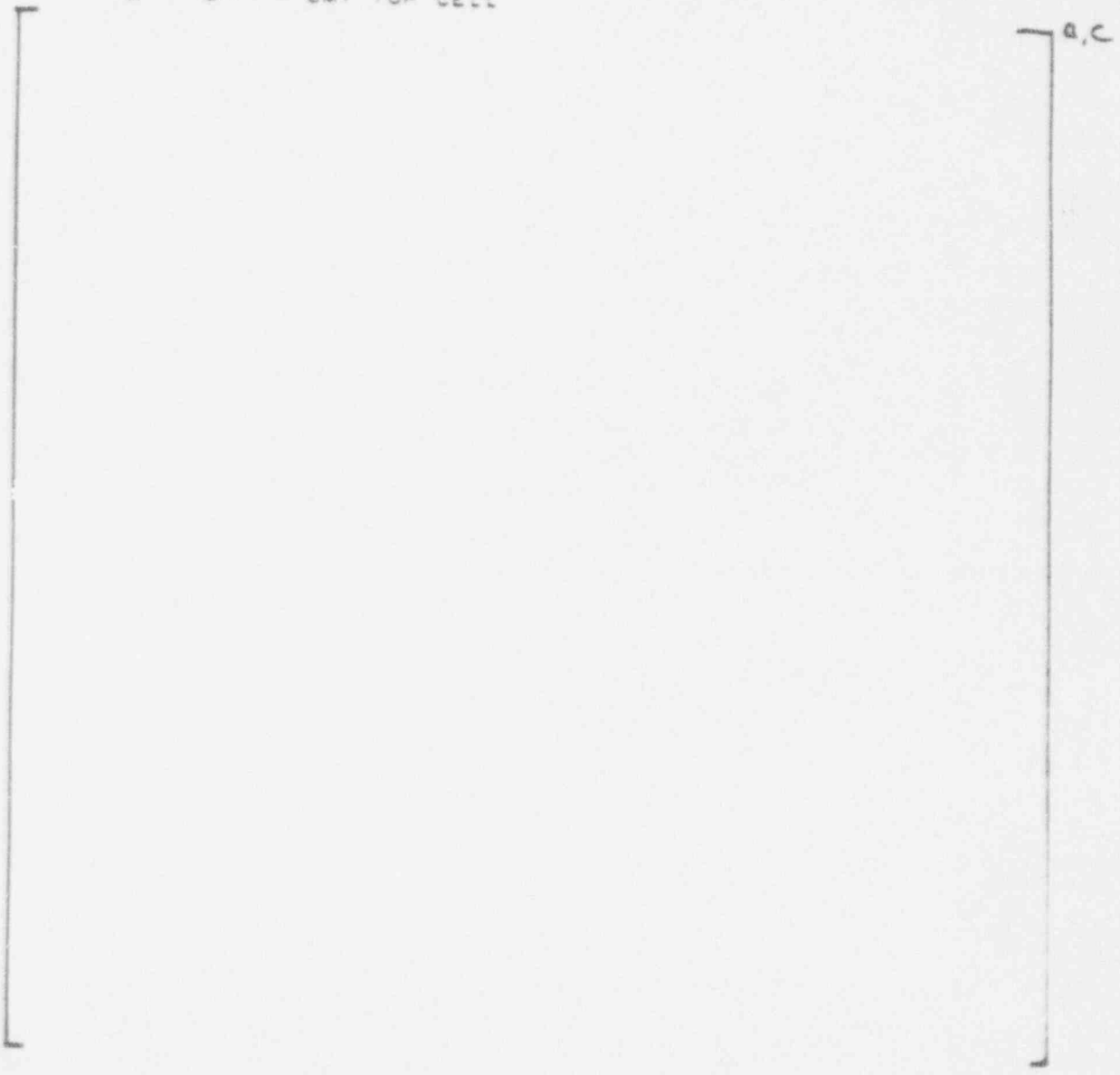
MIXTURE FLOWS AND VELOCITIES
WALL HEAT TRANSFER BEHAVIOR

--- CMT test 24, SL1 wide open ---c694
Pressure in Accumulator, Reservoir, CMT

——— 33 1 PR. CONTROL VALVE INLET

⊡--⊡10 3 TOP OF RESERVOIR

⊖--⊖1 1 CMT TOP CELL

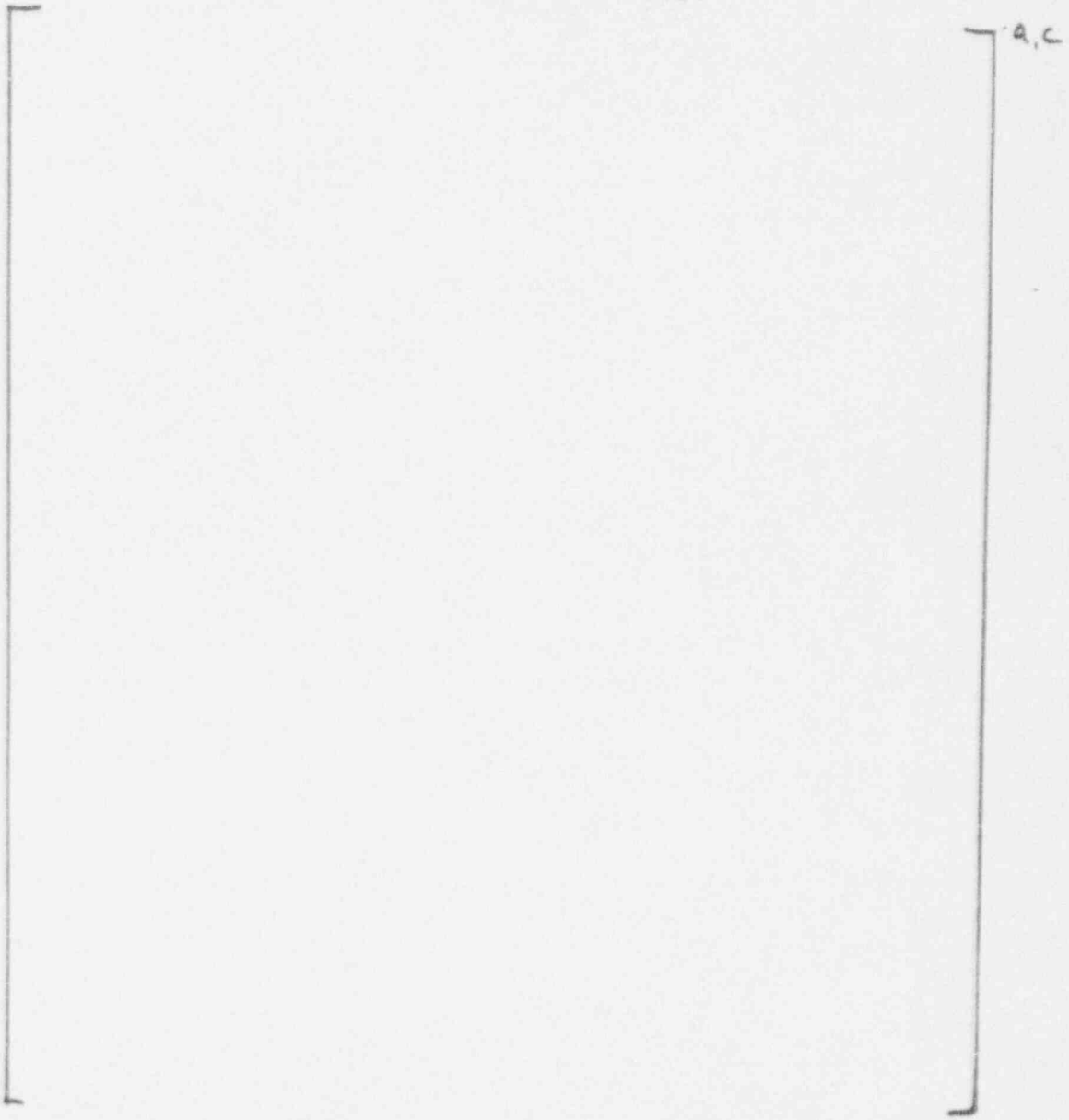


a,c

--- CMT test 24, Slice oben ---c694

——— CMT COLLAPSED WATER LEVEL.

□--□ RESERVOIR COLLAPSED WATER LEVEL.



a,c

--- CMT test 24, SL1 wide open ---c694
Vapor Fractions in Reser. & Steam Lines

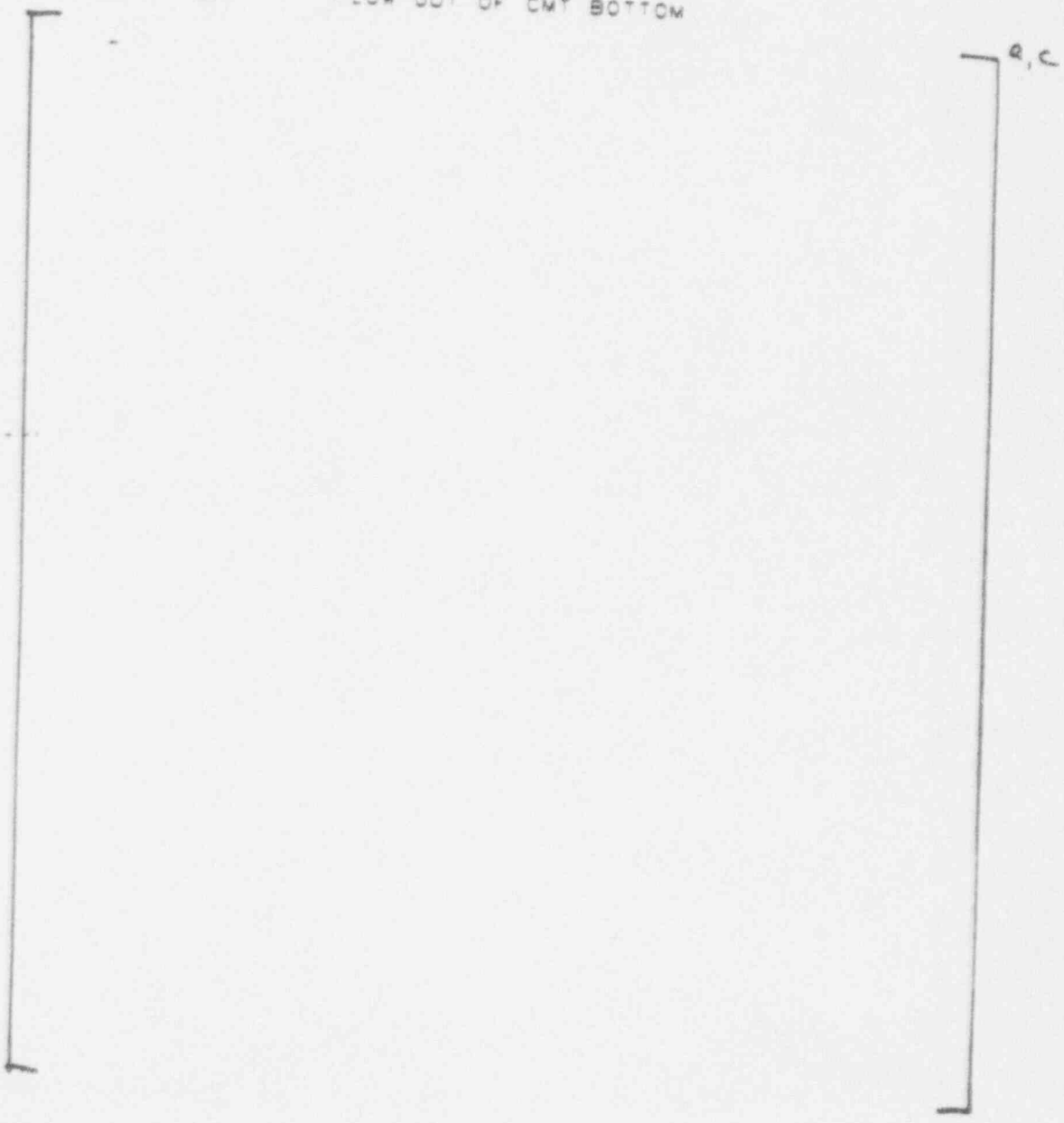
9 2 RESERVOIR BOTTOM DOME
9 3 RESERVOIR
9 4 RESERVOIR
9 5 RESERVOIR
9 6 RESERVOIR
9 7 RESERVOIR
10 1 RESERVOIR
10 2 RESERVOIR TOP DOME
10 3 RESERVOIR 10 TOP NOZZLE
12 3 STEAM LINE 1 TOP
11 5 STEAM LINE 2 MIDDLE
14 3 STEAM LINE TEE TO CMT

[a,c]

CMT test 24, SL1 wide open ---0694
CMT Mass Flow Rates

FLOW INTO CMT TOP

FLOW OUT OF CMT BOTTOM



--- CMT test 24, SL1 wide open ---c694
Mixture Velocity in 0.00976 sq ft pipes

33 1 PR. CONTROL VALVE INLET
33 3 PR. CONTROL VALVE OUTLET
12 3 STEAMLINE 1 TOP
11 5 STEAMLINE 2 MIDDLE
14 3 STEAMLINE TEE TO CMT
1 1 CMT INLET
1 13 CMT EXIT
9 1 RESERVOIR INLET (BOTTTOM)
3 1 CMT DRAIN VALVE INLET

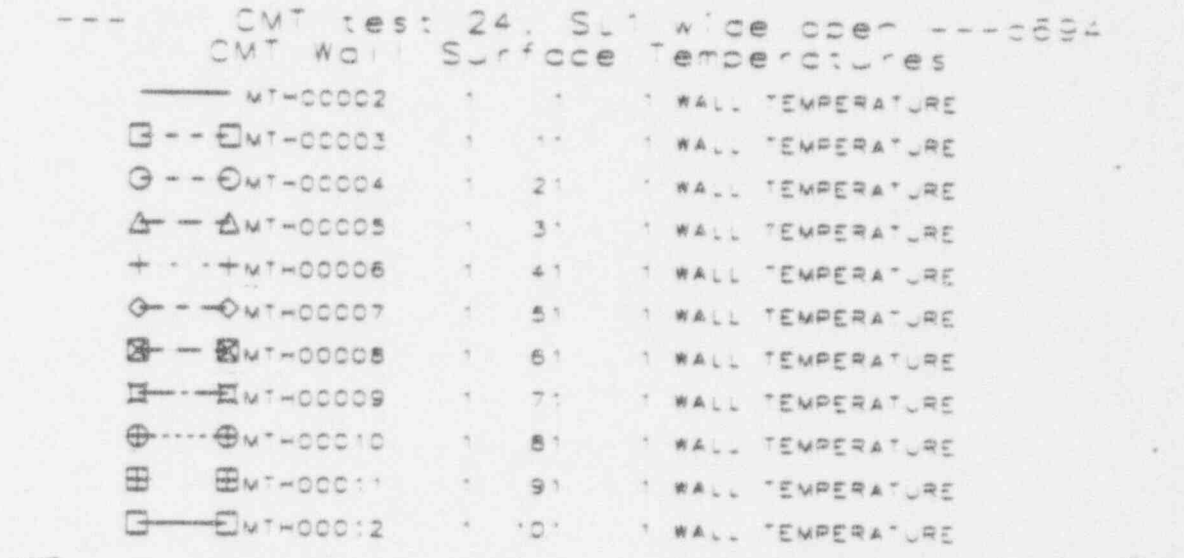
a,c

Preliminary

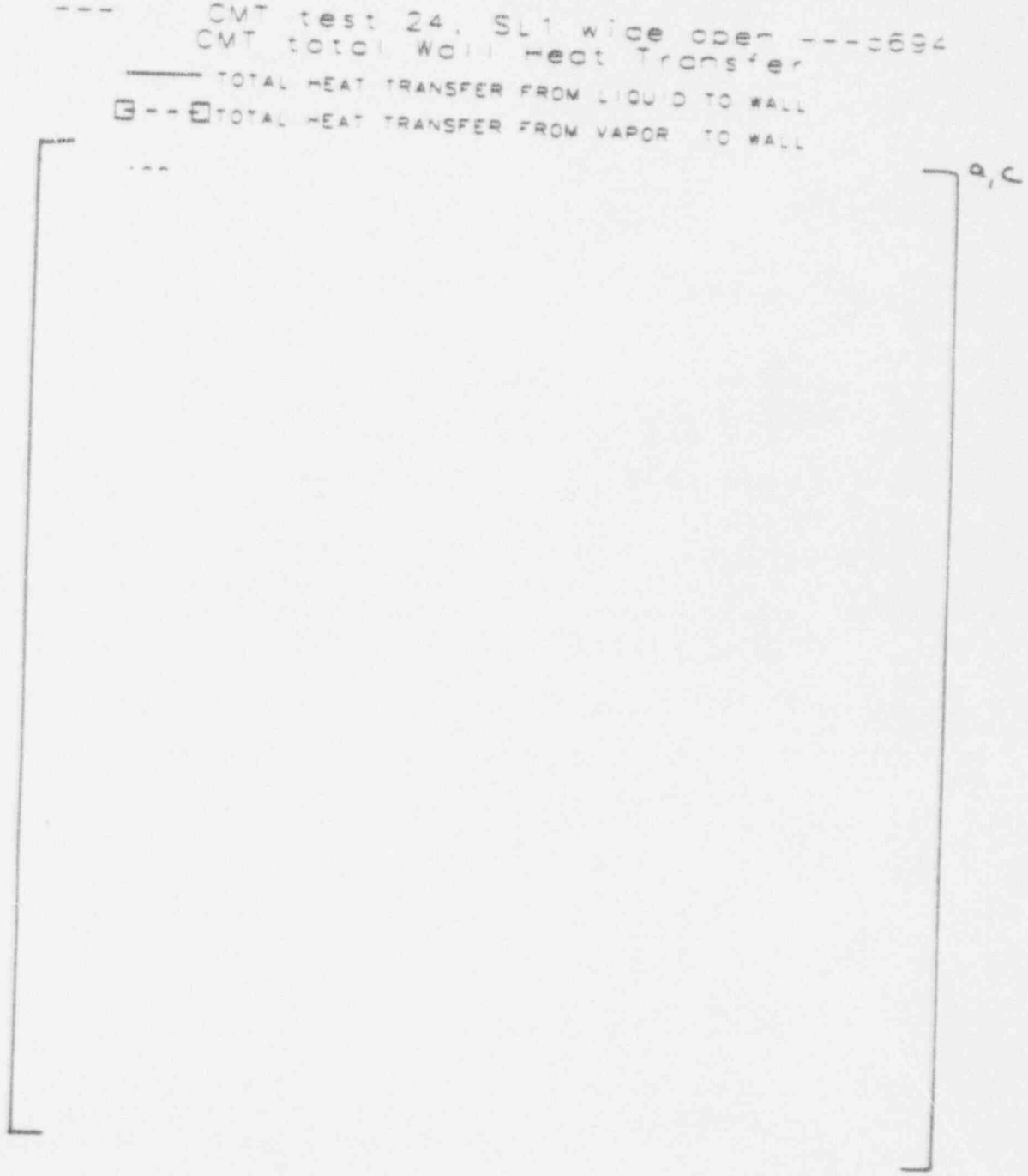
--- CMT test 24, SL1 wide open ---c694
CMT Liquid Temperatures

MTH00002	1	1	0	LIQUID TEMPERATURE
MTH00003	1	2	0	LIQUID TEMPERATURE
MTH00004	1	3	0	LIQUID TEMPERATURE
MTH00005	1	4	0	LIQUID TEMPERATURE
MTH00006	1	5	0	LIQUID TEMPERATURE
MTH00007	1	6	0	LIQUID TEMPERATURE
MTH00008	1	7	0	LIQUID TEMPERATURE
MTH00009	1	8	0	LIQUID TEMPERATURE
MTH00010	1	9	0	LIQUID TEMPERATURE
MTH00011	1	10	0	LIQUID TEMPERATURE
MTH00012	1	11	0	LIQUID TEMPERATURE
MTH00013	1	12	0	LIQUID TEMPERATURE

[ ] a,c


CMT test 24, Slice 0001 ---0694
CMT Wall Surface Temperatures
MT-00002 1 1 1 WALL TEMPERATURE
MT-00003 1 11 1 WALL TEMPERATURE
MT-00004 1 21 1 WALL TEMPERATURE
MT-00005 1 31 1 WALL TEMPERATURE
MT-00006 1 41 1 WALL TEMPERATURE
MT-00007 1 51 1 WALL TEMPERATURE
MT-00008 1 61 1 WALL TEMPERATURE
MT-00009 1 71 1 WALL TEMPERATURE
MT-00010 1 81 1 WALL TEMPERATURE
MT-00011 1 91 1 WALL TEMPERATURE
MT-00012 1 101 1 WALL TEMPERATURE

[ ] a,c


CMT test 24, Slice oder ---0694
CMT total Wall Heat Transfer
TOTAL HEAT TRANSFER FROM LIQUID TO WALL
TOTAL HEAT TRANSFER FROM VAPOR TO WALL
a,c

CASE 2: TEST 08

START WITH A COLD CMT 1/4 FULL, TRY TO HOLD THE LEVEL CONSTANT USING DRAIN TO ATMOSPHERE AND RESERVOIR WHILE STEAM IS ADMITTED FROM ACCUMULATOR.

TARGET PRESSURE IS 2250 PSIA

INITIAL CONDITIONS:

CMT	0.2 PSIA	25% FULL	80 F
RESERVOIR	2250 PSIA	37% FULL	653 F (SAT)
ACCUMULATOR	2500 PSIA	DRY	670 F (SAT+2 F)

TRANSIENT:

OPEN STEAMLINE 1 & 2 VALVES FULLY AT 1 TO 6 SEC.

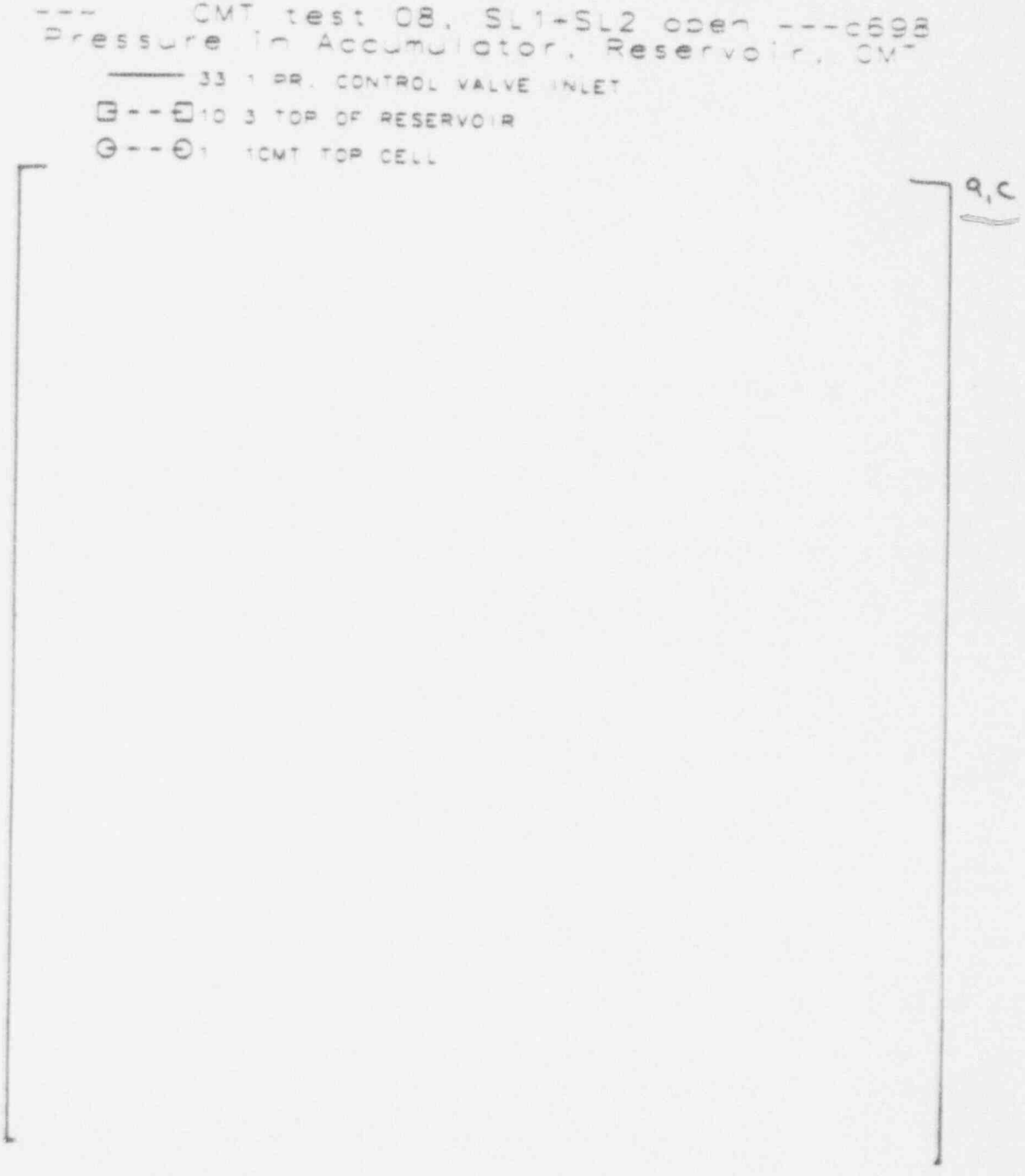
CMT WATER LEVEL HELD BY OVER-SIZE DRAIN VALVE UNTIL VALVE IS SHUT ON HIGH TEMPERATURE AT 32 SEC, THEN LEVEL RISES.

CMT PRESSURE IS HIGH ENOUGH TO ALLOW DRAINING TO RESERVOIR SHORTLY AFTER ATMOSPHERIC DRAIN VALVE CLOSES.

AS CMT WALL HEATS UP, CONDENSATION RATE DECREASES AND CMT LEVEL GOES DOWN.

ACCUMULATOR VOLUME IS NOT SUFFICIENT TO HOLD PRESSURE ABOVE 1800 PSIA

Preliminary



9,C

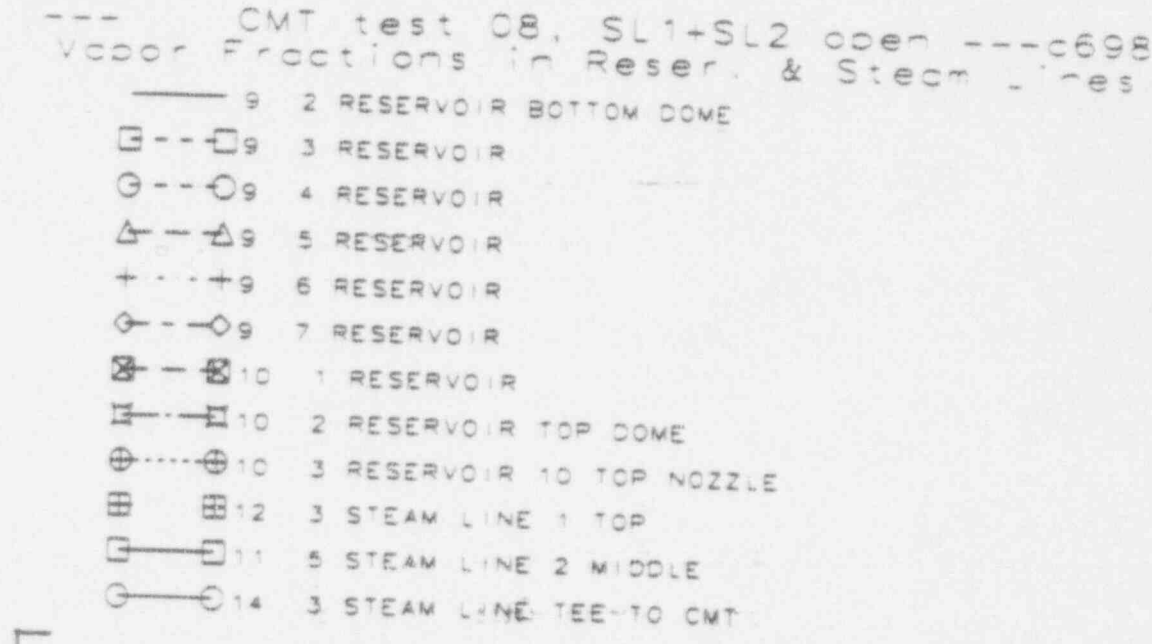
--- CMT test 08, SL1+SL2 open ---c698

——— CMT COLLAPSED WATER LEVEL

□--□ RESERVOIR COLLAPSED WATER LEVEL

[ ]

9,C

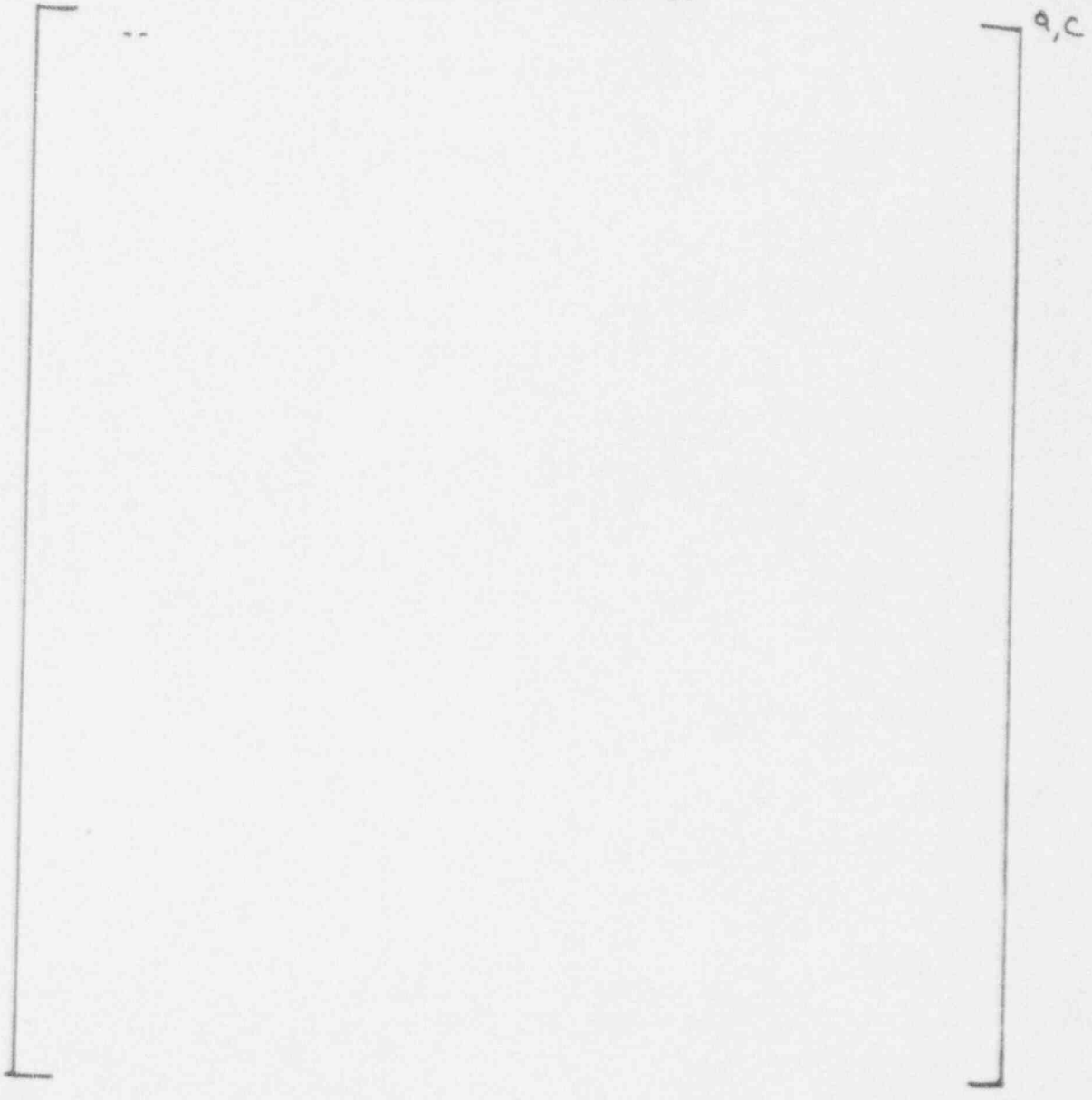

--- CMT test 08, SL1+SL2 open ---c698
Vapor Fractions in Reser. & Steam Lines
9 2 RESERVOIR BOTTOM DOME
9 3 RESERVOIR
9 4 RESERVOIR
9 5 RESERVOIR
9 6 RESERVOIR
9 7 RESERVOIR
10 1 RESERVOIR
10 2 RESERVOIR TOP DOME
10 3 RESERVOIR 10 TOP NOZZLE
12 3 STEAM LINE 1 TOP
11 5 STEAM LINE 2 MIDDLE
14 3 STEAM LINE TEE TO CMT

a.c

--- CMT test OB, SL1+SL2 oper ---c698
CMT Mass Flow Rates

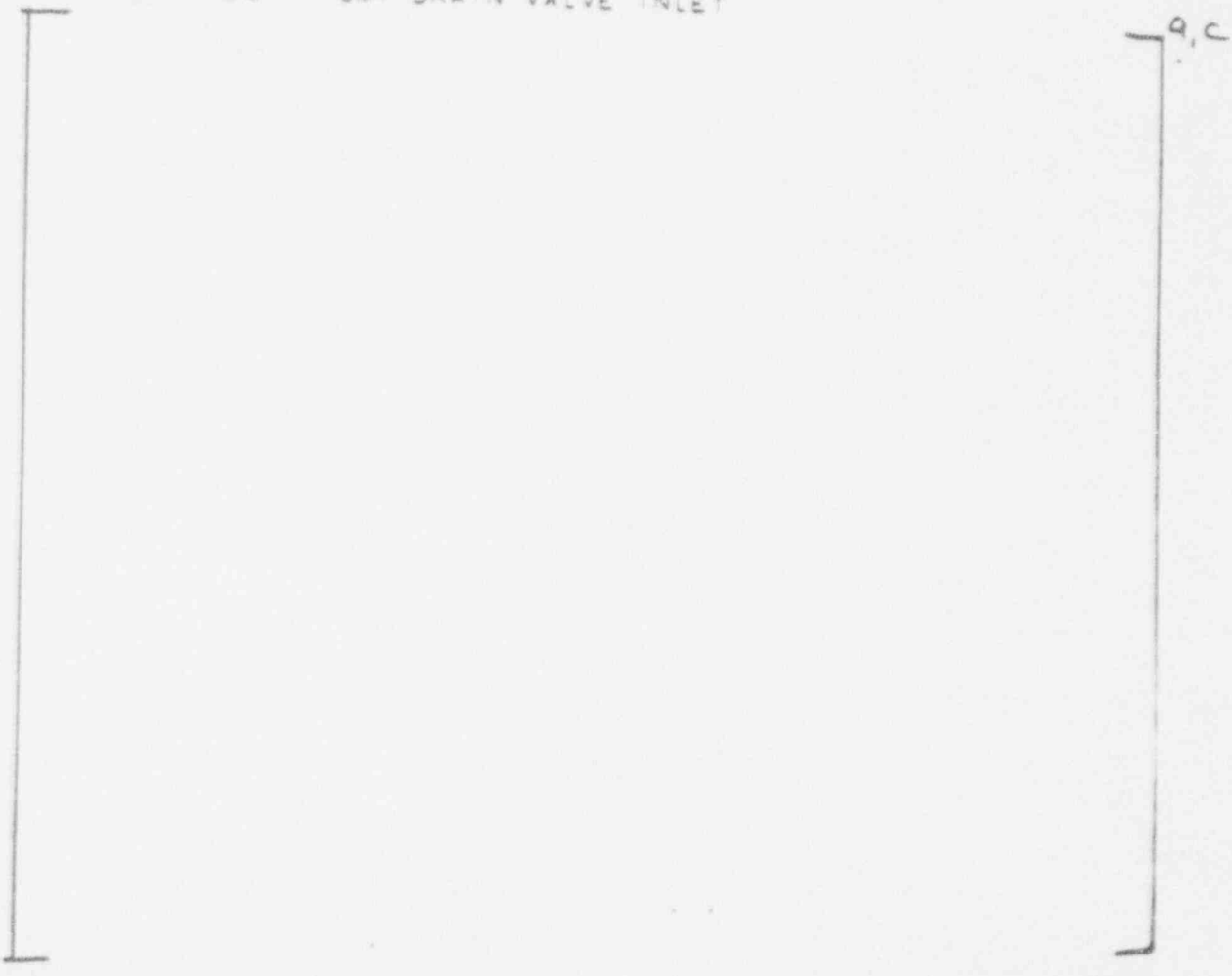
——— : FLOW INTO CMT TOP

⊡--⊡ : FLOW OUT OF CMT BOTTOM



--- CMT test 08, SL1+SL2 open ---c698
Mixture Velocity in 0.00976 sq ft Pipes

———	33	1 PR. CONTROL VALVE INLET
-□-	33	3 PR. CONTROL VALVE OUTLET
-○-	12	3 STEAMLINE 1 TOP
-△-	11	5 STEAMLINE 2 MIDDLE
-+-	14	3 STEAMLINE TEE TO CMT
-◇-	1	1 CMT INLET
-⊠-	1	3 CMT EXIT
-⌑-	9	1 RESERVOIR INLET (BOTTTOM)
-⊕-	3	1 CMT DRAIN VALVE INLET



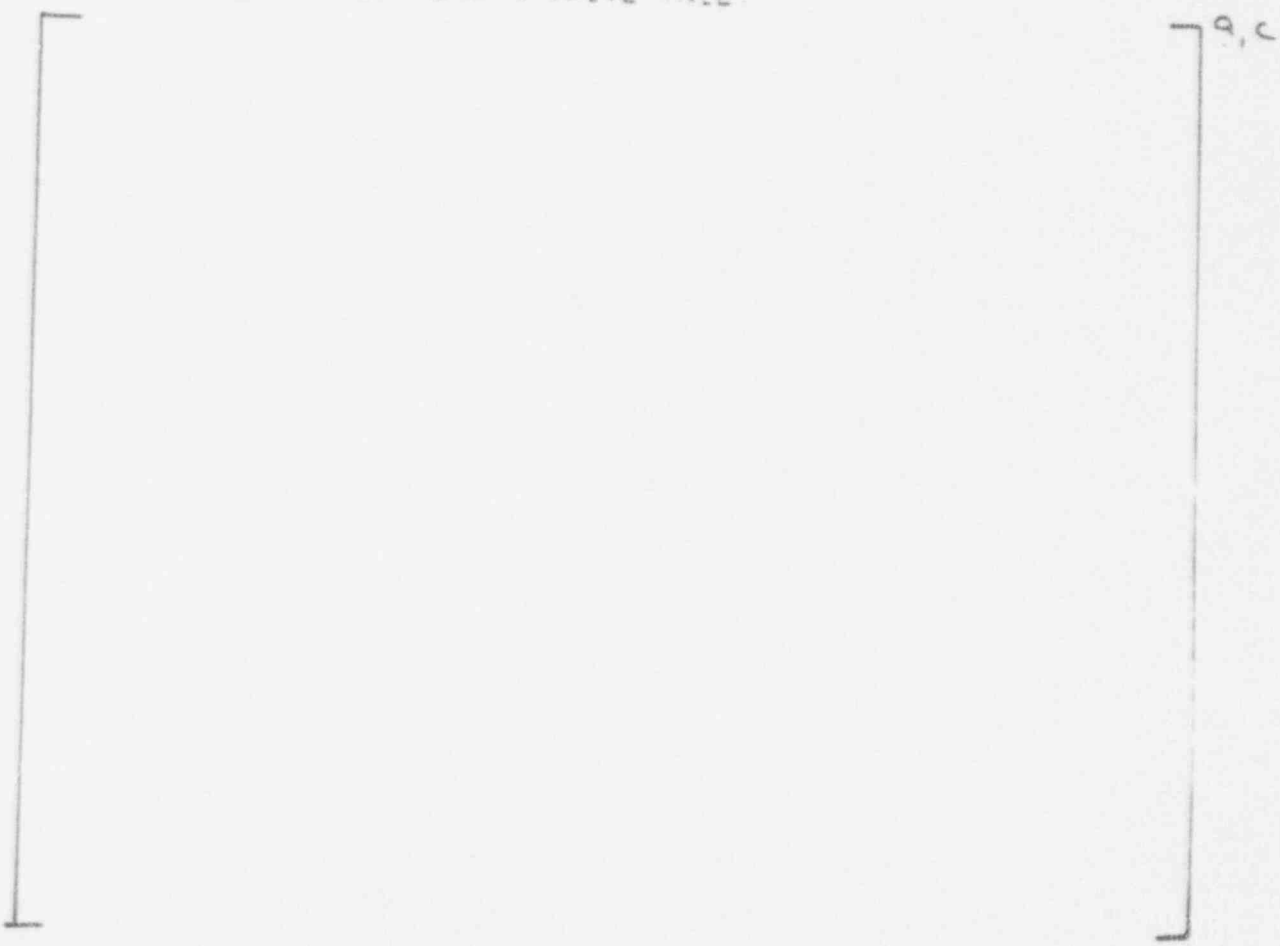
--- CMT test 08, SL1+SL2 open ---c698
Mixture Velocity in 0.00976 sq ft Pipes

———	33	1 PR. CONTROL VALVE INLET
-□--□-	33	3 PR. CONTROL VALVE OUTLET
-○--○-	12	3 STEAMLINE 1 TOP
-△—△-	11	5 STEAMLINE 2 MIDDLE
-+···+-	14	3 STEAMLINE TEE TO CMT
-◇--◇-	1	1 CMT INLET
-⊠—⊠-	1	13 CMT EXIT
-⊏—⊏-	9	1 RESERVOIR INLET (BOTTTOM)
-⊕····⊕-	3	1 CMT DRAIN VALVE INLET

[ ] a,c

CMT test 08, SL1+SL2 open ---c698
Mixture Velocity in 0.00976 sq ft Pipes

33	1	PR. CONTROL VALVE INLET
33	3	PR. CONTROL VALVE OUTLET
12	3	STEAMLINE 1 TOP
11	5	STEAMLINE 2 MIDDLE
14	3	STEAMLINE TEE TO CMT
1	1	CMT INLET
1	13	CMT EXIT
9	1	RESERVOIR INLET (BOTTTOM)
3	1	CMT DRAIN VALVE INLET



9, c

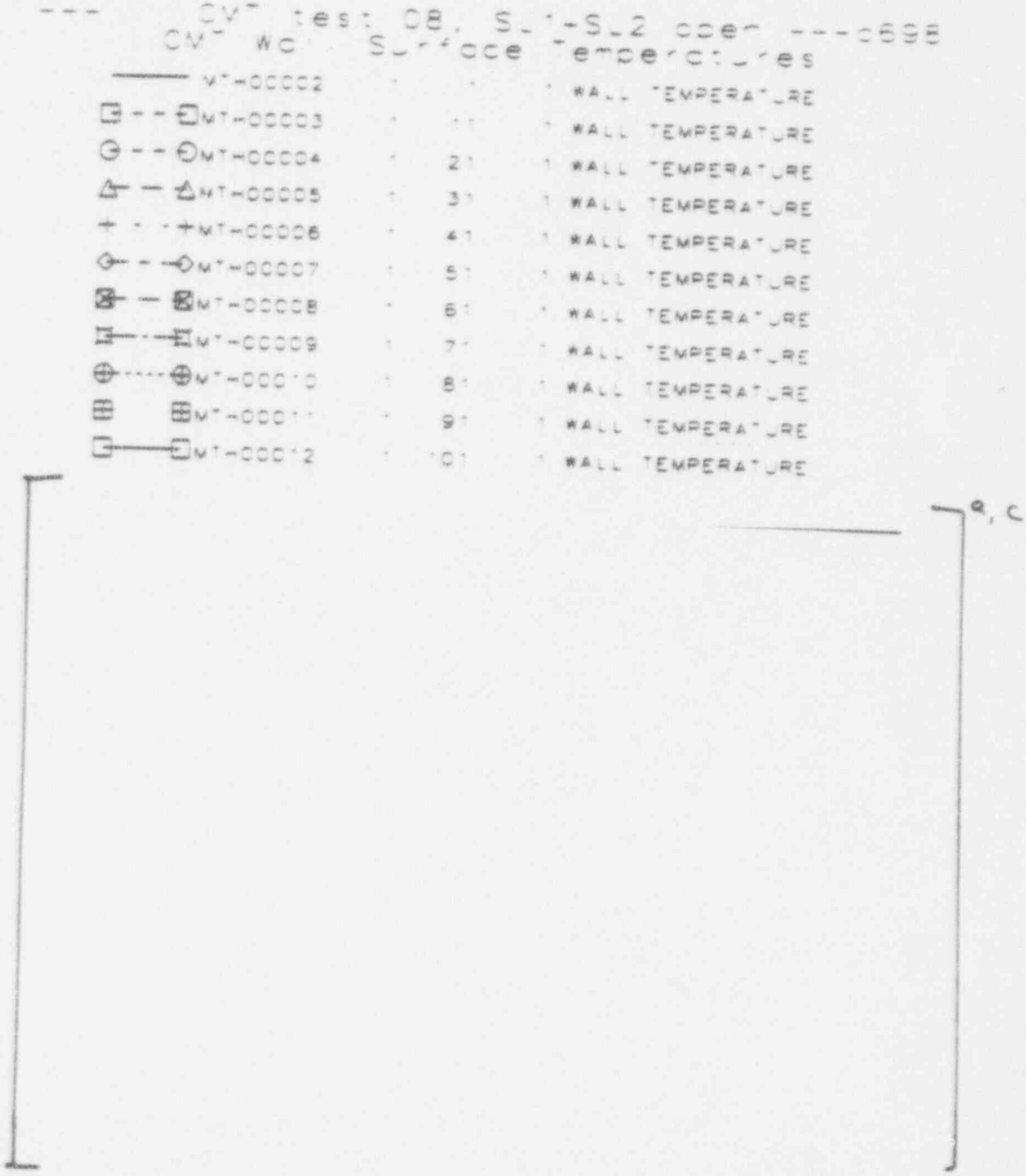
CMT test 08, SL1+SL2 oder ---c698
CMT Liquid Temperatures

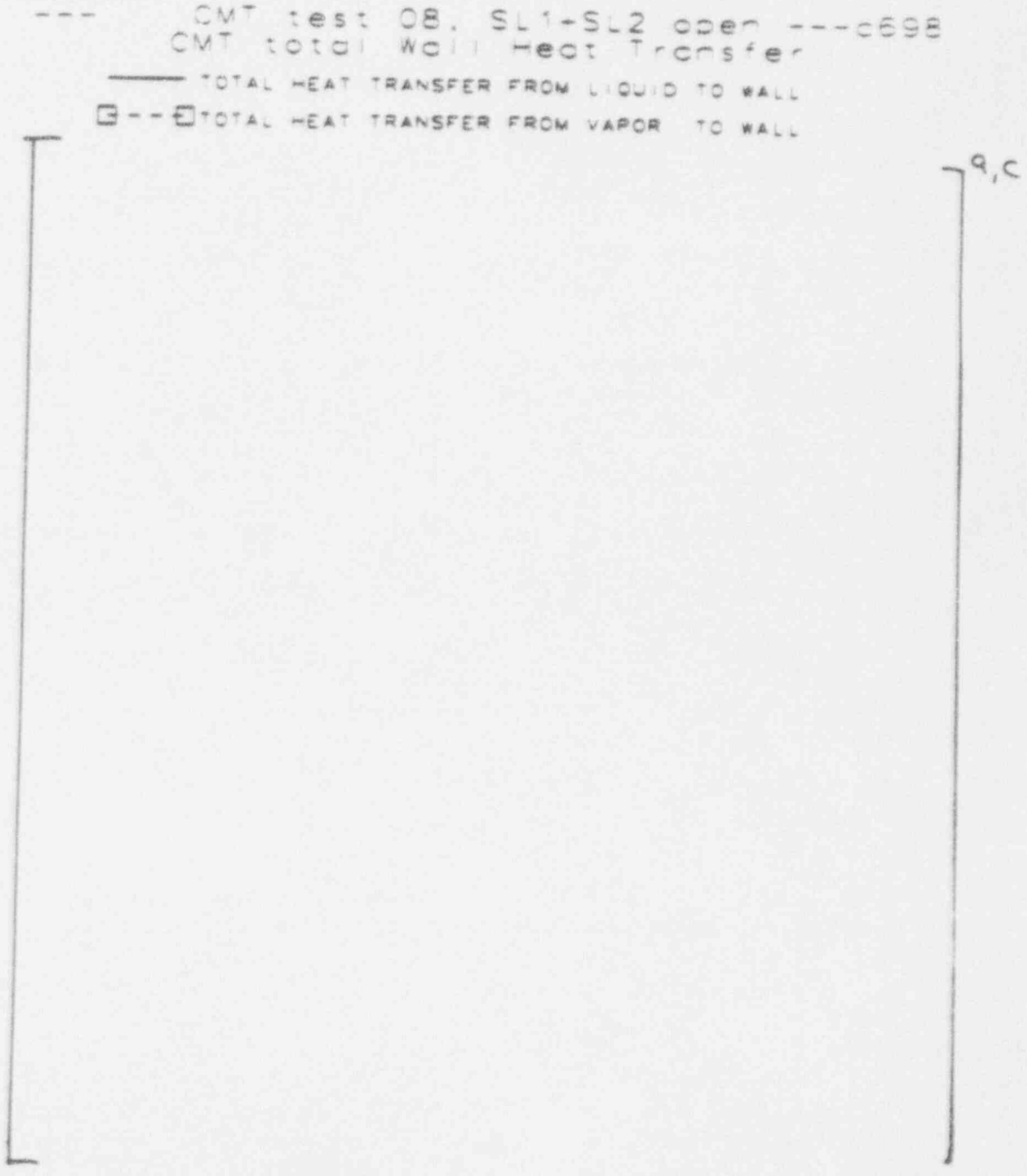
MTH00002	1	1	0	LIQUID TEMPERATURE
MTH00003	1	2	0	LIQUID TEMPERATURE
MTH00004	1	3	0	LIQUID TEMPERATURE
MTH00005	1	4	0	LIQUID TEMPERATURE
MTH00006	1	5	0	LIQUID TEMPERATURE
MTH00007	1	6	0	LIQUID TEMPERATURE
MTH00008	1	7	0	LIQUID TEMPERATURE
MTH00009	1	8	0	LIQUID TEMPERATURE
MTH00010	1	9	0	LIQUID TEMPERATURE
MTH00011	1	10	0	LIQUID TEMPERATURE
MTH00012	1	11	0	LIQUID TEMPERATURE
MTH00013	1	12	0	LIQUID TEMPERATURE

[ ]

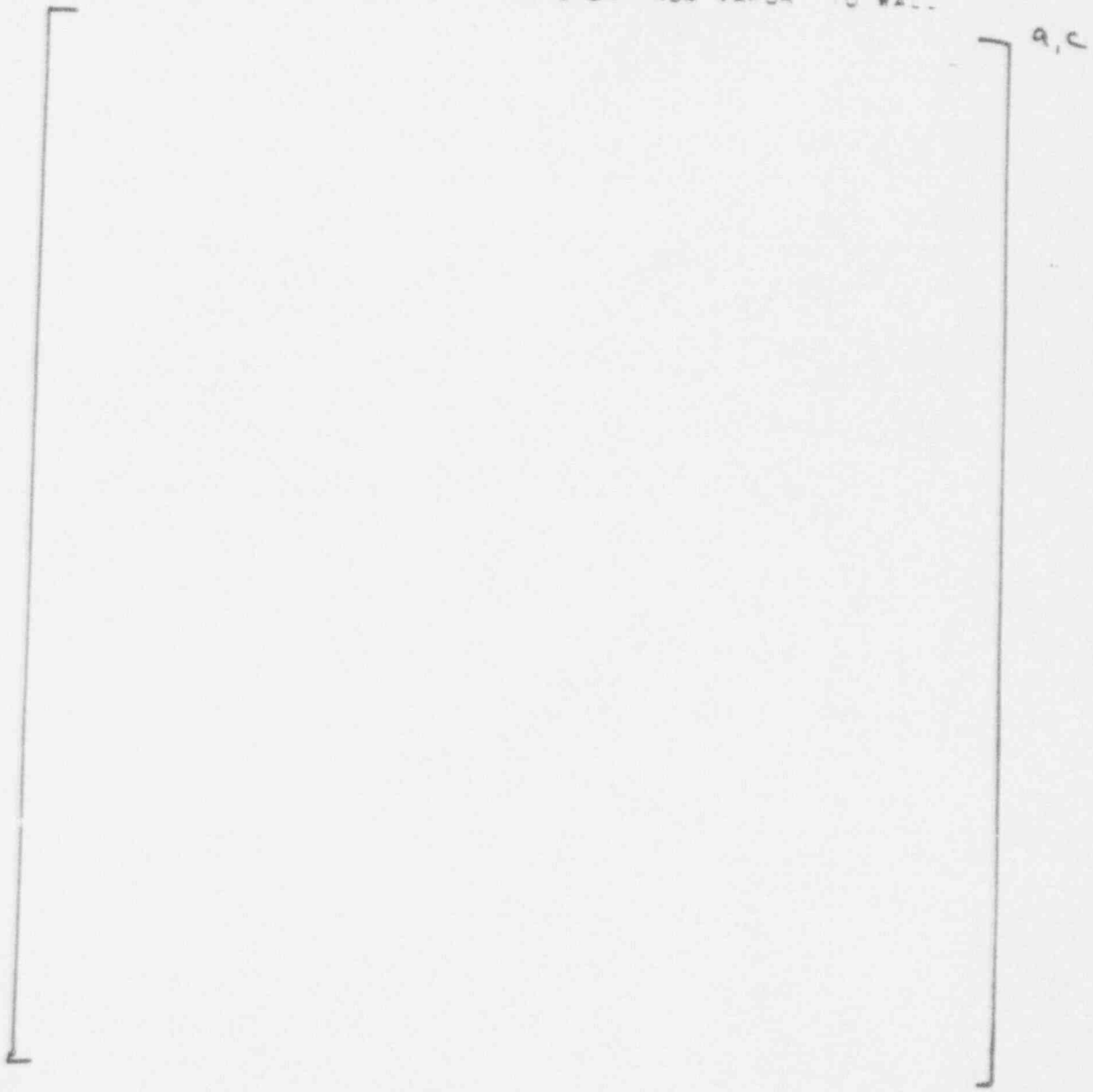
[ ] q.c

Preliminary




--- CMT test 08, SL1-SL2 open ---c698
CMT total Wall Heat Transfer
TOTAL HEAT TRANSFER FROM LIQUID TO WALL
TOTAL HEAT TRANSFER FROM VAPOR TO WALL
9,C

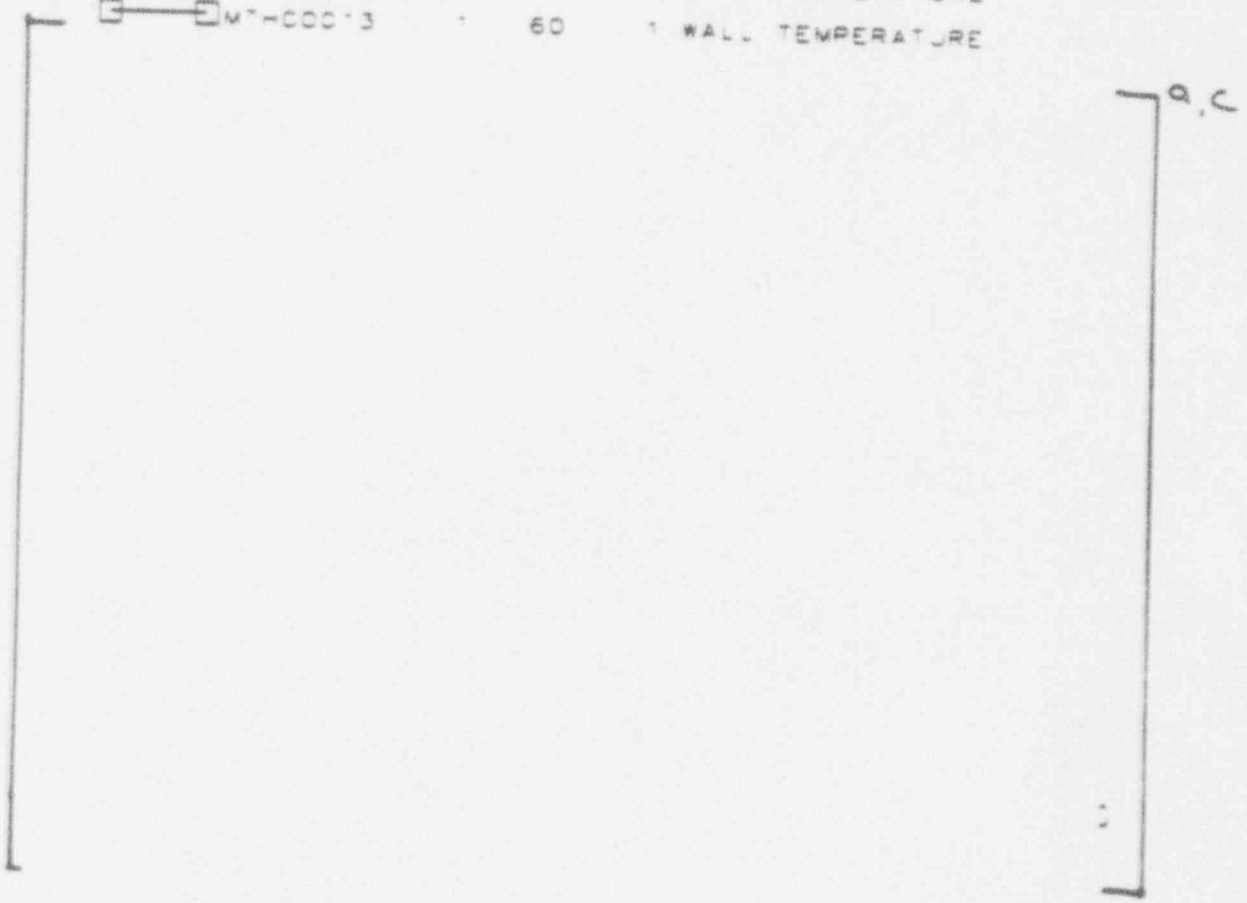
--- CMT test 08, SL1+SL2 oder ---c698
CMT Center Cell Wall H.T. Rates
——— CMT cell 6 HEAT TRANSFER FROM LIQUID TO WALL
⊡--⊡ CMT cell 6 HEAT TRANSFER FROM VAPOR TO WALL



9,C

CMT test 08, SL1+SL2 oper ---c698
CMT Cell 6 Liquid, Wall Temp's

MT-00002	1	6	0 LIQUID TEMPERATURE
MT-00004	1	51	1 WALL TEMPERATURE
MT-00005	1	52	1 WALL TEMPERATURE
MT-00006	1	53	1 WALL TEMPERATURE
MT-00007	1	54	1 WALL TEMPERATURE
MT-00008	1	55	1 WALL TEMPERATURE
MT-00009	1	56	1 WALL TEMPERATURE
MT-00010	1	57	1 WALL TEMPERATURE
MT-00011	1	58	1 WALL TEMPERATURE
MT-00012	1	59	1 WALL TEMPERATURE
MT-00013	1	60	1 WALL TEMPERATURE



CASE 3: TEST 06

START WITH A COLD CMT 1/4 FULL, TRY TO HOLD THE LEVEL CONSTANT USING DRAIN TO ATMOSPHERE AND RESERVOIR WHILE STEAM IS ADMITTED FROM ACCUMULATOR.

TARGET PRESSURE IS 100 PSIA

INITIAL CONDITIONS:

CMT	0.2 PSIA	25% FULL	80 F
RESERVOIR	100 PSIA	37% FULL	326 F (SAT)
ACCUMULATOR	1000 PSIA	DRY	543 F (SAT+1 F)

TRANSIENT:

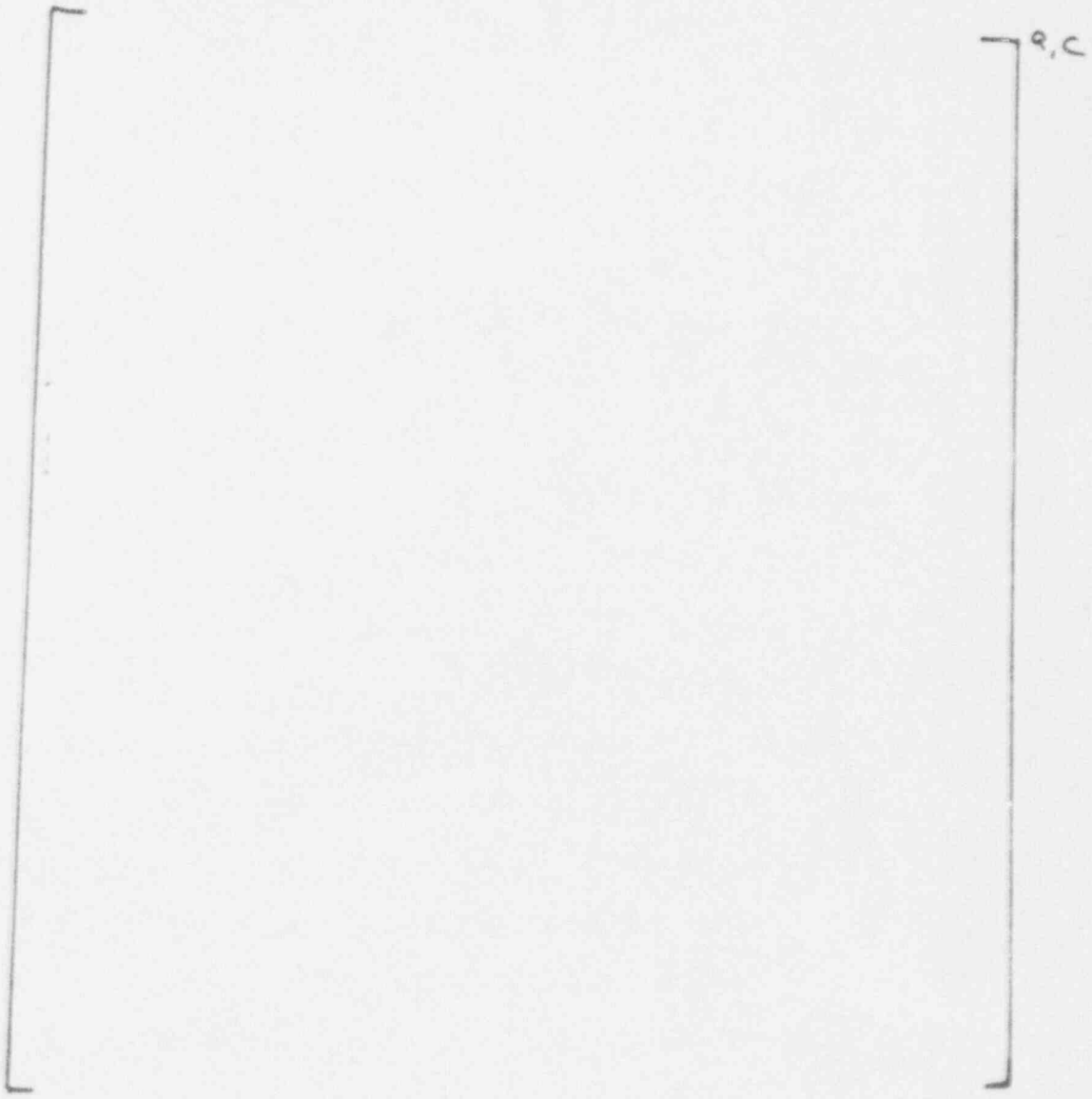
OPEN STEAMLINE 1 & 2 VALVES FULLY AT 1 TO 6 SEC.
SIMPLE PRESSURE CONTROL HOLDS RESERVOIR PRESSURE CONSTANT, BUT TAKES A WHILE TO GET CMT UP TO PRESSURE.
CMT WATER LEVEL HELD BY OVER-SIZE DRAIN VALVE UNTIL DRAINAGE TO RESERVOIR STARTS.
AT 80 SECONDS, CMT PRESSURE IS HIGH ENOUGH TO DRAIN TO THE RESERVOIR, MORE THAN MATCHING THE CONDENSATION RATE.
AS CMT WALL HEATS UP, CONDENSATION RATE DECREASES AND CMT EMPTIES.

--- CMT test 06, SL1+SL2 open ---c700
Pressure in Accumulator, Reservoir, CMT

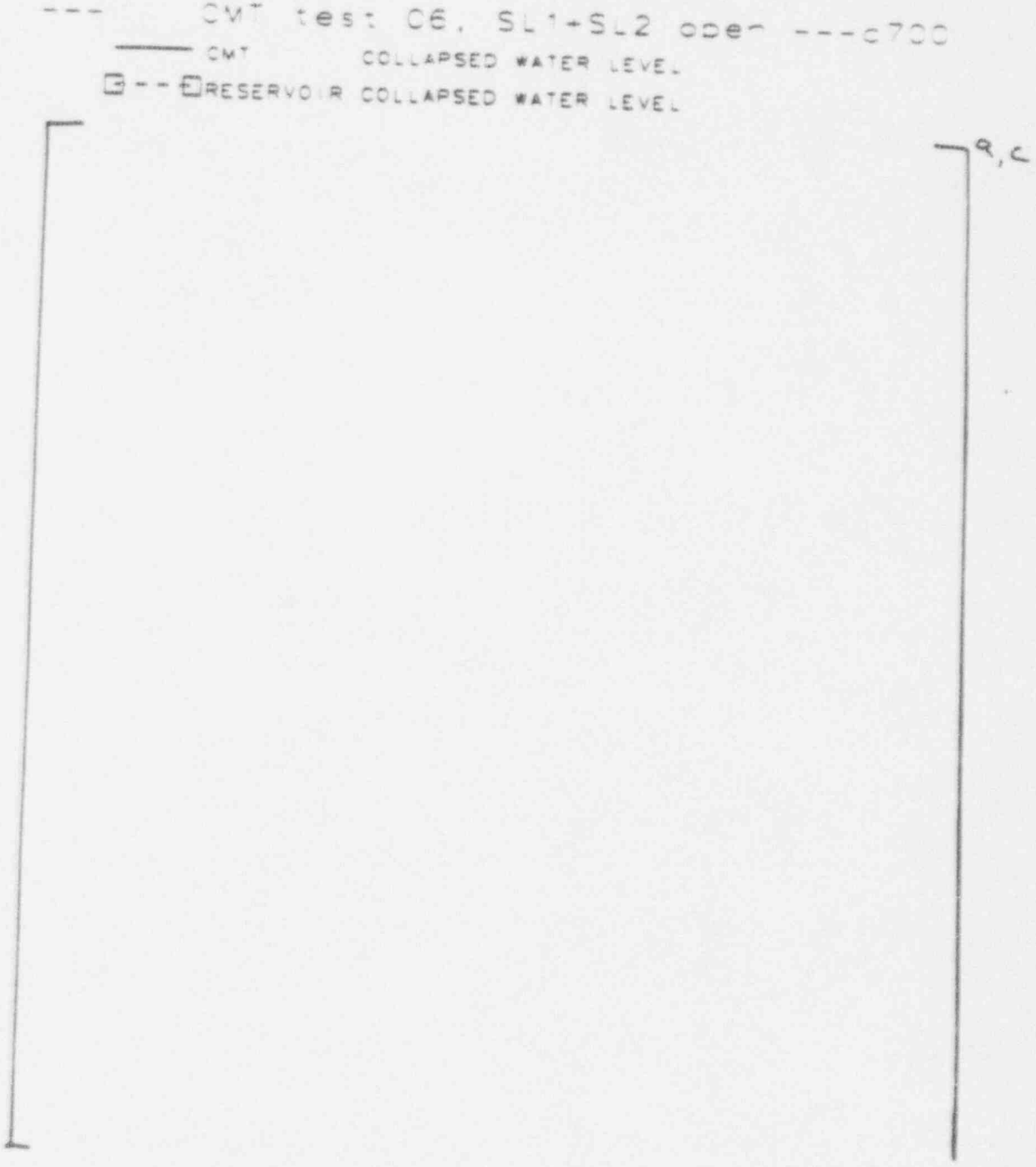
——— PR. CONTROL VALVE INLET

⊡ - - ⊡ TOP OF RESERVOIR

⊖ - - ⊖ CMT TOP CELL



a,c

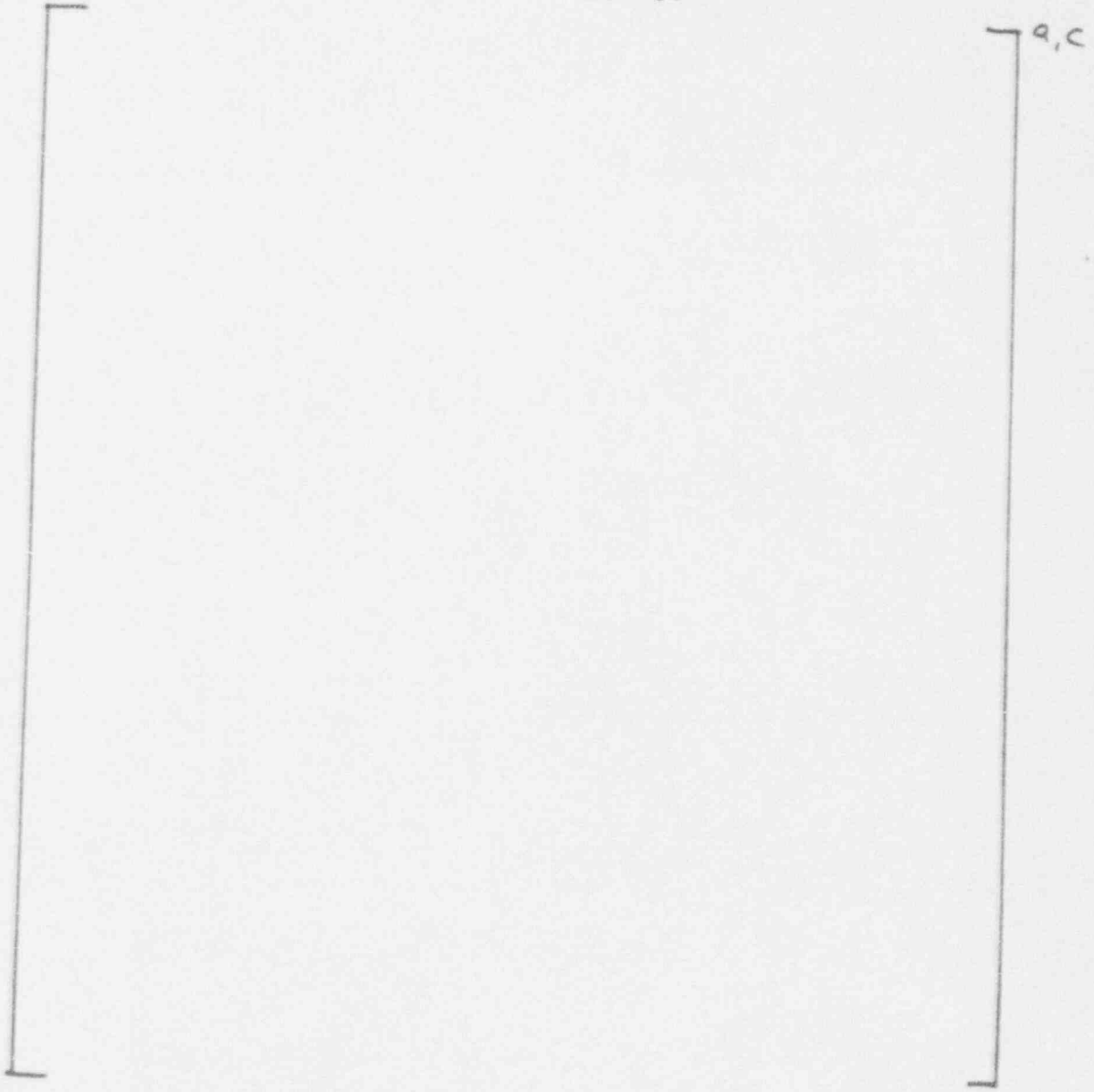

CMT test 06, SL1+SL2 oder ---c700
CMT COLLAPSED WATER LEVEL
RESERVOIR COLLAPSED WATER LEVEL
9,c

Preliminary

CMT test 06, SL1-SL2 open ---c700
CMT Mass Flow Rates

FLOW INTO CMT TOP

FLOW OUT OF CMT BOTTOM



a,c

--- CMT test 06, SL1+SL2 open ---c700
Mixture Velocity in 0.00976 sq ft Pipes

——— PR. CONTROL VALVE INLET

PR. CONTROL VALVE OUTLET

STEAMLINE 1 TOP

STEAMLINE 2 MIDDLE

STEAMLINE TEE TO CMT

CMT INLET

CMT EXIT

RESERVOIR INLET (BOTTTOM)

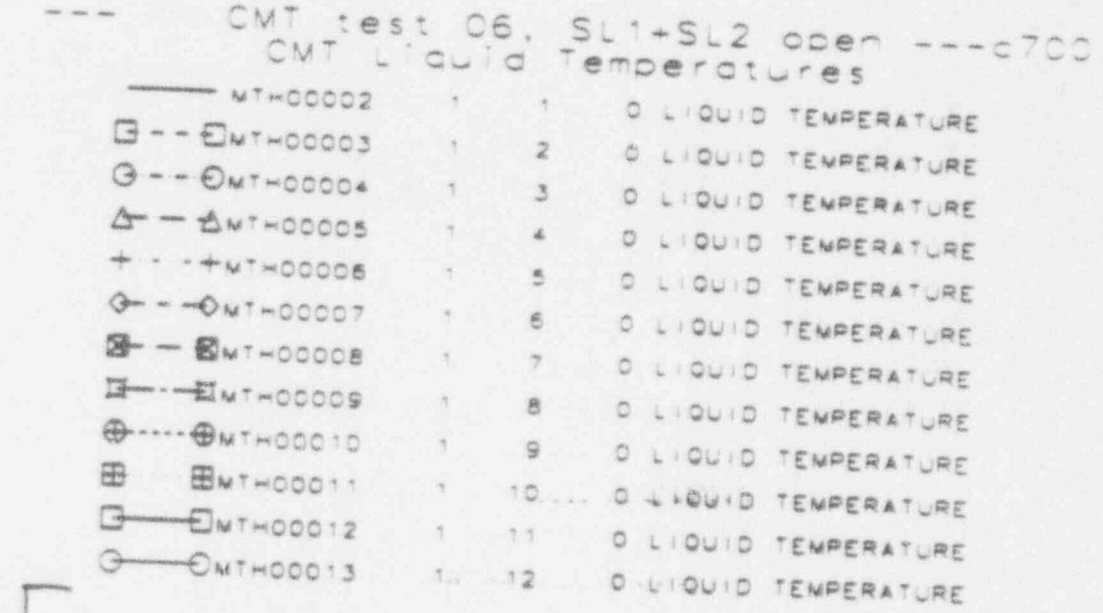
CMT DRAIN VALVE INLET

[[redacted]] 9,c

CMT test 06, SL1+SL2 open ---c700
Mixture Velocity in 0.00976 sq ft pipes

PR. CONTROL VALVE INLET
PR. CONTROL VALVE OUTLET
STEAMLINE 1 TOP
STEAMLINE 2 MIDDLE
STEAMLINE TEE TO CMT
CMT INLET
CMT EXIT
RESERVOIR INLET (BOTTTOM)
CMT DRAIN VALVE INLET

[redacted] a,c


--- CMT test 06, SL1+SL2 open ---c700
CMT Liquid Temperatures
MTH00002 1 1 0 LIQUID TEMPERATURE
MTH00003 1 2 0 LIQUID TEMPERATURE
MTH00004 1 3 0 LIQUID TEMPERATURE
MTH00005 1 4 0 LIQUID TEMPERATURE
MTH00006 1 5 0 LIQUID TEMPERATURE
MTH00007 1 6 0 LIQUID TEMPERATURE
MTH00008 1 7 0 LIQUID TEMPERATURE
MTH00009 1 8 0 LIQUID TEMPERATURE
MTH00010 1 9 0 LIQUID TEMPERATURE
MTH00011 1 10 0 LIQUID TEMPERATURE
MTH00012 1 11 0 LIQUID TEMPERATURE
MTH00013 1 12 0 LIQUID TEMPERATURE

9,C

CMT test 06, SL1-SL2 oder ---c700
CMT Wall Surface Temperatures

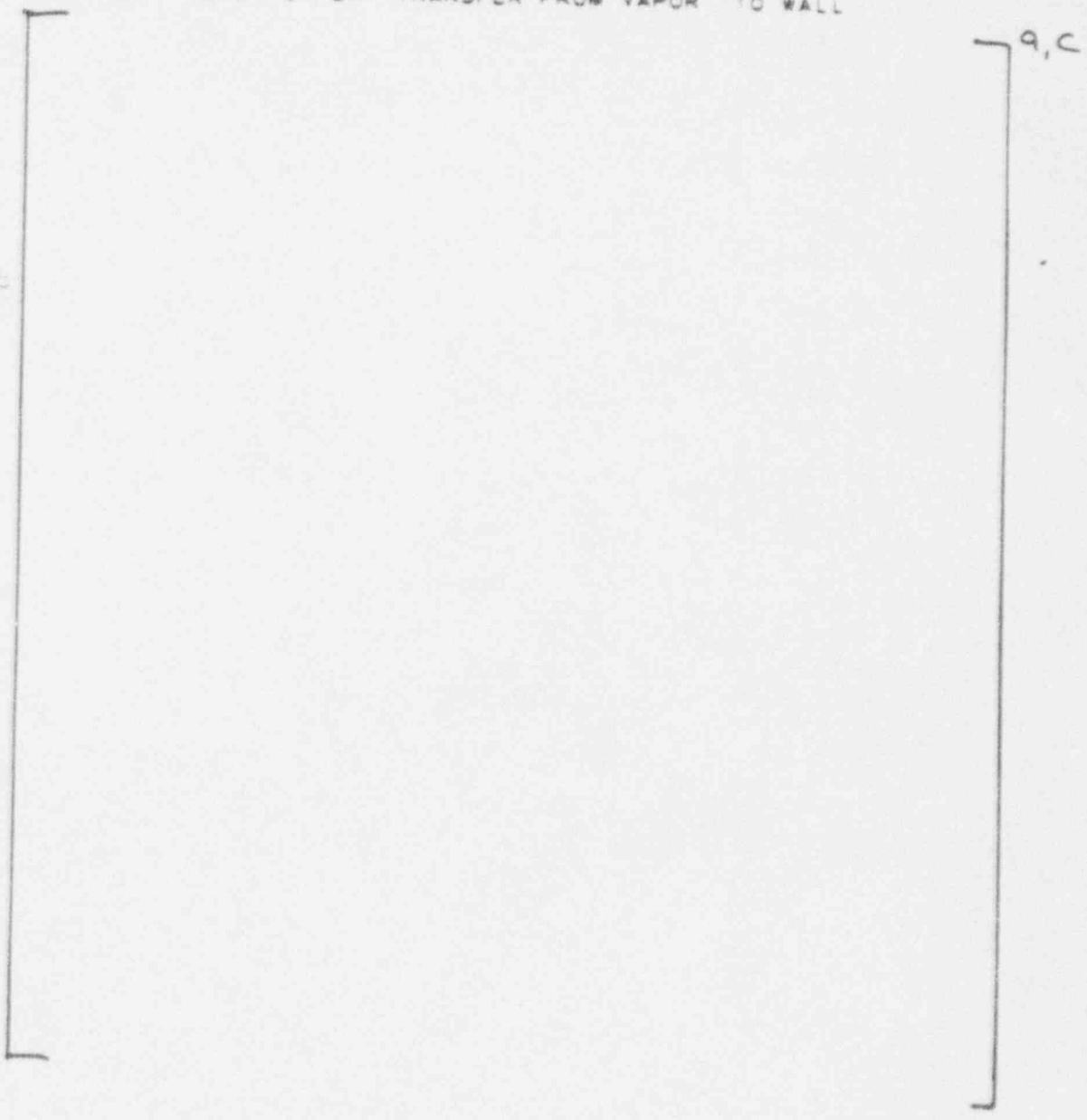
MT-00002	1	1	1	WALL TEMPERATURE
MT-00003	1	11	1	WALL TEMPERATURE
MT-00004	1	21	1	WALL TEMPERATURE
MT-00005	1	31	1	WALL TEMPERATURE
MT-00006	1	41	1	WALL TEMPERATURE
MT-00007	1	51	1	WALL TEMPERATURE
MT-00008	1	61	1	WALL TEMPERATURE
MT-00009	1	71	1	WALL TEMPERATURE
MT-00010	1	81	1	WALL TEMPERATURE
MT-00011	1	91	1	WALL TEMPERATURE
MT-00012	1	101	1	WALL TEMPERATURE

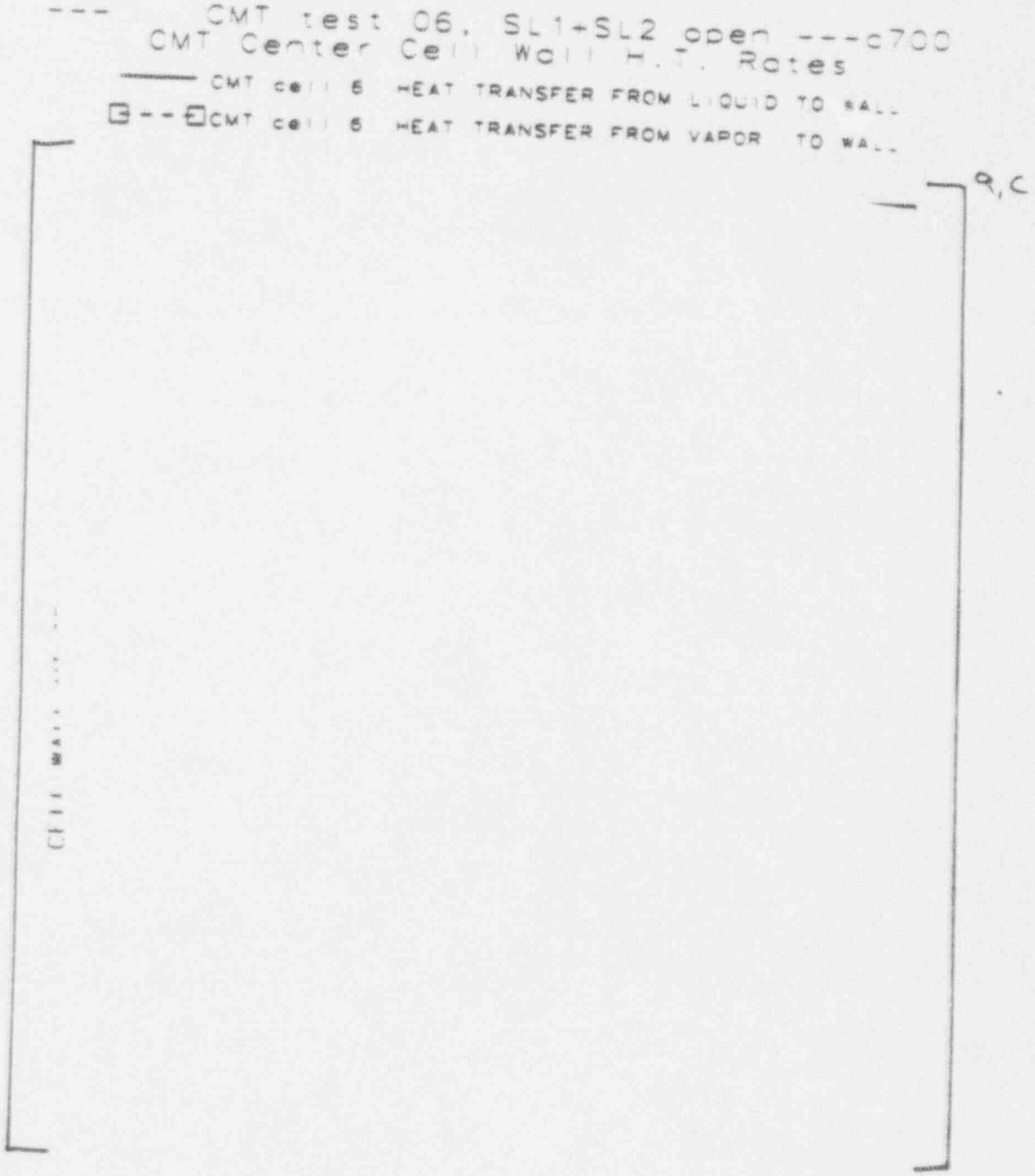
[[9,c]

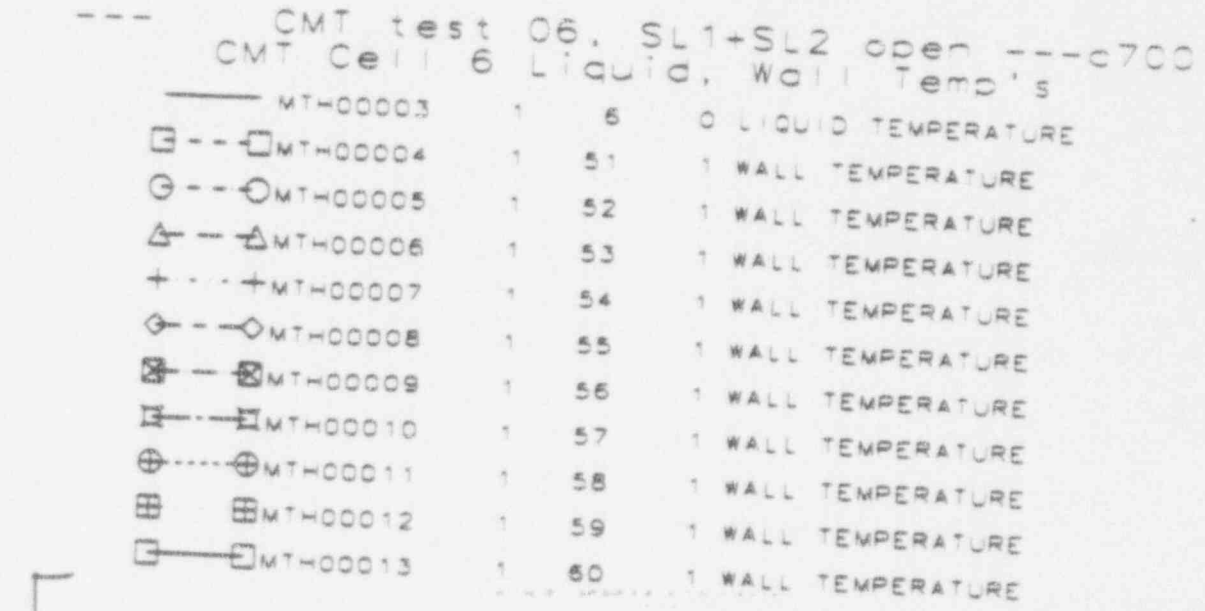
--- CMT test 06, SL1+SL2 open ---c700
CMT total Wall Heat Transfer

——— TOTAL HEAT TRANSFER FROM LIQUID TO WALL

⊡--⊡ TOTAL HEAT TRANSFER FROM VAPOR TO WALL




--- CMT test 06, SL1+SL2 open ---c700
CMT Center Cell Wall H.T. Rates
CMT cell 6 HEAT TRANSFER FROM LIQUID TO WALL
CMT cell 6 HEAT TRANSFER FROM VAPOR TO WALL
9,C
CELL WALL


CMT test 06, SL1+SL2 open ---c700
CMT Cell 6 Liquid, Wall Temp's
MTH00003 1 6 0 LIQUID TEMPERATURE
MTH00004 1 51 1 WALL TEMPERATURE
MTH00005 1 52 1 WALL TEMPERATURE
MTH00006 1 53 1 WALL TEMPERATURE
MTH00007 1 54 1 WALL TEMPERATURE
MTH00008 1 55 1 WALL TEMPERATURE
MTH00009 1 56 1 WALL TEMPERATURE
MTH00010 1 57 1 WALL TEMPERATURE
MTH00011 1 58 1 WALL TEMPERATURE
MTH00012 1 59 1 WALL TEMPERATURE
MTH00013 1 60 1 WALL TEMPERATURE

9,C

Westinghouse/NRC Meeting on CMT Tests
February 25, 1993

SCHEDULE

E. J. Piplica