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International Agreement Report

Assessment Study of RELAP5/MOD2 Cycle 36.04 Based on Pressurizer Safety and Relief Valve Tests

Prepared by
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Office of Nuclear Regulatory Research
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ABSTRACT

This report presents a code assessment study based on full size relief and assisted safety valve (called SEBIM) tests performed on the CUMULUS valve test rig operated by Electricité de France (EdF).

The increased awareness that the pressuriser safety and relief valves are not reliable under water blowdown conditions, has led to the design, testing and installation of so called assisted safety valves of which the SEBIM (TM) valves are an example. These valves, used in tandem, are gradually replacing the safety and relief valves on pressurisers in some European PWR's.

Before installation at the plant, the Belgian safety authorities requested a thorough full scale testing of these valves on a test rig (CUMULUS) equipped with sufficient diagnostics to measure the characteristics of the valve.

The Belgian architect-engineering firm TRACTEBEL was called upon to specify, order and test these valves for installation at the DOEL 1 and DOEL 2 power plants.

These tests do provide sufficient data of high quality to justify an assessment study of the code RELAP-5 MOD-2 CYCLE 36 in the ICAP framework which is the subject of this report.

EXECUTIVE SUMMARY

Since the Three Mile Island accident, there is an increased awareness of the vital role of pressuriser safety and relief valves in a LWR, not only for the valve behaviour in vapour conditions, but also for saturated and subcooled water conditions.

Besides the classical role of protecting the reactor coolant system against overpressures during transients and accidents, the PORV's can provide :

- a protection against Pressurised Thermal Shock of the reactor coolant vessel during reactor heat-up and cooldown phases for solid pressuriser conditions;

- adequate energy removal from the primary coolant system in case of a complete loss of secondary heat sink by using a so called feed and bleed procedure;

- an adequate depressurisation of the primary coolant system for degraded core conditions, thereby alleviating the possible consequences of direct containment heating in case of vessel failure.

To qualify for above roles, the pressuriser safety and relief valves should be tested and qualified for steam as well as water release conditions, which was not the case in the past.

The SEBIM assisted pressuriser safety and relief valve, described in this study, has been the subject of intensive testing on the CUMULUS test rig, owned and operated by EdF (Electricité de France).

The objective of this study is to investigate the behaviour of such valves under a wide range of thermal hydraulic conditions, from superheated vapour to subcooled water and to evaluate the valve capacity and stability over such wide operating conditions.

A RELAP-5 MOD-2 simulation of the valve and valve rig has been performed in order to establish the feasibility of a lumped valve simulation approach and to evaluate the main parameters (pressures, flow rates) from such non-mechanistic approach by comparing the measured to calculated data, over a wide range of superheated vapour and subcooled water conditions.

To establish the RELAP-5 equivalent parameters of the valve system, one steam test was used to evaluate the RELAP-5 equivalent valve junction, and an addition subcooled blowdown test was used to evaluate the RELAP-5 equivalent subcooled discharge coefficient, assuming an abrupt area change and an energy loss coefficient equal to zero.

By comparing the measured to calculated data, one can conclude that :

a. For only 2 steam tests available, the above methodology is applicable, as the calculated data are well within the specified test tolerances.

b. For four subcooled water discharge tests, the above methodology yields calculated valve discharge flows within the specified test measurement tolerances, for three tests. Only one test at lowest subcooling margin (ΔT_{SAT} = - 43° C) yields calculated flow rate about 4 % below the measured flow.

This exercise also manifested some RELAP-5 anomalies which are, to our understanding, related to the treatment of superheated vapour conditions such as :

- initialisation of a time dependent volume,
- discontinuities in the speed of sound calculations
- vapour critical mass flow rate versus degree of superheat.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX

1. INTRODUCTION

Since the three Mile Island accident in 1979, various plant safety systems have been the subject of a thorough analysis of which the pressuriser safety and relief valves were priority items (Ref. 1).

EPRI has undertaken a large effort to investigate the behaviour of relief and safety valves from various manufacturers (Ref. 2). These tests generally have indicated that the behaviour of these safety systems are questionable when operated beyond their specified range of operability.

More specifically, the behaviour and characteristics of the passive safety valves and relief valves under water blowdown condition which can occur under degraded plant conditions are not reliable.

A French valve manufacturer has designed and patented a so called assisted safety valve (SEBIM) in order to enlarge he range of reliable operation of the safety valves for overpressure protection of vital PWR systems such as pressurisers, shut-down cooling systems etc.

In the context of a 10 yearly revision of the DOEL-1, DOEL-2 PWR plants (2 loop Westinghouse plants with thermal rating of 1192 MWth), it was decided to equip the pressuriser with SEBIM valves.

These valves will serve a multiple purpose :

- as safety valves for plant overpressure protection
- as pressuriser relief valves to cope with operational transients to avoid the high pressure scram setpoint

- to limit pressure excursions in water solid conditions at low temperature (PTS concern)

Before installing these protection valves, the Belgian safety authorities requested a thorough testing of the valves. These tests were performed on the CUMULUS valve testing, operated by Electricity de France (EdF). After installation of these valves at the plant, further tests were performed in order to check the dynamics and characteristics of these valves at the plant itself.

The resulting data and recordings from these valve tests constitute a valuable data base for an assessment study of the RELAP-5 code models and associated constitutive equations for full scale valve simulation.

The assessment study is principally based on the full scale valve tests on the CUMULUS test rig which is heavily instrumented with well established initial and boundary conditions.

The objectives of this study are :

- to identify the important geometrical parameters which require special attention by the code user.

- to evaluate the impact of the initial thermalhydraulic conditions which have an impact on the valve behaviour.

- to assess the code constitutive equations which govern the basic physical phenomena : e.g. critical flow for saturated and superheated vapour and subcooled water.

- to identify possible code weaknesses and propose code model modifications.

This report is organised as follows : Section 2 presents a detailled description of the valve and test rig used to measure the valve characteristics. Section 3 presents a comparison of test rig data and the code simulation data. Section 4 presents the RELAP-5 weaknesses observed during the work. Section 5 presents the conclusions.

2. FACILITY AND TEST DESCRIPTION

This chapter gives a description of the SEBIM valve, the CUMULUS test rig and the DOEL-2 test arrangement. This description is limited to the essential items required for this code assessment study (réf. 3).

2.1. Description of the assisted SEBIM valve geometry and arrangements

Figure 1 presents a drawing of the SEBIM valve, consisting of the safety valve itself and the pilot arrangement (detector) which pilots the valve in a pure hydraulic way (for safety valves).

The safety valve is mounted directly on the pressurised reservoir to be protected. One distinguishes respectively the lower valve body and upper valve body. The lower valve body, shown in a closed configuration, contains the valve seat pressed against the valve inlet pipe by means of a spring assisted piston, thus isolating the valve inlet from the valve outlet volume with outlet axis at 90° from inlet axis.

A piston stem connects the lower chamber to the valve upper chamber which contains a piston of larger diameter and exposed to a fluid at same pressure as the reservoir pressure in closed conditions. The ratio of the seat surface and the piston surface is optimised to asssure a leaktight valve.

The valve pilot arrangement consists of an upper pilot chamber, containing a spring assisted piston which is exposed to the reservoir pressure. Any displacement of the piston is transmitted by the stem containing a lever which activates two check valves in the lower pilot chamber.

For a reservoir pressure lower than the setpoint pressure, the pilot piston is in the upper position (as shown) and, by means of the lever, opens the check valve R1 in the lower pilot chamber, thereby exposing the valve upper piston to the reservoir pressure which keeps the valve closed.

When the reservoir pressure increases beyond the pilot chamber setpoint pressure (adjustable by means of a ring setting on the pilot chamber spring), the pilot piston is pushed downward, closes the check valve in chamber R1 first and subsequently opens the check valve in chamber R2 which exposes the valve upper piston to the atmospheric pressure. Under the large pressure differential between upper and lower piston in the valve body, the stem lifts and opens the safety valve.

When pressure drops below the closing setpoint pressure, the pilot piston moves upwards, closes the check valve R2, opens check valve R1 and exposes the valve upper piston to the reservoir pressure which leads to a closure of the valve.

With such an arrangement, ringing of the valve is excluded since the valve stem positon is not controlled by the force difference on the valve seat (by the fluid) and the valve spring, but by the large force difference between valve seat and upper piston. This makes the valve immune to large fluctuating pressures at the valve inlet when discharging subcooled water and leads to a very stable valve behaviour for all fluid conditions.

The disadvantages of such valves are mainly a slower response time to reservoir fluctuating pressures and a very delicate pilot system which requires an utmost quality in design and maintenance for a failproof operation.

The SEBIM valves are always installed in TANDEM of which the upstream valve, being mounted vertically, assures the essential safety and relief function.

The downstream valve, mounted horizontally close to the outlet of the upstream valve, assures the isolaton function in case the upstream valve would refuse to close when needed. The principal technical and functional characteristics of a SEBIM tandem pair are listed in table 1.

2.2. Description of the CUMULUS test rig

Fig. 2 shows a schematic of the test rig components. It essentially consists of 3 high pressure reservoirs respectively the driver and the driven reservoirs to condition the discharge fluid through the test section.

A direct heating electrical boiler is capable of producing supercritical water conditions (up to 310 bar and 450°C) and feeds the driver (R1) reservoirs (total volume 20 m^3).

A recirculating type electrical heated boiler feeds the driven (R2) reservoir (volume 16 m^3). The fluid conditons generated in this electrical boiler are either

- saturated vapour (up to 200 bar, 365°C)
- superheated vapour (up to 400°C)
- subcooled water (up to 180°C and 30 > p > 200 bar)

Once both reservoirs are properly conditonned for the test, the electrical boilers are isolated and quick opening valves initiate the blowdown by connecting the driver and the driven reservoir via a regulating valve which adjust the fluid condition in the driven reservoir and by connecting the driven reservoir to the test section.

At the test section outlet, a downstream valve is located to regulate the backpressure, followed by a silencer and a fluid recuperating system.

Fig. 3 gives the component lay-out surrounding the test section with loop seal arrangement. Downstream the 2 quick opening valves follows a horizontal section with internal diameter of 124 mm (6"SCH 160). A 90° bend leads via a vertical reduction (6" to 4" SCH140) to the loop seal U bend (internal diameter 80 mm) which contains about 12.7 liter water and is connected to the safety valve inlet pipe.

Downstream the SEBIM-TANDEM test valves, with an outlet section of 6" SCH 160 follows a concentric divergent cone (6" to 12") and a 12" discharge line which leads to the silencer-recuperator system.

Fig. 4 shows an enlarged illustration of the mounted TANDEM arrangement with the safety valve upstream and the isolation valve downstream, mounted at 90° angle.

2.3. CUMULUS test rig instrumentation

Figure 5 illustrates the location of the instrumentation which consists of :

- Flow measuring devices upstream the test section using flow venturi (PST flow, TF flow, ΔP flow)

- Pressure loss measurements over the loop seal (PST0 à PST3) and at outlet (PST10 à PST13)

- Absolute pressure measurements in the valve outlet section and between the valves (PST4 and PST8)

- Valve stem displacement gauges for both the discharge valve (DPL/SP) and the isolating valve (DPL/SI)

- Thermocouples (TF0 à TF12) to measure the fluid temperature upstream and in between both valves

- Pipe wall thermocouples with fast response to measure the external wall temperatures (TPE1 à TPE7) and the valve internal wall temperatures (TP112 à TP119)

About 33 measurement devices are hooked up to a data aquisition system which permits real time display of the results and storage on tape to allow replay and treatment of the data.

The list of instruments useful for this report is limited to the parameters in the main flow path and this excludes all measurements intended to check the behaviour of the pilot valve system.

Table 2 lists the instrumentation matrix used in the tests decribed below.

2.4. CUMULUS-SEBIM test matrix

Out of a total of 12 tests performed on the rig with the SEBIM-TANDEM test valves, only 6 tests are of interest for code assessment. The remaining tests were performed to verify the functional behaviour of the pilot system which controls the valves.

Table 3 summarises the initial and boundary condition for the 6 tests.

Basically 2 types of tests can be distinguished.

- Superheated steam discharge (no loop seal) (test 1 and 2)
- Subcooled water discharge (tests 3 to 6)

Table 3 also lists the measured steady-state flowrates obtained from a normalised venturi design (ISO 5167) using the accepted conversion ($\Delta P \rightarrow$ flowrate) based on the norm ISO 4126.

The flowrate precision (based on ISO 5168) is listed in table 3 for a 95 % confidence level.

The available steady state recorded data are shown in figs. 6 to 9 for three tests, respectively tests 1, 4 and 5.

3. RELAP-5 SIMULATION OF THE VALVE TESTS

3.1. Objectives of the simulation

a) Since a valve-behaviour is strongly dependent on the configuration of the piping upstream and downstream the valve, the valve capacity on the test rig may be different from the capacity in the plant due to differences in the piping lay-out. In order to verify that the valve capacity in the plant is according to design specification, a simulation of the plant "as built" valve performance is required. Such demonstration requires a calibration of the valve parameters which can be obtained by simulating the valve performance on the instrumented test rig, for which measured data are available.

b) Following the test results on the Cumulus test rig, it turned out that the valve capacity was exceeding the design specification for the plant and it was decided to install SEBIM valves of identical design, however with a valve inlet diameter of 46 mm, instead of the 50 mm valve inlet of the tested valves. Instead of repeating the test matrix with a smaller valve inlet section, it was decided to evaluate the new valve capacity, for steam and for water, by means of a simulation.

c) The available data from the full scale test can provide valuable insight in the modeling requirements and the code critical flow models for the code RELAP-5. Such data is of vital importance for simulation of plant transients and severe accidents since the pressuriser safety and relief valve are important safety systems for plant protection.

3.2. Simulation guidelines

a) A non mechanistic modeling of the tandem valve system was selected. This means that both valves from inlet of the safety valve to the outlet of the isolation valve are simulated by a single RELAP-5 VALVE component for the following reasons :

- From a hydraulic point of view, it is not warranted to simulate both components separately as the downstream valve inlet is less than 5 outlet diameters from the upstream valve outlet. Hence a 1D simulation of a highly turbulent flow field inbetween both valves is not justified.

- From a geometrical point of view, the internal structure of the valves is not known with sufficient precison to use a mechanistic model of the valve. Furthermore, the available RELAP-5 mechanistic model of a relief valve is not applicable for pilot operated valves.

- From an economic point of view, it is not justified to simulate explicitely the valves upstream piping and the short piping in between valves when performing plant transient studies. Such explicit simulation would seriously reduce the minimum courant time step for the code. Hence it is important to see how a single non-mechanistic valve component is capable of simulating the important phenomena such as the critical flow for steam and water relief.

For the remainder of the report, the word "valve" refers then to the combined system of safety and isolation valve mounted in tandem as shown in fig. 4.

b) The nodalisation detail chosen to simulate the CUMULUS test rig and valve is selected in function of the location of the instrumented sections of the test rig in order to reproduce as close as possible the measured data.

c) Since only the steady-state portion of the test run was important for these tests, the wall heat tranfer could be neglected since its influence on the valve behaviour is negligible.

d) To fullfill the objectives of these tests, only the test section was simulated by imposing suitable boundary conditions from test data.

3.3. RELAP-5 input model description

Figure 10 illustrates the nodalisatiion adopted for the test section, conform to the guidelines above. It consists of 8 volumes and 7 junctions of which junction 550 represents the valve system.

On same figure are represented the instrument location, where the encircled number corresponds to the instrument number of table 2.

The volume roughness is taken as 4E-5 m for all volumes. The form loss factors are introduced in the junctions to represent the pressure losses due to bends, contractions, expansions. The large expansion between volumes 560 and 600 was simulated by an abrupt junction, instead of a form loss factor.
The listing of the reference case is joined in annexe 1.

For the valve junction, one has decided to calibrate the valve parameters such as :

- valve effective orifice area
- valve discharge coefficients

on the basis of a single test as described in chapter 3.4. For all other tests, these valve parameters were kept constant to verify the RELAP-5 data versus measured data.

3.4. Calibration of the valve junction parameters

Using a non-mechanistic approach for simulating the complex valve system requires a calibration of the valve junction parameters based either on the valve specifications or on the measured valve performance in an instrumented test facility.

To assess the validity of the RELAP-5 physical models underlying the correct valve behaviour, one chooses one experiment for calibrating the RELAP-5 valve model and one verifies if for different initial states or other fluid conditions, the calculated results agree with the measured data.

3.4.1. Calibration of the valve parameters for steam discharge

In RELAP, a valve junction is defined by the full open area of the valve, and an energy loss coefficient, where the abrupt area flag (vcahs) is mandatory.

For a complicated valve system as described here, it is impossible to define above parameters from geometrical valve data, and one usually introduces a so called discharge coefficient which is defined as the ratio of the measured mass flow to the ideal calculated mass flow based on an isentropic expansion, through a nominal valve area.

Such ratio is always less than unity as it incorporates such factors as :

- unknown choking area in the valve, which is smaller than the nominal valve inlet diameter

- flow discontinuities throughout valve system

- three-dimensional effects which are unaccounted for in a 1D nodalisation

- inlet-outlet pressure drops

Based on the nominal valve inlet area (A_N = 19.63 cm²) and the well-known vapour critical flow correlation (Napier or Napier corrected for high pressures), table 4 summarises the results for the discharge coefficients for both steam tests, which compare favourably with the given vendor discharge coefficient of C_D = 0.794.

Since a discharge coefficient is not explicity an input to the RELAP valve junction (for steam), one has ajusted the RELAP-5 equivalent junction area in order to obtain the measured vapour flow rate, assuming zero energy loss coefficients.

As only two steam tests were available for calibration, one has adjusted the RELAP-5 equivalent junction area to converge to an average critical valve flow of 39,12 kg/s which is the result of averaging the uncorrected Napier discharge coefficients (table 4) to a value of 0.8.

This is done by performing a quasi-steady run whereby the equivalent area is changed by means of a control block, affecting the valve opening area of the servovalve, until the calculated vapour critical flow converges to the desired flow for the initial conditions of test 86.73 (which is closest to the PORV setpoints in a power plant).

This exercise yields an equivalent RELAP-5 valve area of 14.72 cm^2 which compared to the nominal valve area, yields an equivalent C_D of 0.75.

For all further runs, the valve area was reset at the nominal value of 19.63 cm^2 (Ø = 50 mm) whereby the initial valve area ratio is fixed at 75 % by means of a trip unit control block (appendix 1).

3.4.2. Calibration of the valve parameters for subcooled water discharge

The test matrix contains also four tests at low pressure and high liquid subcooling.

Since the behaviour of a valve is different for steam or water discharges, one has to calibrate the model for different upstream conditions.

In RELAP-5, there exists a subcooled discharge coefficient which can be used to calibrate the valve under subcooled upstream conditions.

Calibration has been done on test n° 86.77 at 70 bar and 205°C.

The subcooled discharge coefficient ($C_{D,Sc}$) obtained based on the RELAP-5 equivalent flow area (§ 3.4.1.) is $C_{D,SC}$ = 0.778

The combined discharge coefficient (0.75 * 0.778 = 0.584) agrees well with the calculated discharge coefficient of 0.56 based on the measured flow and the critical flow for subcooled fluid from the ZALOUDEK correlation as shown in fig. 11 for all four water tests (run 3 to 6).

3.5. Analysis of the RELAP-5 data

The RELAP-5 valve parameters are

AN = nominal flow area (= 19.63 cm^2)

$C_{D,E}$ = AE/AN = 0.75 for the RELAP maximum valve area ratio

$C_{D,SC}$ = 0.778 for the subcooled discharge coefficient

Having fixed those parameters on the basis of 2 tests (one in steam and the other in water conditions), the RELAP-5 results for other upstream conditions or tests can be checked by comparing the calculated flow rates to the measured values.

Table 5 summarises the results and shows the calculated error versus the data imprecision.

One can observe that the calculated values agree well with the measured data and that the differences are smaller than the imprecision in the measured data except for the last test (86.81). Since an average C_D was used for steam calibration, the RELAP-5 results present a positive difference for the first test and a negative one for the second.

Since there is a good agreement on the 3 out of 4 subcooled test, one can suspect an error in test 86.81.

Those results suggest that the method of calibrating the RELAP-5 valve parameters is acceptable and that the RELAP-5 models are adequate for calculating the vapor and subcooled fluid valve capacity.

To compare the line pressure drop, table 6 summarises the measured and the calculated static pressure along the test rig for one test (number 86.78) for subcooled water conditions where the static pressures were recorded (fig 7,8) (ref. 3).

The four loss factors introduced in RELAP-5 were based on engineering correlations (e.g. IDELCHIK), and not on the measured pressure (as the test report was not yet available).

From table 6, it appears that the measured pressure drop along the rig is larger than calculated by the code, which is caused by the presence of a large number of instrumentation taps and inserts which were not accounted for in the calculation.

The large discrepancy at the valve outlet piping results is mainly due to the crude nodalisation at this location.

4. RELAP-5 WEAKNESSES

While elaborating this test simulation, a few RELAP-5 anomalies have been observed, of which three have been examined more closely through parametric studies.

4.1. Initial conditions for time dependent volumes

Since the steam discharge valve tests have been performed at slightly superheated valve inlet conditions (table 3), a time dependent volume (component number 100) was used to specify inlet pressure and temperature.

One observed in several cases a mismatch between the imposed initial temperature in the input data deck and the result of the initial input processing. A few cases are shown in table 7.

A similar problem has already been reported in the 8th issue of the RELAP-5 newsletter, referenced as problem number 87054. Such problem can be overcome by slightly increasing the input temperature, and occurs only for overheated steam conditions.

4.2. Mass flow rate oscillations

During some calculations, the valve junction mass flow rate shows a flip-flop variation of the critical flow which is in phase with the time step. It appears that such variations occur only for critical flow from high superheated steam conditions.

Table 8 summarises the nodalisation scheme and the valve boundary conditions for 5 parametric studies which highlight this anomaly.

In general, the anomaly can be traced to a change in the speed of sound at every time step (listing A2-3, A2-4), pointing to a discontinuity in the critical flow model. By reducing the degree of superheat, the magnitude of the jump is also reduced (listing A2-4).

Related to above anomaly is the evolution of the mass error (see listing A2-3).

Although the steady state seems to converge to a stable solution for case A2-4, one observes an anomaly in the profile of the mass flow rate along the pipe upstream of the valve of about 0.012kg/s for a nominal flow rate of 35.1 kg/s. This anomaly disappears however when the upstream pressure is lowered to 100 bar (case A2-5), which makes us believe that it is caused by the table look-up procedure in RELAP-5.

4.3. Impact of mass flow rate at various degrees of superheat

In order to evaluate the vapour critical mass flow rate at various degrees of superheat, one can use (as a first approximation) the isentropic expansion law for a perfect gas.

$$\frac{W}{C_D A_N} = \left[\alpha \left(\frac{2}{\alpha + 1} \right)^{\frac{\alpha + 1}{\alpha - 1}} R \right]^{1/2} \frac{P_o}{\sqrt{T_O}}$$

Wherein : α = isentropic expansion index (from steamtables)
R = gas constant for vapour (= 461.5 J/kg; K)
Po,To = upstream vapour pressure and temperature

Table 9 illustrates the results, for 4 different upstream temperatures at constant pressure of 100 bar.

The perfect gas law illustrates a much lower temperature dependence on the critical specific mass flow than the RELAP-5 results, as the degree of superheat increases from 14 to 91 degrees.

Again, it is our opinion that the thermodynamic parameters for steam in this region are not precise enough in RELAP-5, especially concerning the calculation of the isentropic expansion index ($\alpha = \delta \ln P / \delta \ln v$ at constant entropy).

5. CONCLUSION

This study clearly illustrates some of the difficulties which arise when trying to use a simulation code for simulating the behaviour of a complex piece of equipment.

The required data for simulating a complex valve system are not readily available from manufacturing data, and one is often forced to lump many unknown (such as the valve choking area the valve form loss factors) as well as any limitation of the simulation model itself (1D versus 3D behaviour) into a single parameter which is usually known as the discharge coefficient.

This study has illustrated that :

1. a single RELAP calibration test, needed to evaluate the discharge coefficient, yields reliable results for the valve flow rate over a wide range of upstream conditions for steam only.

2. an additional calibration is required to fix the subcooled discharge coefficient when subcooled water conditions exist at the valve inlet.

Hence, this study illustrates the RELAP-5 potential to simulate a valve component (in a lumped fashion) to perform plant transients which activate valve system.

3. In order to evaluate correctly the pressure drop in the upstream pipe segments, the presence of a large number of instrument taps and inserts should properly be accounted for.

This exercise also manifested some RELAP-5 shortcomings which are all related in some way to the RELAP-5 treatment of superheated steam conditions such as :

- initialisation of a time dependent volume
- discontinuities in the speed of sound calculation
- mass flow reduction versus vapour superheat

Although one can work around these problems, it is however recommended to clean up these anomalies in future RELAP-5 versions.

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TEST REPORT HT 24/87.02 MARCH 1987

TABLE 1 : TECHNICAL AND FUNCTIONAL CHARACTERISTICS OF THE TESTED SEBIM VALVE ARRANGEMENT

TECHNICAL

- Valve inlet interior diameter : 50 mm
- Maximum stem lift of valve piston : 16 mm
- Valve seat located 13 mm below axis of valve outlet pipe
- Distance between first valve inlet axis and second valve outlet axis : 505 mm
- Total length between flanges : 1010 mm

FUNCTIONAL

SAFETY VALVE

opening setpoint pressure : 171.9 bar
closing setpoint pressure : 167 bar

ISOLATION VALVE

opening setpoint pressure : 145.3 bar
closing setpoint pressure : 138.3 bar

TABLE 2 : INSTRUMENTATION MATRIX FOR DESCRIBED TESTS

INSTRUMENT N°	DESCRIPTION	LABEL	UNITS	RANGE	PRECISION	COMMENT
1	Pressure of driver reservoir	PST-B1-REF	BAR	0 - 300		
4	Fluid temperature in flow measuring device	TF-DEBIT	DEGR. C	0 - 500	ISO-5168	
5	Fluid static pressure in flow measuring device	PST-DEBIT	BAR	0 - 200		
7	Flow measuring device (venturi)	DP-DEBIT	BAR	0 - 1.2		Converted to kg/s
10	Static pressure at safety valve inlet flange	PST-3	BAR	0 - 300		
14	Static pressure between valves	PST-8	BAR	0 - 300		
16	Static pressure at isolation valve outlet flange	PST-10	BAR	0 - 50		
18	Static pressure at silencer inlet	PST-12	BAR	0 - 10		
32	Fluid temperature in between valves	TF-12	DEGR.C	0 - 500		
49	Inner wall temperature in between valves	TPI-13	DEGR.C	0 - 300		
53	Fluid static pressure upstream U bend	PST-0	BAR	0 - 300		
54	Fluid static pressure at bottom U bend	PST-2	BAR	0 - 300		
139	Valve stem displacement in protection valve	DPL-SP	MM	0 - 16		
140	Valve stem displacement in isolation valve	DPL-SI	MM	0 - 16		

TABLE 3 : CUMULUS-SEBIM TEST MATRIX

TEST RUN	TEST NUMBER	INLET PRESSURE (BAR)	TEMPERATURE (°C)	ΔTSAT* (°C)	FLOW RATE (kg/s)	PRECISION (%)		COMMENT
	GAUGE →	5/PST-DEBIT	4/TF-DEBIT	-	7/DP-DEBIT		Fig.	
1	86.72	164.6	377	26.8	36.5	± 3	6	vapour, no loop seal
2	86.73	170.9	374.4	21	40.3	± 3.5	-	vapour, no loop seal
3	86.77	69.9	204.7	- 81.3	109.1	± 2.0	-	water
4	86.78	49.9	180.3	- 84.0	96.1	± 1.5	7.8	water
5	86.79	29.8	182.7	- 51.3	67.9	± 1.5	9	water
6	86.81	70	243	- 43	91.8	± 2.5	-	water

ΔTSAT = T - TSAT(P) (positive : overheated steam, negative : subcooled liquid)

TABLE 4 : EVALUATION OF THE DISCHARGE COEFFICIENT FOR STEAM

	UNITS	TEST 86.72	TEST 86.73
Valve upstream pressure	BAR	164.6	170.9
Valve inlet nominal area (A_N)	cm^2	19.63	19.63
"Napier" specific flow	$kg/m^2.s$	23950	24868
Measured specific flow	$kg/m^2.s$	18589	20525
Discharge coefficient ($C_{D,NA}$)	-	0.776	0.825
"Corrected Napier" specific flow	$kg/m^2.s$	25396	25796
Discharge coefficient ($C_{D,NC}$)	-	0.732	0.796
Vendor discharge coefficient ($C_{D,V}$)	-	0.794	0.794
RELAP equivalent C_D ($C_{D,R}$)	-	0.75	0.75
RELAP equivalent flow area	cm^2	14.72	14.72

NAPIER correlation : $W/A_N = 145.51 * Po\ (bar)$

Corrected NAPIER : $W/A_N = \frac{1000 - 2.764\ Po}{1001 - 3.323\ Po} 145.51 * Po\ (bar)$

TABLE 5 : COMPARISON BETWEEN CALCULATED AND MEASURED DATA

TEST NUMBER	UPSTREAM PRESSURE	INLET TEMPERATURE	ΔT SAT	MASS FLOW RATE			MEASUREMENT UNCERTAINTY
				MEASURED	CALCULATED	DIFFERENCE	
	bar	°C	°C	kg/s	kg/s	%	± %
86.72	164.6	377	26.8	36.5	37.1	1.6	3.
86.73	170.9	374.4	21	40.3	39.2	- 2.8	3.5
86.77	69.9	204.7	- 81.3	109.1	108.6	- 0.5	2.0
86.78	49.9	180.3	- 84.0	96.1	95.7	- 0.5	1.5
86.79	29.8	182.7	- 51.3	67.9	68.0	0.1	1.5
86.81	70	243	- 43	91.8	95.7	4.2	2.5

TABLE 6 : COMPARISON OF THE STATIC PRESSURE PROFILE

INSTRUMENT		STATIC PRESSURE		PRESSURE DISCREPANCY	RELAP-5 VOLUME
NUMBER	LABEL	MEASURED	CALCULATED *		
Table 2	Fig 5	bar	bar	bar	Fig 10
53	PST 0	49.4	49.8	+ 0.4	200
54	PST 2	46.4	48.0	+ 1.6	400
10	PST 3	45.8	47.5	+ 1.66	500
16	PST 10	7.5	4.7	- 2.8	560

* The data are corrected for the gravitational head difference between pressure tap location and the volume center location (in RELAP).

TABLE 7 : EXAMPLES OF TEMPERATURE MISMATCH IN RELAP FOR TIME DEPENDENT VOLUMES

Input Pressure	Specified Temperature	ΔT_{SAT}	RELAP-5 Temperature	Temperature Difference
bar	°K	°K	°K	°K
171.5	630	3.85	629.34	- 0.66
171.5	647.55	21.40	647.27	- 0.28
163.6	650.15	27.15	649.51	- 1.0
170.9	640.85	17.85	640.44	- 0.41

TABLE 8 : INITIAL AND BOUNDARY CONDITIONS FOR FLOW OSCILLATION PARAMETRIC STUDIES

RUN	NODALISATION	VALVE JUNCTION AREA	UPSTREAM PRESSURE	UPSTREAM TEMPERATURE	ΔT SAT	REQUESTED TIME STEP	OBSERVATIONS	LISTING
-	-	cm^2	bar	°K	°K	msec		
1	Reference *	19.63	170.9	650.56	24.72	0.1	flow oscillations through valve	A2-1
2	Reference	16.62	171.5	647.27	21.14	0.5	reduced oscillations	A2-2
3	Simplified **	16.62	171.5	641.2	15	0.5	"steady state" oscillations	A2-3
4	Simplified	16.62	171.5	631	5	0.5	converges to a stable solution	A2-4
5	Reference	19.63	100	594.15	10	0.5	constant and steady flow along the pipe	A2-5

* : Nodalisation as shown in fig. 10

** : upstream TDV, feeding a branch component followed by a valve junction and a downstream TDV

TABLE 9 : IMPACT OF SUPERHEATING ON MASS FLOW RATE (upstream pressure : 100 bar)

RUN	STEAM TEMPERATURE	ISENTROPIC INDEX (α)	ΔT SAT	SPECIFIC MASS FLOW RATE			
				PERFECT GAS LAW		RELAP-5 MOD-2	
	°C	-	°C	kg/m²,s	%	kg/m²,s	%
1	325	1.25	14	12 525	100	11 423	100
2	342	1.26	31	12 385	98.88	10 950	95.9
3	365	1.27	54	12 195	97.37	10 484	91.8
4	402	1.28	91	11 889	94.92	9 927	86.9

FIG. 1 : CROSS SECTIONAL VIEW OF A SEBIM VALUE AND HYDRAULIC PILOT VALVE

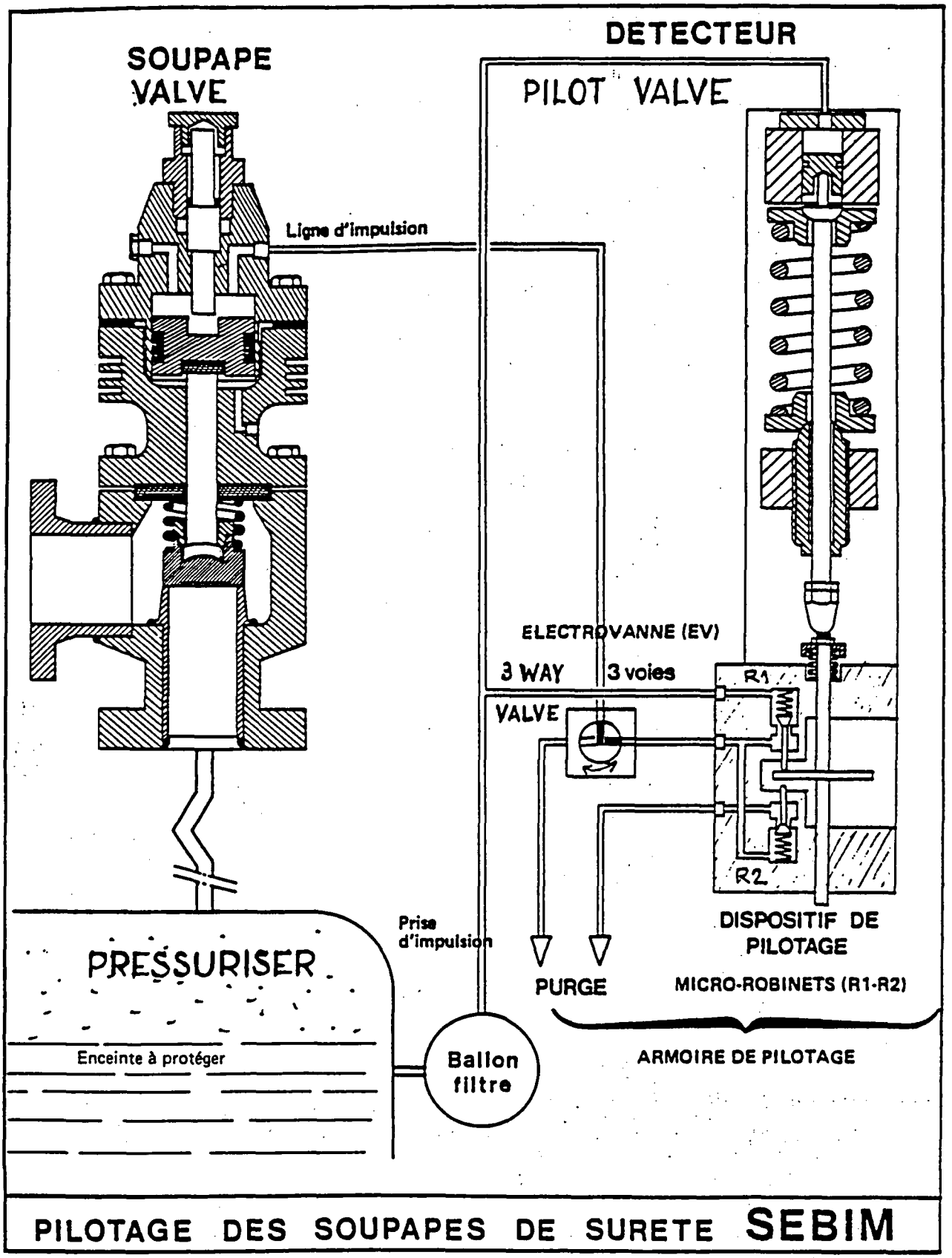
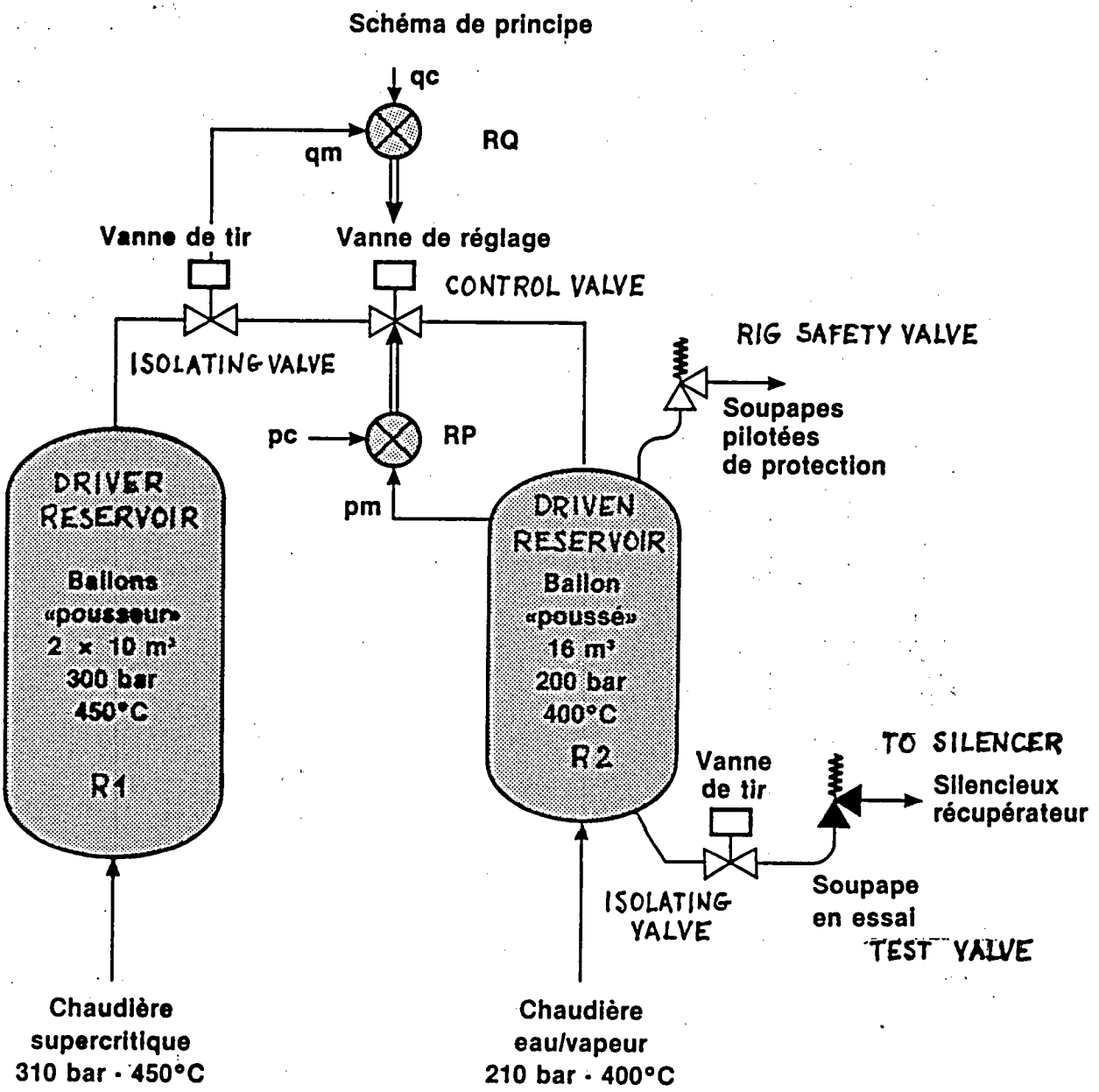


FIG. 2 : SCHEMATIC OF CUMULUS TEST RIG

LA BOUCLE CUMULUS



2 TYPES D'ESSAI :

RP : à pression constante (vanne de décharge)
RQ : à gradient de pression constant (soupape de sûreté).

FIG. 3 : TEST SECTION ARRANGEMENT WITH LOOP SEAL

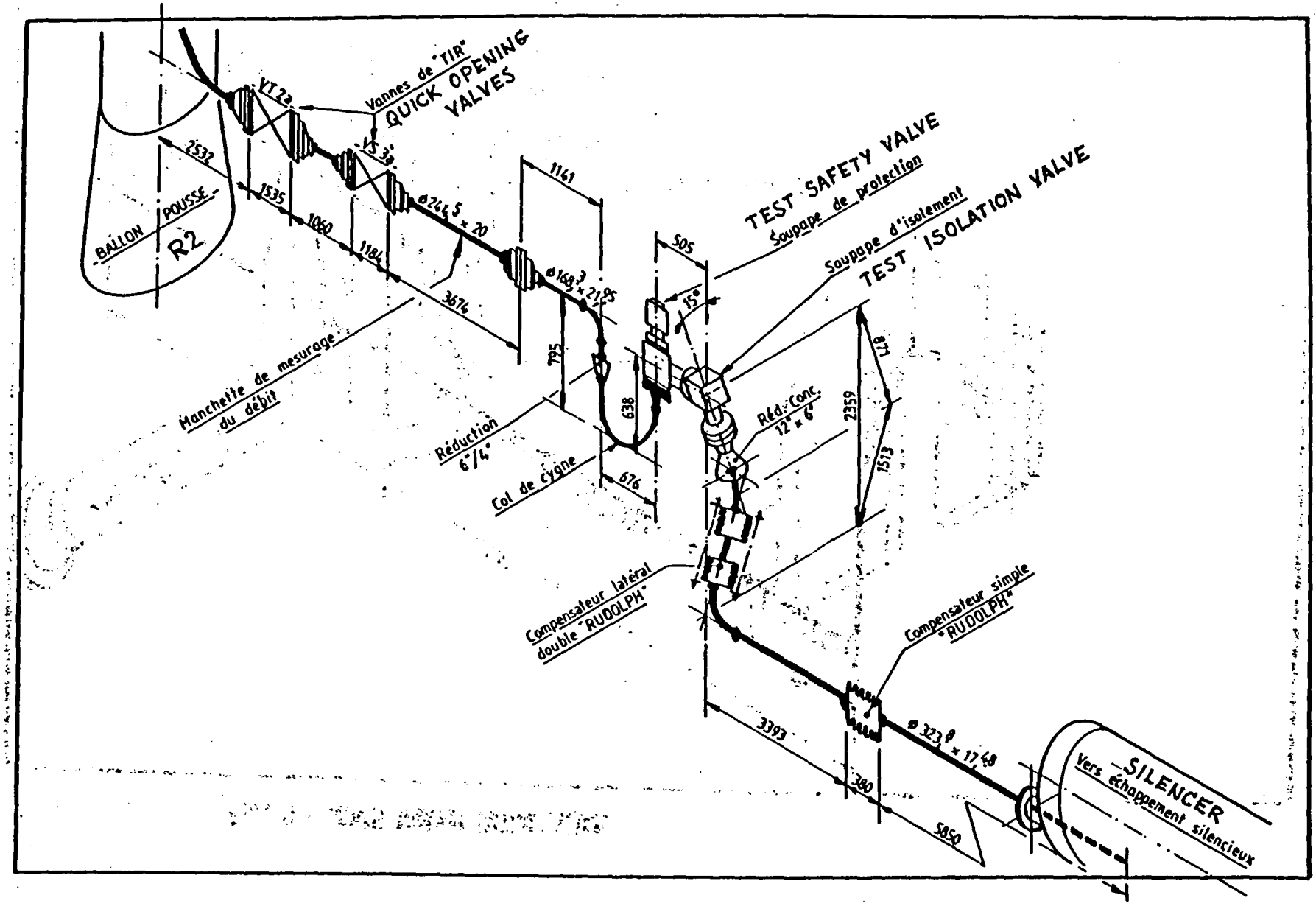


Fig. 4 : SEBIM TANDEM INSTALLATION

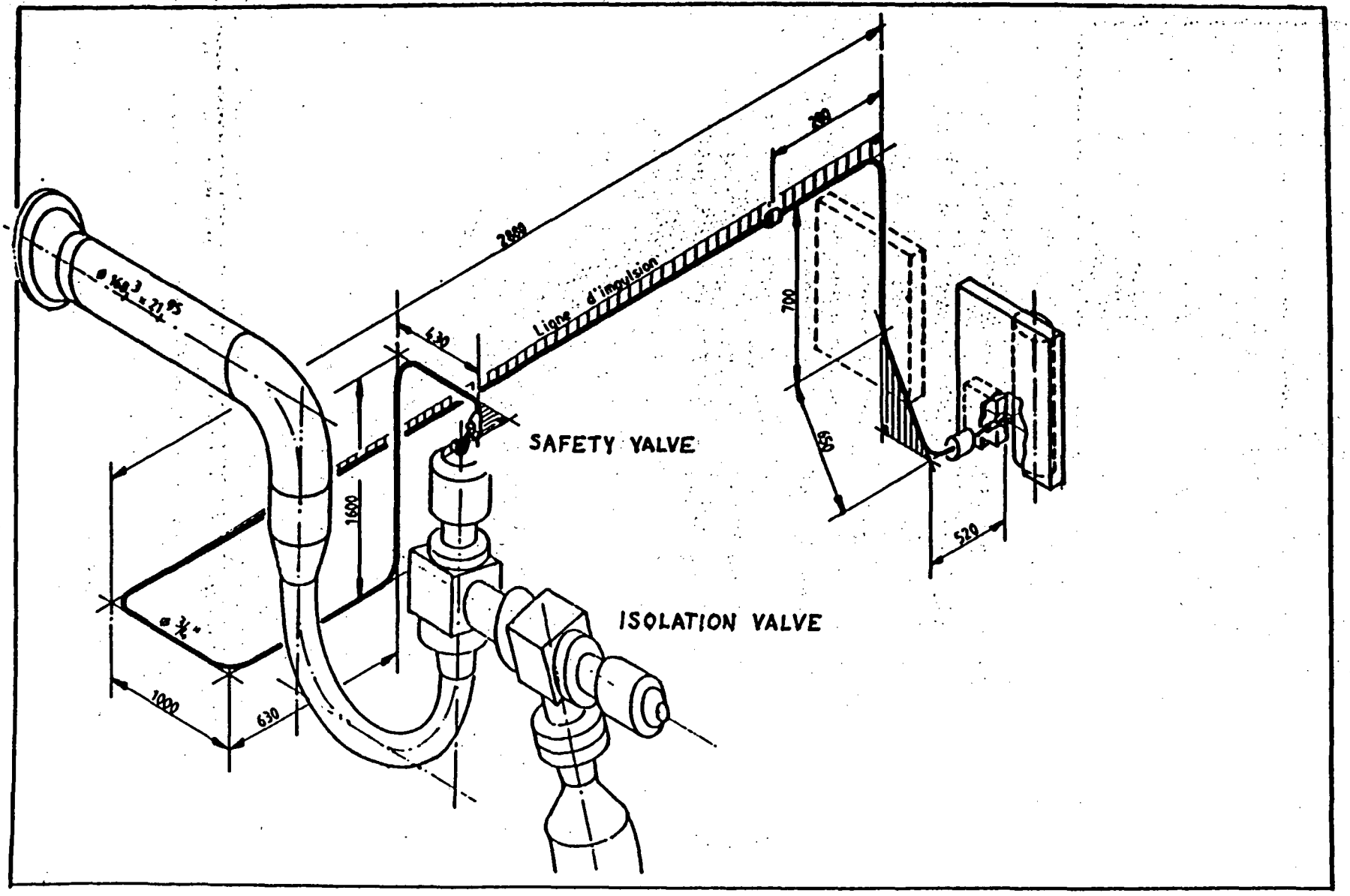


FIG. 5 : LAYOUT OF INSTRUMENTATION IN TEST SECTION

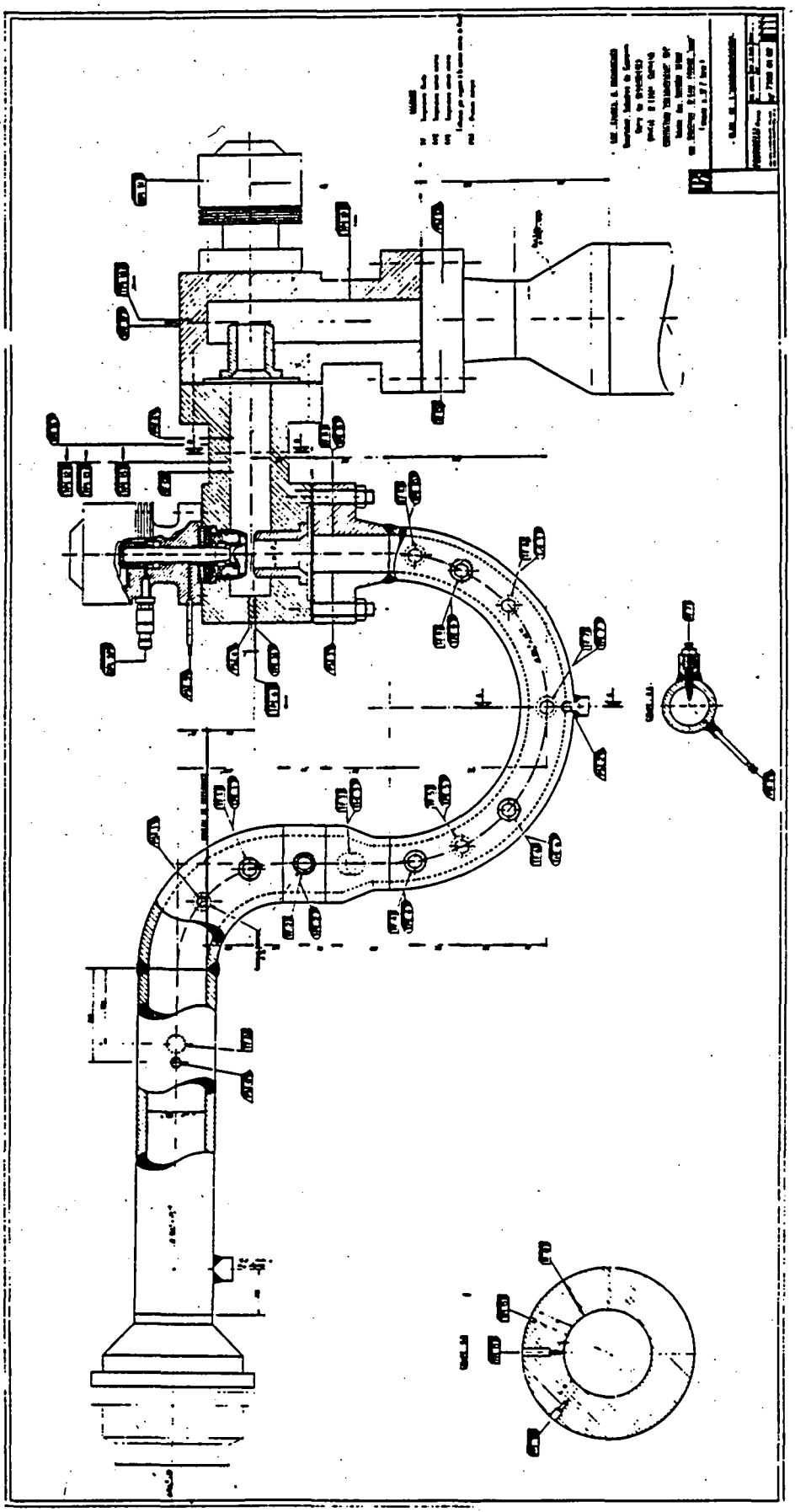


FIG. 6 : STEADY STATE RESULTS FOR TEST 1

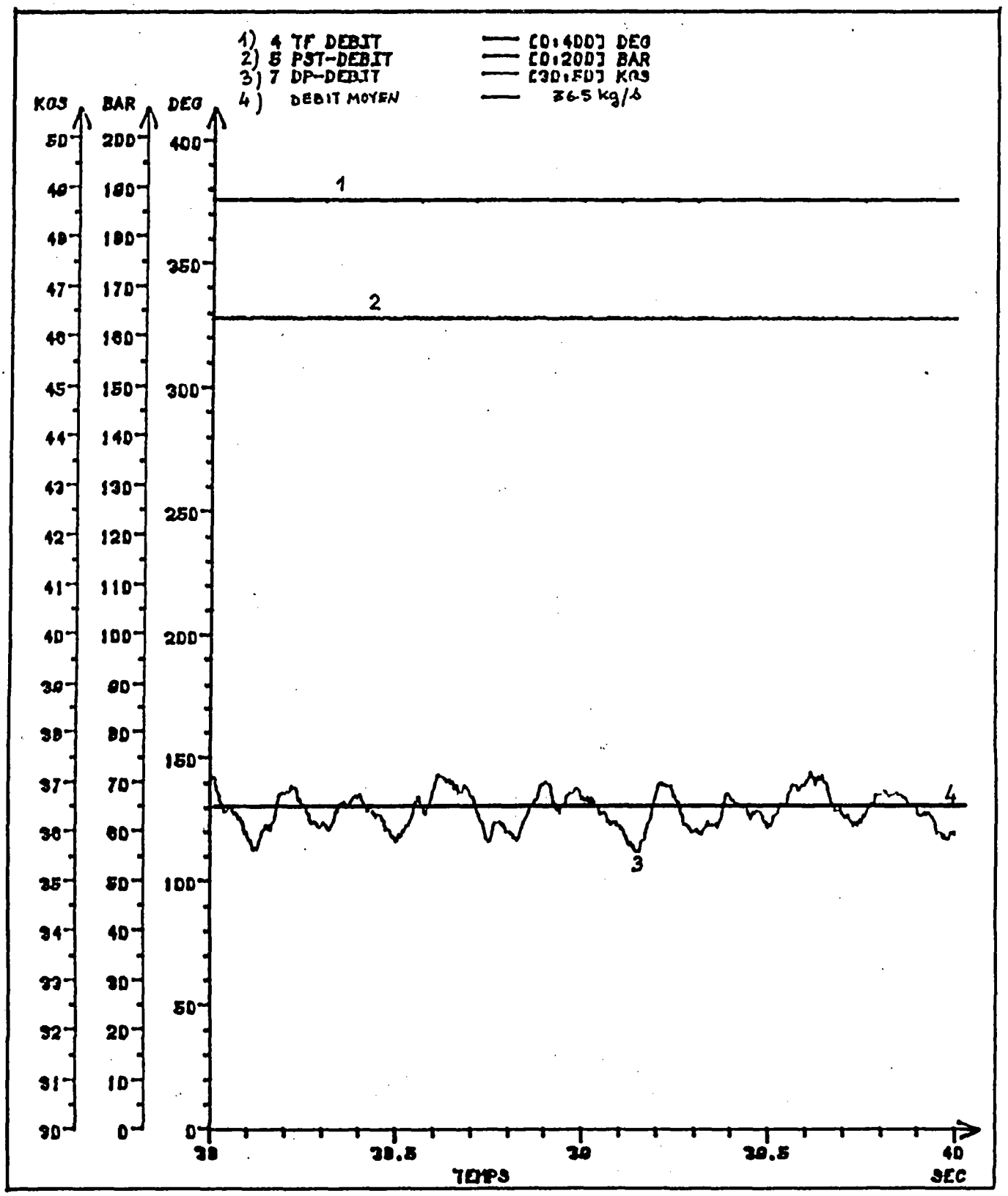


FIG. 7 : STEADY STATE RESULTS FOR TEST 4

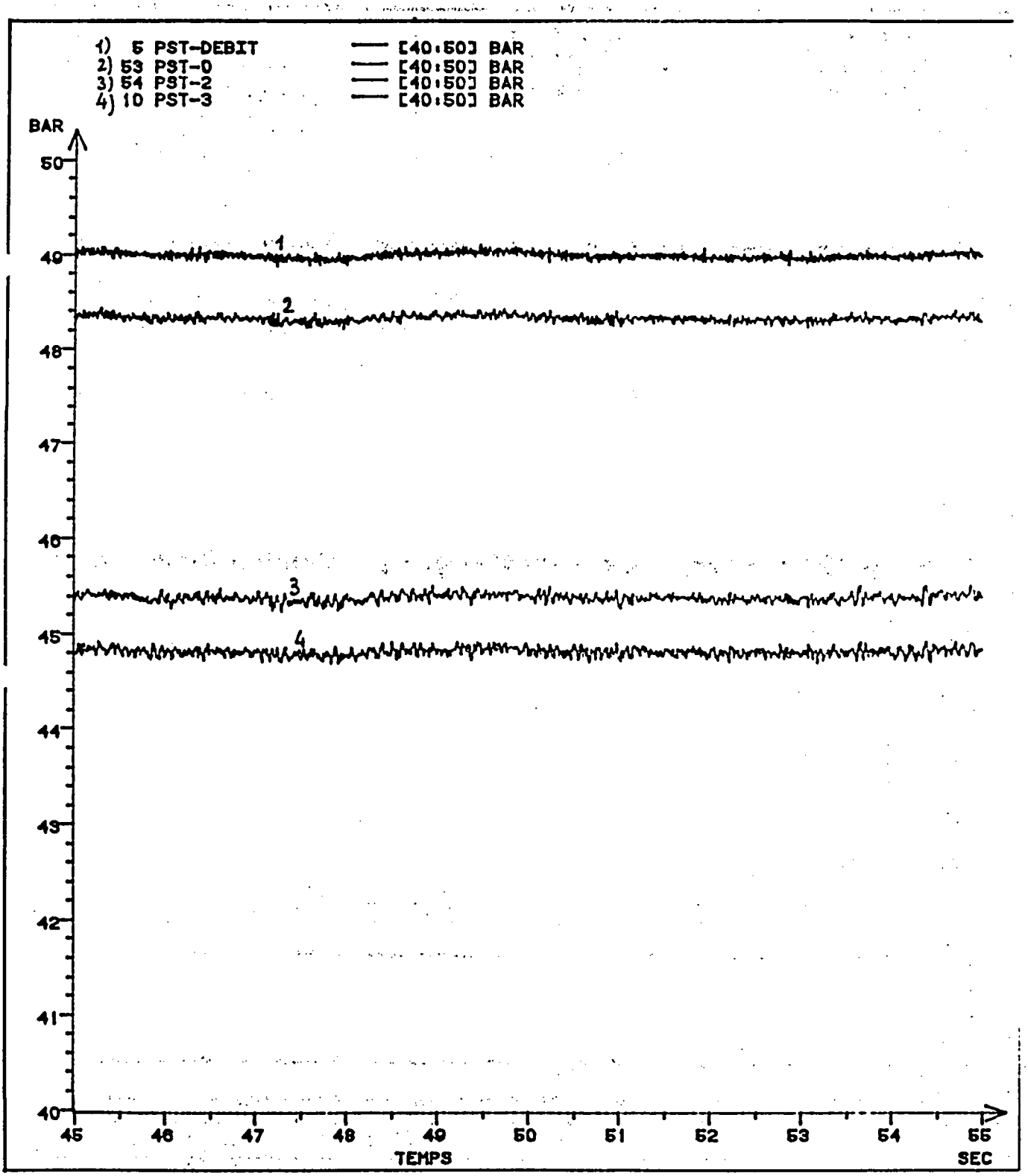


FIG. 8 : STEADY STATE RESULTS FOR TEST 4

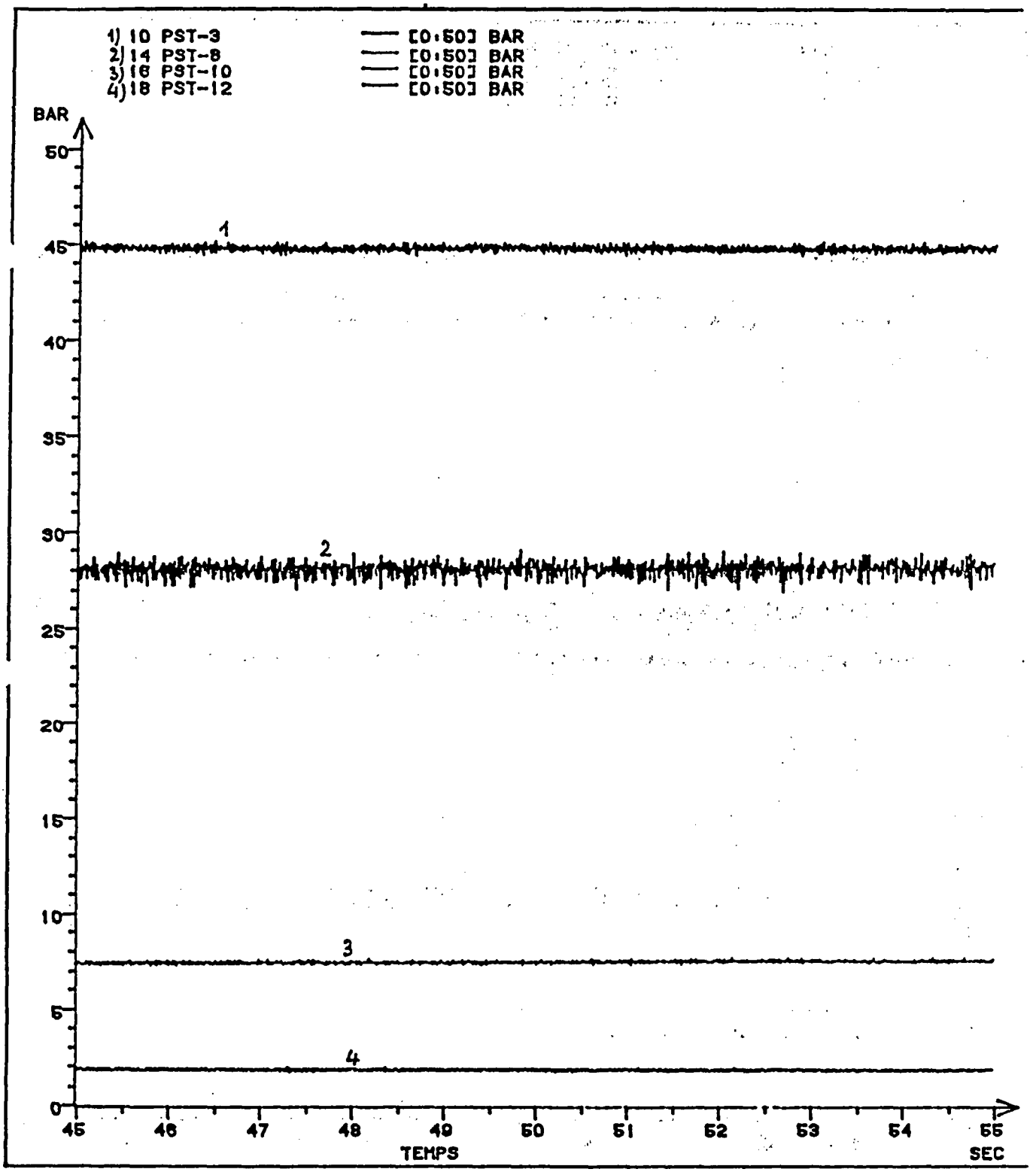


FIG. 9 : STEADY STATE RESULTS FOR TEST 5

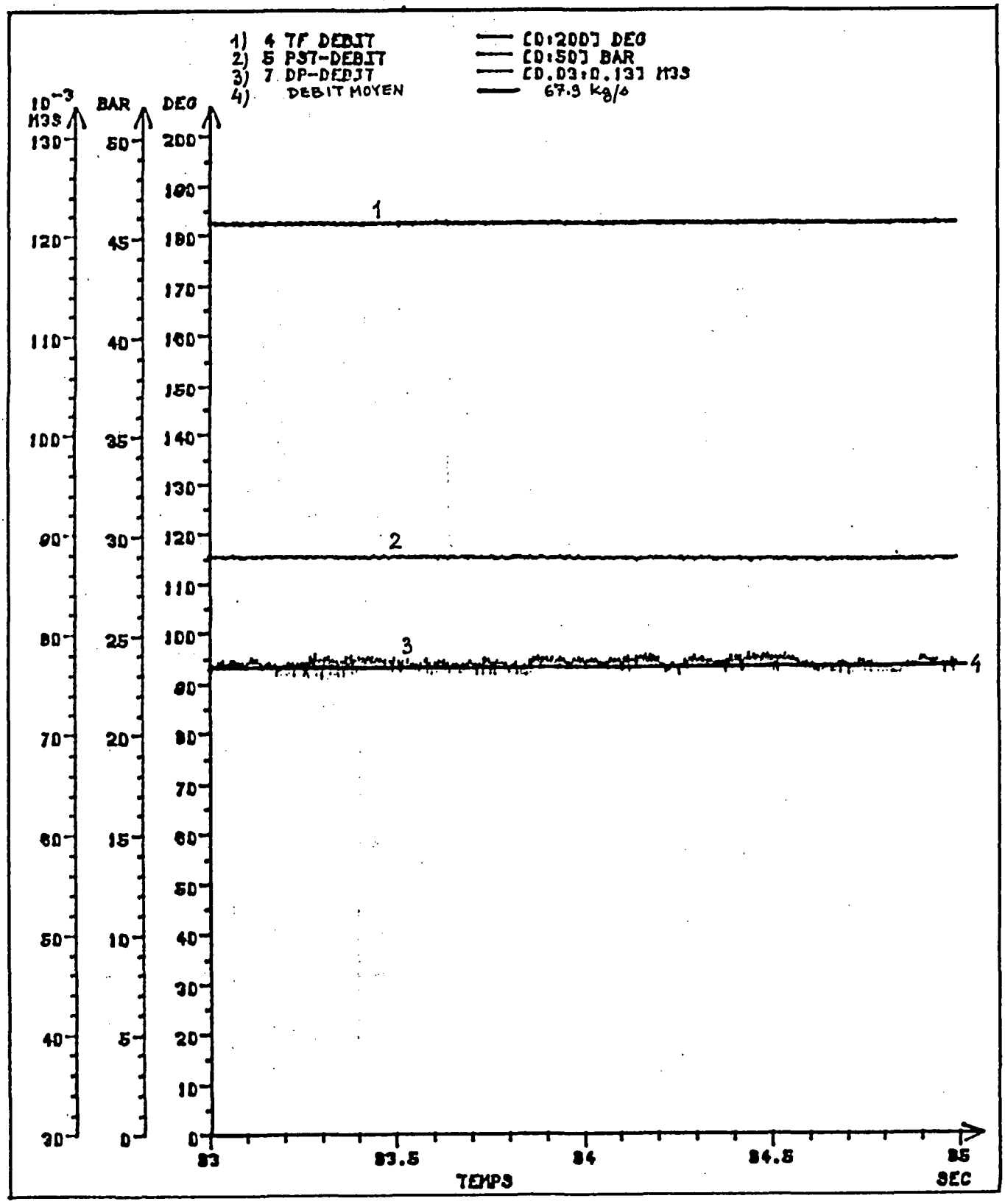
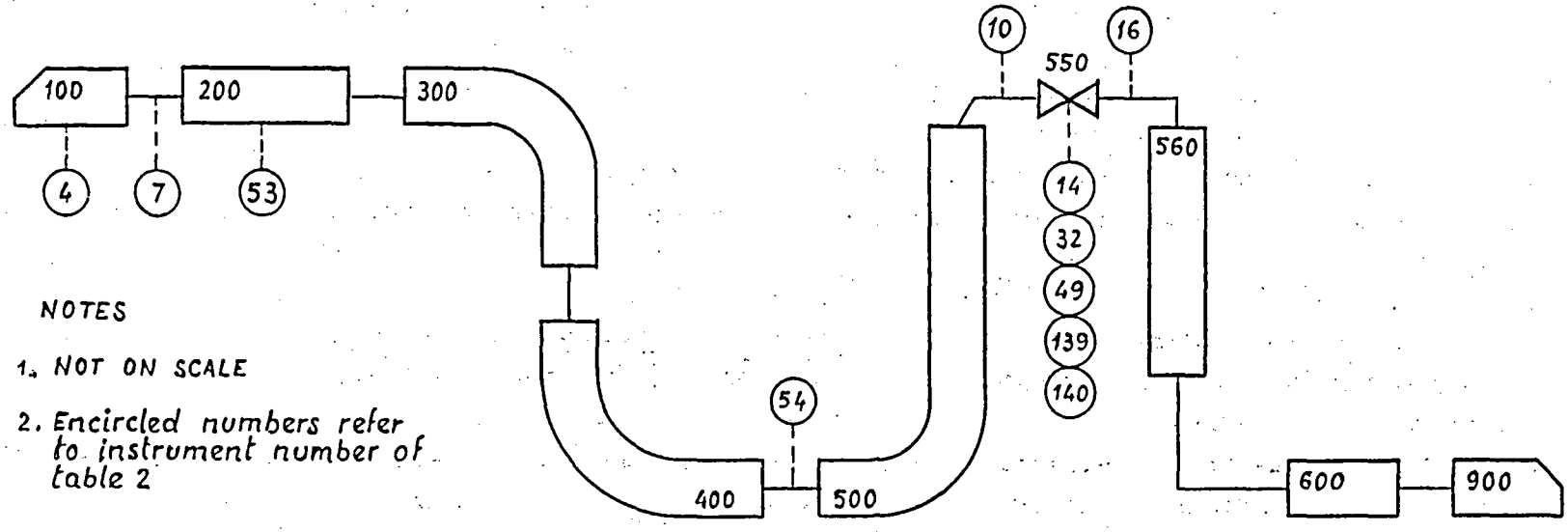


FIG. 10 : NODALISATION DIAGRAM FOR CUMULUS TEST SECTION

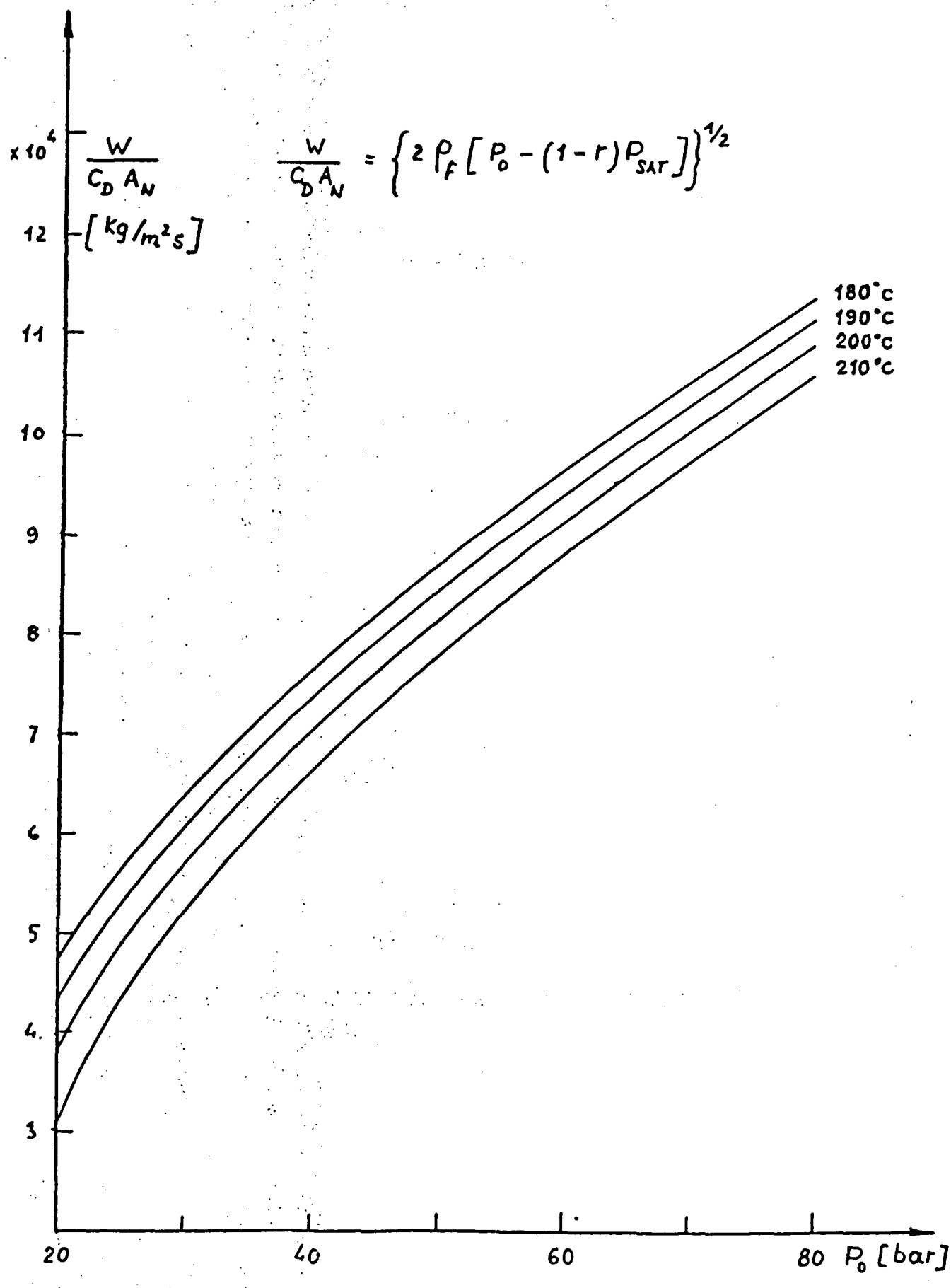


NOTES

1. NOT ON SCALE
2. Encircled numbers refer to instrument number of table 2

COMPONENT Nr	200	300	400	500	550	560	600	900
Cross section (m^2)	0,01215	0.01215	0.00503	0.00503	0.001963	0.006362	0.051923	10
Length (m)	0.4	0.517	0.601	0.698	ABRUPT	0.370	10.	1.
ΔH (m)	0.0	- 0.387	- 0.4075	+ 0.505	0	- 0.370	0.	0.
Internal ϕ (mm)	124.4	124.4	79.8	79.8	50 (inlet)	90	257	3568
Hor. $\measuredangle$ (°)	0	-90	- 90	+ 90	0	- 90	0	0
Component type	BRANCH	BRANCH	BRANCH	BRANCH	VALVE	BRANCH	BRANCH	TDV
Name	PST0	PST1	B 400	B 500	SEBIM	BRA 560	B 600	TV 900

FIG. 11 : SPECIFIC CRITICAL FLOW FOR SUBCOOLED WATER (ZALOUDEK)



APPENDIX 1

INPUT DECK

LISTING OF INPUT DATA FOR CASE 1

```
    1   =CUMULUS E001   ESSAI BUSE 50  ESSAI VAP  A 171 BAR 374 C
    2   100  NEW  TRANSNT
    3   101  RUN
    4   104  NONE
    5   201   10.   1.E-6  0.1  3  1  100  1000
    6   301  P  010010000
    7   302  P  200010000
    8   303  P  300010000
    9   304  P  400010000
   10   305  P  500010000
   11   *306  P  560010000
   12   310  TEMPG  010010000
   13   311  TEMPG  400010000
   14   312  TEMPG  500010000
   15   313  TEMPG  600010000
   16   314  VOIDG  400010000
   17   315  VOIDG  500010000
   18   316  VOIDG  600010000
   19   320  MFLOWJ 200010000
   20   *323  MFLOWJ 560010000
   21   322  MFLOWJ 550000000
   22   330  CNTRLVAR  550
   23   331  VLVAREA  550
   24   *
   25   501  TIME     0  GT  NULL  0  200.  L  *EOP
   26   502  CPUTIME  0  GT  NULL  0  9000. L  *EOP
   27   503  TIME     0  LT  NULL  0  900. N 0.
   28   600  501  502
   29   *
   30   0100000  TV010 TMDPVOL
   31   0100101  10. 1.  0.  0   0.  0.  0.  0.  00
   32   0100200  3
   33   0100201  0.  171.50E5  647.55
   34   *
   35   2000000 PST0  BRANCH
   36   2000001 1  1
   37   2000101 0.01215   0.4       0.  0.  00.0  0.  4.E-5  0.  00
   38   2000200  3   171.20E5  647.55
   39   2001101 010000000 200000000  00.00  0.  0.  00000
   40   2001201 0.0    0.0   0.0
   41   *
   42   3000000 PST1 BRANCH
   43   3000001 1  1
   44   3000101 0.01215   0.517     0.  0. -90. -.387 4.E-5  0.  00
   45   3000200  3   171.20E5  647.55
   46   3001101 200010000 300000000  00.00  .11 .11 00000
   47   3001201 0.0    0.0   0.0
   48   *
   49   4000000 B400 BRANCH
   50   4000001 1  1
   51   4000101 5.03E-3   0.601     0.  0. -90. -.4075  4.E-5  0.  00
   52   4000200  3   171.20E5  647.55
   53   4001101 300010000 400000000  00.00  0.  0.  00000
   54   4001201 0. 0.        0.0
   55   *
   56   5000000 B500 BRANCH
```

```
5000001 1  1
5000101 5.03E-3   0.698     0.  0.  90.0 +.505  4.E-5  0.  00
5000200  3  171.20E5  647.55
5001101 400010000 500000000  00.00 .143 .143 00000
5001201 0.     0.    0.0
*
5500000  SEBIM VALVE
5500101  500010000  600000000 1.963E-3 .0  0.0 00100  0.00  0.
5500201  1  0.0      0.0     0.0
5500300   SRVVLV
5500301  550
*
*5600000 BRA560 BRANCH
*5600001 1  1
*5600101  63.62E-4  .370     0.  0. -90.0   -.370  4.E-5  0.  00
*5600200  2  1.E5  1.
*5601101 560010000 600000000  00.00  0.  0.  00100
*5601201 0.     0.     0.0
*
6000000 B600 BRANCH
6000001 1  1
6000101 519.23E-4  10.     0.  0. -90.0 -10.  4.E-5  0.  00
6000200  2  1.E5  1.
6001101 600010000 900000000  00.00  0.  0.  00000
6001201 0.     0.     0.0
*
9000000  TV900 TMDPVOL
9000101  10. 1.  0.  0  0.  0.  0.  0.  00
9000200  2
9000201  0.  1.E5  1.
*
20555000  VLVAREA  SUM  1.  0.75  0  3  0.  1.
20555001  0.00392   -1.E-4  MFLOWJ 550000000
20555002          1.  CNTRLVAR  550
*
20555100  VLVAREA   TRIPUNIT .7717 .7717 0
20555101  503
*
************************************************************************
*  E N D   O F   D A T A                                               *
************************************************************************
```

PROCESSING TYPE IS NEW PROBLEM OPTION IS TRANSNT

INP-CHK, RUN OPTION IS RUN.

NO RESTART-PLOT FILE IS TO BE WRITTEN.

INPUT UNITS ARE ASSUMED SI OUTPUT UNITS ARE SI

REMAINING CPU TIME VALUES ARE 1.0 AND 2.0 SEC.

TIME STEP CONTROL DATA

END TIME (SEC)	MIN.TIME STEP (SEC)	MAX.TIME STEP (SEC)	OPTION	MINOR EDIT FREQUENCY	MAJOR EDIT FREQUENCY	RESTART FREQUENCY
1.000000E+01	1.000000E-06	1.000000E-01	3	1	100	1000

MINOR EDIT REQUESTS

REQ.NUM.	VARIABLE CODE	PARAMETER
301	P	10010000
302	P	200010000
303	P	300010000
304	P	400010000
305	P	500010000
310	TEMPG	10010000
311	TEMPG	400010000
312	TEMPG	500010000
313	TEMPG	600010000
314	VOIDG	400010000
315	VOIDG	500010000
316	VOIDG	600010000
320	MFLOWJ	200010000
322	MFLOWJ	550000000
330	CNTRLVAR	550
331	VLVAREA	550

EDIT OF COMPONENT INPUT DATA
(QUANTITIES PRINTED ARE INPUT VALUES, SET BY DEFAULT, OR SET BY ERROR RECOVERY)

INPUT DATA FOR COMPONENT 10, TV010 TMDPVOL , HAVING 1 VOLUMES AND 0 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
010010000	10.0000	1.00000	10.0000	0.	0.	0.

VOL.NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	EQUIL. FLAG
010010000	0.	3.56825	0

TABULAR DATA

TIME (SEC)	PRESSURE (PA)	TEMPERATURE (K)
0.	1.715000E+07	647.550

INPUT DATA FOR COMPONENT 200, PST0 BRANCH , HAVING 1 VOLUMES AND 1 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
200010000	1.215000E-02	.400000	4.860000E-03	0.	0.	0.

VOL NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	VOLUME FLAGS	I. C. FLAG	I.C.VALUE 1	I.C.VALUE 2	I.C.VALUE 3	I.C.VALUE 4	I.C.VALUE 5
200010000	4.000000E-05	.124378	0	3	1.7120E+07	647.6	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS
200010000	010000000	200000000	0.	0.	0.	00000

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
200010000	0.	0.

INPUT DATA FOR COMPONENT 300, PST1 BRANCH , HAVING 1 VOLUMES AND 1 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
300010000	1.215000E-02	.517000	6.281550E-03	0.	-90.0000	-.387000

VOL NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	VOLUME FLAGS	I. C. FLAG	I.C.VALUE 1	I.C.VALUE 2	I.C.VALUE 3	I.C.VALUE 4	I.C.VALUE 5
300010000	4.000000E-05	.124378	0	3	1.7120E+07	647.6	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS
300010000	200010000	300000000	0.	.110000	.110000	00000

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
300010000	0.	0.

INPUT DATA FOR COMPONENT 400, B400 BRANCH , HAVING 1 VOLUMES AND 1 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
400010000	5.030000E-03	.601000	3.023030E-03	0.	-90.0000	-.407500

VOL NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	VOLUME FLAGS	I. C. FLAG	I.C.VALUE 1	I.C.VALUE 2	I.C.VALUE 3	I.C.VALUE 4	I.C.VALUE 5
400010000	4.000000E-05	8.002746E-02	0	3	1.7120E+07	647.6	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS
400010000	300010000	400000000	0.	0.	0.	00000

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
400010000	0.	0.

INPUT DATA FOR COMPONENT 500, B500 BRANCH , HAVING 1 VOLUMES AND 1 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
500010000	5.030000E-03	.698000	3.510940E-03	0.	90.0000	.505000

VOL NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	VOLUME FLAGS	I. C. FLAG	I.C.VALUE 1	I.C.VALUE 2	I.C.VALUE 3	I.C.VALUE 4	I.C.VALUE 5
500010000	4.000000E-05	8.002746E-02	0	3	1.7120E+07	647.6	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS
500010000	400010000	500000000	0.	.143000	.143000	00000

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
500010000	0.	0.

INPUT DATA FOR COMPONENT 550, SEBIM VALVE , HAVING 0 VOLUMES AND 1 JUNCTIONS

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS	SUBCOOLED DISCHARGE COEF.	TWO-PHASE DISCHARGE COEF.55
0000000	500010000	600000000	1.963000E-03	.000000E+00	.000000E+00	00100	1.000000E+00	1.000000E+00

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
550000000	.000000E+00	.000000E+00

JUN.NO.	CONTROL NUMBER	TABLE NUMBER
550000000	550	0

INPUT DATA FOR COMPONENT 600, B600 BRANCH , HAVING 1 VOLUMES AND 1 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
600010000	5.192300E-02	10.0000	.519230	0.	-90.0000	-10.0000

VOL NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	VOLUME FLAGS	I. C. FLAG	I.C.VALUE 1	I.C.VALUE 2	I.C.VALUE 3	I.C.VALUE 4	I.C.VALUE 5
600010000	4.000000E-05	.257119	0	2	1.0000E+05	1.000	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	JUNCTION AREA (M2)	FORWARD LOSS COEFFICIENT	REVERSE LOSS COEFFICIENT	JUNCTION FLAGS
600010000	600010000	900000000	0.	0.	0.	00000

JUN.NO.	INIT. LIQ. FLOW (KG/SEC)	INIT. VAP. FLOW (KG/SEC)
600010000	0.	0.

INPUT DATA FOR COMPONENT 900, TV900 TMDPVOL , HAVING 1 VOLUMES AND 0 JUNCTIONS

VOL NO.	FLOW AREA (M2)	FLOW LENGTH (M)	VOLUME (M3)	HORIZ. ANGLE (DEG)	VERT. ANGLE (DEG)	ELEV. CHNG. (M)
900010000	10.0000	1.00000	10.0000	0.	0.	0.

VOL.NO.	ROUGHNESS (M)	HYDRAULIC DIAM. (M)	EQUIL. FLAG
900010000	0.	3.56825	0

TABULAR DATA

TIME (SEC)	PRESSURE (PA)	QUALITY
0.	100000.	1.00000

EDIT OF CONTROL COMPONENT INPUT DATA

```
CONTROL COMPONENT  550  VLVAREA            TYPE = SUM

          Y =   1.0000    *[    3.92000E-03
                          + -1.00000E-04*(MFLOWJ       550000000)
                          +   1.0000    *(CNTRLVAR           550)]
INITIALIZATION FLAG IS OFF, INPUT INITIAL VALUE IS    .750000
LOWER LIMIT IS     0.
UPPER LIMIT IS     1.00000

CONTROL COMPONENT  551  VLVAREA            TYPE = TRIPUNIT

          Y =   .77170    *UNITTRIP(  503)
INITIALIZATION FLAG IS OFF, INPUT INITIAL VALUE IS    .771700
```

EDIT TRIP DATA

TRIP NO.	LEFT VAR.	CODE	PARAMETER	REL.	RIGHT VAR.	CODE	PARAMETER	+	CONSTANT	LATCH OPTION	TRPTIM
501	TIME		0	GT	NULL		0		200.000	LATCH	-1.00000
502	CPUTIME		0	GT	NULL		0		9000.00	LATCH	-1.00000
503	TIME		0	LT	NULL		0		900.000	NOLATCH	0.

TRANSIENT ADVANCEMENT WILL BE TERMINATED BY TRIPS 501 AND 502.

REFERENCE VOLUMES AND ELEVATIONS FOR EACH LOOP AND SEGMENT FOR EACH HYDRODYNAMIC SYSTEM

VOL. NO.	INLET ELEV. (M)	OUTLET ELEV. (M)	VOL. NO.	INLET ELEV. (M)	OUTLET ELEV. (M)	VOL. NO.	INLET ELEV. (M)	OUTLET ELEV. (M)
REFERENCE VOLUME OF SYSTEM		1 NAMED	IS 10010000 AND HAS INLET ELEVATION 0. (M) .					
10010000	0.	0.	200010000	0.	0.	300010000	0.	-.387000
400010000	-.387000	-.794500	500010000	-.794500	-.289500	600010000	-.289500	-10.2895
900010000	-10.2895	-10.2895						

EDIT OF HYDRODYNAMIC COMPONENTS AFTER INPUT PROCESSING

NUMBER OF VOLUMES = 7, NUMBER OF JUNCTIONS = 6.

TOTAL SYSTEM MASS = 1.92401E+00 KG, TOTAL SYSTEM VOLUME = 5.36906E-01 M3.

VOL.NO.	PRESSURE (PA)	VOIDG	TEMPF (K)	TEMPG (K)	SAT. TEMP. (K)	NONCOND. VAPOR QUAL.	BORON DENS. (KG/M3)	UF (J/KG)	UG (J/KG)	VOL. FLAG
SYSTEM 1	MASS = 1.9240 KG		VOLUME= .53691 M3							
TV010	TMDPVOL	COMPONENT								
10-010000	1.71500E+07	1.0000	626.13	647.27	626.13	0.	0.	1.66772E+06	2.57474E+06	00
PST0	BRANCH	COMPONENT								
200-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
PST1	BRANCH	COMPONENT								
300-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B400	BRANCH	COMPONENT								
400-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B500	BRANCH	COMPONENT								
500-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B600	BRANCH	COMPONENT								
600-010000	1.00000E+05	1.0000	372.78	372.78	372.78	0.	0.	4.17407E+05	2.50606E+06	00
TV900	TMDPVOL	COMPONENT								
900-010000	1.00000E+05	1.0000	372.78	372.78	372.78	0.	0.	4.17407E+05	2.50606E+06	00

VOL.NO.	RHOF (KG/M3)	RHOG (KG/M3)	LIQ.V.VEL. (M/SEC)	VAP.V.VEL. (M/SEC)	SOUNDE (M/SEC)	STATIC QUAL.	TOT.HT.INP. (WATTS)	VAP.HT.INP. (WATTS)	VAPOR GEN. (KG/M3-SEC)
10-010000	562.02	91.807	0.	0.	482.31	1.0000	0.	0.	0.
200-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
300-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
400-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
500-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
600-010000	958.39	.59041	0.	0.	473.21	1.0000	0.	0.	0.
900-010000	958.39	.59041	0.	0.	473.21	1.0000	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	LIQ.J.VEL. (M/SEC)	VAP.J.VEL. (M/SEC)	MASS FLOW (KG/SEC)	JUN.AREA (M2)	THROAT RATIO	JUNCTION FLAGS	CHOKE FLAG	NO.ADVS.CHOKED EDIT	NO.ADVS.CHOKED TOTAL
SYSTEM 1											
PST0	BRANCH	COMPONENT									
200-010000	10-010000	200-010000	0.	0.	0.	1.21500E-02	1.0000	00000	0	0	0
PST1	BRANCH	COMPONENT									
300-010000	200-010000	300-010000	0.	0.	0.	1.21500E-02	1.0000	00000	0	0	0
B400	BRANCH	COMPONENT									
400-010000	300-010000	400-010000	0.	0.	0.	5.03000E-03	1.0000	00000	0	0	0
B500	BRANCH	COMPONENT									
500-010000	400-010000	500-010000	0.	0.	0.	5.03000E-03	1.0000	00000	0	0	0
SEBIM	VALVE	COMPONENT									
550-000000	500-010000	600-010000	0.	0.	0.	5.03000E-03	.29269	00100	0	0	0
B600	BRANCH	COMPONENT									
600-010000	600-010000	900-010000	0.	0.	0.	5.19230E-02	1.0000	00000	0	0	0

JUN.NO.	VOIDFJ	VOIDGJ	FROM	TO	FIJ (N-S2/M5)	FWALFJ	FWALGJ	FJUNF	FJUNR	FORMFJ	FORMGJ
200-010000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.
300-010000	0.	1.0000	X	X	0.	0.	0.	.110	.110	0.	0.
400-010000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.

```
500-010000  0.          1.0000      X    X    0.        0.        0.        .143      .143      0.        0.
550-000000  0.          1.0000      X    X    0.        0.        0.        0.        0.        0.        0.
600-010000  0.          1.0000      X    X    0.        0.        0.        0.        0.        0.        0.

                  CONTROL VARIABLE EDIT
 550   VLVAREA     SUM            .750000            551   VLVAREA     TRIPUNIT       .771700
```

$$$$ INPUT PROCESSING COMPLETED SUCCESSFULLY $$$$

LIST OF DYNAMIC STORAGE INFORMATION FOR TRANSIENT CALCULATION

NUM.	FILID	FILE INDEX	FILE SIZE
1	-17.	38779	442
2	3.	37905	5
3	8.	37910	68
4	9.	37978	541
5	10.	38519	212
6	-12.	601	13367
10	14.	38731	19
12	-4.	-65	33
16	16.	13968	-996
18	6.	14964	-26
20	15.	14990	-64
27	11.	38750	29
28	7.	15054	-9
30	13.	15063	-13

LIST OF FTB INFORMATION

```
FLS = 00163103     FLL = 00035344
SIZE =          0          0  536870847  536870911  536870911  536870911  536870911
 MAX =      39221      15076  536870912  536870912  536870912  536870912  536870912
 MIN =      39221      15076          1          1          1          1          1
NOLINK=  1   NOFILS = 17   LINK1 = 39221   LASDES = 39285   NEXDES = 39289   FA(1)(8) = 046106   LFA(1)(8) =00000000
```

				LINK 1					
ID	SETSIZ	NOSETS	BUFFER	UNIT	INDEX(10)	SIZE(10)	INDEX(8)	SIZE(8)	ADDR(8)
0.	0	0	0	1	39221	200	00114465	00000310	00162572
1.	37904	0	0	1	1	37904	00000001	00112020	00046106
-1.	600	0	0	2	1	600	00000001	00001130	00000000
11.	29	0	0	1	38750	29	00113536	00000035	00161643
3.	5	0	0	1	37905	5	00112021	00000005	00160126
4.	33	0	0	3	65	64	00000101	00000100	00000101
16.	996	0	0	2	13968	996	00033220	00001744	00033217
6.	26	0	0	2	14964	26	00035164	00000032	00035163
7.	9	0	0	2	15054	9	00035316	00000011	00035315
8.	68	0	0	1	37910	68	00112026	00000104	00160133
9.	541	0	0	1	37978	541	00112132	00001035	00160237
10.	212	0	0	1	38519	212	00113167	00000324	00161274
-12.	13367	0	0	2	601	13367	00001131	00032067	00001130
13.	13	0	0	2	15063	13	00035327	00000015	00035326
14.	19	0	0	1	38731	19	00113513	00000023	00161620
15.	64	0	0	2	14990	64	00035216	00000100	00035215
-17.	442	0	0	1	38779	442	00113573	00000672	00161700

ATTEMPTED ADV: TOT.= 0 EDIT= 0 MIN.DT= 0. SEC LAST DT= .100000 SEC MS.ERR= 0. KG
REPEATED ADV: TOT.= 0 EDIT= 0 MAX.DT= 0. SEC CRNT.DT= 0. SEC TOT.MS= 1.92401 KG
SUCCESSFUL ADV: TOT.= 0 EDIT= 0 AVG.DT= 0. SEC ERR.EST= 0. M.RATN= 0.
REQUESTED ADV: TOT.= 0 EDIT= 0 REQ.DT= .100000 SEC CPU= 1.15500 SEC TIME= 0. SEC

TRIP NUMBER, TRIP TIME (SEC)
501 -1.000000 502 -1.000000 503 0.

VOL.NO.	PRESSURE (PA)	VOIDG	TEMPF (K)	TEMPG (K)	SAT. TEMP. (K)	NONCOND. VAPOR QUAL.	BORON DENS. (KG/M3)	UF (J/KG)	UG (J/KG)	VOL. FLAG
SYSTEM 1	MASS= 1.9240 KG		MASS ERROR= 0. KG			ERR.EST.= 0.				
TV010	TMDPVOL	COMPONENT								
10-010000	1.71500E+07	1.0000	626.13	647.27	626.13	0.	0.	1.66772E+06	2.57474E+06	00
PST0	BRANCH	COMPONENT								
200-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
PST1	BRANCH	COMPONENT								
300-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B400	BRANCH	COMPONENT								
400-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B500	BRANCH	COMPONENT								
500-010000	1.71200E+07	1.0000	625.99	647.25	625.99	0.	0.	1.66650E+06	2.57557E+06	00
B600	BRANCH	COMPONENT								
600-010000	1.00000E+05	1.0000	372.78	372.78	372.78	0.	0.	4.17407E+05	2.50606E+06	00
TV900	TMDPVOL	COMPONENT								
900-010000	1.00000E+05	1.0000	372.78	372.78	372.78	0.	0.	4.17407E+05	2.50606E+06	00

VOL.NO.	RHOF (KG/M3)	RHOG (KG/M3)	LIQ.V.VEL. (M/SEC)	VAP.V.VEL. (M/SEC)	SOUNDE (M/SEC)	STATIC QUAL.	TOT.HT.INP. (WATTS)	VAP.HT.INP. (WATTS)	VAPOR GEN. (KG/M3-SEC)
10-010000	562.02	91.807	0.	0.	482.31	1.0000	0.	0.	0.
200-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
300-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
400-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
500-010000	562.64	91.508	0.	0.	479.80	1.0000	0.	0.	0.
600-010000	958.39	.59041	0.	0.	473.21	1.0000	0.	0.	0.
900-010000	958.39	.59041	0.	0.	473.21	1.0000	0.	0.	0.

JUN.NO.	FROM VOL.	TO VOL.	LIQ.J.VEL. (M/SEC)	VAP.J.VEL. (M/SEC)	MASS FLOW (KG/SEC)	JUN.AREA (M2)	THROAT RATIO	JUNCTION FLAGS	CHOKE FLAG	NO.ADVS.CHOKED EDIT	NO.ADVS.CHOKED TOTAL
SYSTEM 1											
PST0	BRANCH	COMPONENT									
200-010000	10-010000	200-010000	0.	0.	0.	1.21500E-02	1.0000	00000	0	0	0
PST1	BRANCH	COMPONENT									
300-010000	200-010000	300-010000	0.	0.	0.	1.21500E-02	1.0000	00000	0	0	0
B400	BRANCH	COMPONENT									
400-010000	300-010000	400-010000	0.	0.	0.	5.03000E-03	1.0000	00000	0	0	0
B500	BRANCH	COMPONENT									
500-010000	400-010000	500-010000	0.	0.	0.	5.03000E-03	1.0000	00000	0	0	0
SEBIM	VALVE	COMPONENT									
550-000000	500-010000	600-010000	0.	0.	0.	5.03000E-03	.29269	00100	0	0	0
B600	BRANCH	COMPONENT									
600-010000	600-010000	900-010000	0.	0.	0.	5.19230E-02	1.0000	00000	0	0	0

JUN.NO.	VOIDFJ	VOIDGJ	FROM	TO	FIJ (N-S2/M5)	FWALFJ	FWALGJ	FJUNF	FJUNR	FORMFJ	FORMGJ
200-010000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.

300-010000	0.	1.0000	X	X	0.	0.	0.	.110	.110	0.	0.
400-010000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.
500-010000	0.	1.0000	X	X	0.	0.	0.	.143	.143	0.	0.
550-000000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.
600-010000	0.	1.0000	X	X	0.	0.	0.	0.	0.	0.	0.

CONTROL VARIABLE EDIT

550 VLVAREA SUM .750000 551 VLVAREA TRIPUNIT .771700

NUMBER OF ELEMENTS IN SPARSE MATRIX 1: ORIGINAL = 18, FACTORED = 18 ROUNDOFF ERROR = 1.000000E-12 NCOUNT = 1

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 500010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)	TEMPG 600010000 (K)
0.	1.71500E+07	1.71200E+07	1.71200E+07	1.71200E+07	1.71200E+07	647.27	647.25	647.25	372.78
.100000	1.71500E+07	1.70875E+07	1.70747E+07	1.67559E+07	1.66365E+07	647.27	644.41	643.57	420.56
.200000	1.71500E+07	1.70908E+07	1.70819E+07	1.67805E+07	1.66790E+07	647.27	644.60	643.89	420.61
.300000	1.71500E+07	1.70908E+07	1.70815E+07	1.67799E+07	1.66769E+07	647.27	644.59	643.87	420.60
.400000	1.71500E+07	1.70909E+07	1.70814E+07	1.67801E+07	1.66766E+07	647.27	644.59	643.87	420.57
.500000	1.71500E+07	1.70909E+07	1.70815E+07	1.67805E+07	1.66770E+07	647.27	644.60	643.87	420.54
.600000	1.71500E+07	1.70910E+07	1.70815E+07	1.67810E+07	1.66775E+07	647.27	644.60	643.88	420.51
.700000	1.71500E+07	1.70911E+07	1.70816E+07	1.67815E+07	1.66781E+07	647.27	644.60	643.88	420.48
.800000	1.71500E+07	1.70912E+07	1.70817E+07	1.67819E+07	1.66787E+07	647.27	644.61	643.89	420.46
.900000	1.71500E+07	1.70912E+07	1.70818E+07	1.67824E+07	1.66793E+07	647.27	644.61	643.89	420.44
1.00000	1.71500E+07	1.70913E+07	1.70819E+07	1.67828E+07	1.66799E+07	647.27	644.61	643.90	420.42
1.10000	1.71500E+07	1.70914E+07	1.70820E+07	1.67833E+07	1.66806E+07	647.27	644.62	643.90	420.40
1.20000	1.71500E+07	1.70914E+07	1.70821E+07	1.67837E+07	1.66812E+07	647.27	644.62	643.90	420.38
1.30000	1.71500E+07	1.70915E+07	1.70822E+07	1.67841E+07	1.66818E+07	647.27	644.62	643.91	420.36
1.40000	1.71500E+07	1.70915E+07	1.70823E+07	1.67844E+07	1.66824E+07	647.27	644.63	643.91	420.35
1.50000	1.71500E+07	1.70916E+07	1.70823E+07	1.67847E+07	1.66829E+07	647.27	644.63	643.92	420.33
1.60000	1.71500E+07	1.70916E+07	1.70824E+07	1.67850E+07	1.66834E+07	647.27	644.63	643.92	420.32
1.70000	1.71500E+07	1.70917E+07	1.70825E+07	1.67853E+07	1.66838E+07	647.27	644.63	643.92	420.31
1.80000	1.71500E+07	1.70917E+07	1.70825E+07	1.67856E+07	1.66842E+07	647.27	644.64	643.93	420.30
1.90000	1.71500E+07	1.70917E+07	1.70826E+07	1.67858E+07	1.66845E+07	647.27	644.64	643.93	420.29
2.00000	1.71500E+07	1.70918E+07	1.70826E+07	1.67860E+07	1.66848E+07	647.27	644.64	643.93	420.28
2.10000	1.71500E+07	1.70918E+07	1.70827E+07	1.67862E+07	1.66851E+07	647.27	644.64	643.93	420.27
2.20000	1.71500E+07	1.70918E+07	1.70827E+07	1.67863E+07	1.66854E+07	647.27	644.64	643.94	420.26
2.30000	1.71500E+07	1.70919E+07	1.70828E+07	1.67865E+07	1.66856E+07	647.27	644.64	643.94	420.25
2.40000	1.71500E+07	1.70919E+07	1.70828E+07	1.67866E+07	1.66858E+07	647.27	644.64	643.94	420.25
2.50000	1.71500E+07	1.70919E+07	1.70828E+07	1.67868E+07	1.66860E+07	647.27	644.64	643.94	420.24
2.60000	1.71500E+07	1.70919E+07	1.70828E+07	1.67869E+07	1.66862E+07	647.27	644.65	643.94	420.23
2.70000	1.71500E+07	1.70919E+07	1.70829E+07	1.67870E+07	1.66863E+07	647.27	644.65	643.94	420.23
2.80000	1.71500E+07	1.70919E+07	1.70829E+07	1.67871E+07	1.66865E+07	647.27	644.65	643.94	420.22
2.90000	1.71500E+07	1.70920E+07	1.70829E+07	1.67872E+07	1.66866E+07	647.27	644.65	643.94	420.22
3.00000	1.71500E+07	1.70920E+07	1.70829E+07	1.67873E+07	1.66868E+07	647.27	644.65	643.95	420.22
3.10000	1.71500E+07	1.70920E+07	1.70830E+07	1.67874E+07	1.66869E+07	647.27	644.65	643.95	420.21
3.20000	1.71500E+07	1.70920E+07	1.70830E+07	1.67875E+07	1.66870E+07	647.27	644.65	643.95	420.21
3.30000	1.71500E+07	1.70920E+07	1.70830E+07	1.67875E+07	1.66871E+07	647.27	644.65	643.95	420.20
3.40000	1.71500E+07	1.70920E+07	1.70830E+07	1.67876E+07	1.66872E+07	647.27	644.65	643.95	420.20
3.50000	1.71500E+07	1.70920E+07	1.70830E+07	1.67876E+07	1.66873E+07	647.27	644.65	643.95	420.20
3.60000	1.71500E+07	1.70920E+07	1.70830E+07	1.67877E+07	1.66873E+07	647.27	644.65	643.95	420.20
3.70000	1.71500E+07	1.70920E+07	1.70830E+07	1.67877E+07	1.66874E+07	647.27	644.65	643.95	420.19
3.80000	1.71500E+07	1.70920E+07	1.70830E+07	1.67878E+07	1.66875E+07	647.27	644.65	643.95	420.19
3.90000	1.71500E+07	1.70921E+07	1.70831E+07	1.67878E+07	1.66875E+07	647.27	644.65	643.95	420.19
4.00000	1.71500E+07	1.70921E+07	1.70831E+07	1.67879E+07	1.66876E+07	647.27	644.65	643.95	420.19
4.10000	1.71500E+07	1.70921E+07	1.70831E+07	1.67879E+07	1.66876E+07	647.27	644.65	643.95	420.19
4.20000	1.71500E+07	1.70921E+07	1.70831E+07	1.67879E+07	1.66877E+07	647.27	644.65	643.95	420.19
4.30000	1.71500E+07	1.70921E+07	1.70831E+07	1.67880E+07	1.66877E+07	647.27	644.65	643.95	420.18
4.40000	1.71500E+07	1.70921E+07	1.70831E+07	1.67880E+07	1.66878E+07	647.27	644.65	643.95	420.18
4.50000	1.71500E+07	1.70921E+07	1.70831E+07	1.67880E+07	1.66878E+07	647.27	644.65	643.95	420.18
4.60000	1.71500E+07	1.70921E+07	1.70831E+07	1.67880E+07	1.66878E+07	647.27	644.65	643.95	420.18
4.70000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66879E+07	647.27	644.65	643.95	420.18
4.80000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66879E+07	647.27	644.65	643.95	420.18
4.90000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66879E+07	647.27	644.65	643.95	420.18

TIME (SEC)	VOIDG 400010000	VOIDG 500010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM	VLVAREA 550
0.	1.0000	1.0000	1.0000	0.	0.	.75000	.29269
.100000	1.0000	1.0000	.99981	40.764	40.847	.76025	.29676
.200000	1.0000	1.0000	.99979	39.582	39.536	.75958	.29644
.300000	1.0000	1.0000	.99979	39.604	39.578	.75885	.29616
.400000	1.0000	1.0000	.99979	39.587	39.570	.75817	.29590
.500000	1.0000	1.0000	.99979	39.561	39.548	.75754	.29565
.600000	1.0000	1.0000	.99979	39.534	39.523	.75695	.29542
.700000	1.0000	1.0000	.99979	39.508	39.497	.75642	.29521
.800000	1.0000	1.0000	.99979	39.482	39.472	.75592	.29502
.900000	1.0000	1.0000	.99979	39.458	39.447	.75546	.29484
1.00000	1.0000	1.0000	.99979	39.435	39.423	.75504	.29467
1.10000	1.0000	1.0000	.99979	39.413	39.400	.75466	.29452
1.20000	1.0000	1.0000	.99979	39.392	39.378	.75430	.29438
1.30000	1.0000	1.0000	.99979	39.373	39.357	.75397	.29425
1.40000	1.0000	1.0000	.99979	39.355	39.337	.75367	.29413
1.50000	1.0000	1.0000	.99979	39.338	39.319	.75339	.29402
1.60000	1.0000	1.0000	.99979	39.323	39.302	.75313	.29392
1.70000	1.0000	1.0000	.99979	39.309	39.287	.75289	.29383
1.80000	1.0000	1.0000	.99979	39.296	39.274	.75268	.29374
1.90000	1.0000	1.0000	.99979	39.285	39.262	.75247	.29366
2.00000	1.0000	1.0000	.99979	39.275	39.251	.75229	.29359
2.10000	1.0000	1.0000	.99979	39.265	39.240	.75212	.29352
2.20000	1.0000	1.0000	.99979	39.256	39.231	.75196	.29346
2.30000	1.0000	1.0000	.99979	39.248	39.223	.75181	.29340
2.40000	1.0000	1.0000	.99979	39.240	39.215	.75168	.29335
2.50000	1.0000	1.0000	.99979	39.234	39.208	.75155	.29330
2.60000	1.0000	1.0000	.99979	39.227	39.201	.75144	.29326
2.70000	1.0000	1.0000	.99979	39.221	39.195	.75133	.29321
2.80000	1.0000	1.0000	.99979	39.216	39.189	.75124	.29318
2.90000	1.0000	1.0000	.99979	39.211	39.184	.75115	.29314
3.00000	1.0000	1.0000	.99979	39.207	39.179	.75106	.29311
3.10000	1.0000	1.0000	.99979	39.202	39.175	.75099	.29308
3.20000	1.0000	1.0000	.99979	39.199	39.171	.75092	.29305
3.30000	1.0000	1.0000	.99979	39.195	39.167	.75085	.29303
3.40000	1.0000	1.0000	.99979	39.192	39.164	.75079	.29300
3.50000	1.0000	1.0000	.99979	39.189	39.161	.75074	.29298
3.60000	1.0000	1.0000	.99979	39.186	39.158	.75069	.29296
3.70000	1.0000	1.0000	.99979	39.183	39.155	.75064	.29294
3.80000	1.0000	1.0000	.99979	39.181	39.153	.75060	.29293
3.90000	1.0000	1.0000	.99979	39.179	39.150	.75056	.29291
4.00000	1.0000	1.0000	.99979	39.177	39.148	.75052	.29290
4.10000	1.0000	1.0000	.99979	39.175	39.146	.75049	.29288
4.20000	1.0000	1.0000	.99979	39.173	39.144	.75046	.29287
4.30000	1.0000	1.0000	.99979	39.172	39.143	.75043	.29286
4.40000	1.0000	1.0000	.99979	39.170	39.141	.75040	.29285
4.50000	1.0000	1.0000	.99979	39.169	39.140	.75038	.29284
4.60000	1.0000	1.0000	.99979	39.168	39.139	.75036	.29283
4.70000	1.0000	1.0000	.99979	39.167	39.138	.75034	.29282
4.80000	1.0000	1.0000	.99979	39.166	39.136	.75032	.29282
4.90000	1.0000	1.0000	.99979	39.165	39.135	.75030	.29281

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 500010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)	TEMPG 600010000 (K)
5.00000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66880E+07	647.27	644.65	643.95	420.18
5.10000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66880E+07	647.27	644.65	643.95	420.18
5.20000	1.71500E+07	1.70921E+07	1.70831E+07	1.67881E+07	1.66880E+07	647.27	644.65	643.95	420.17
5.30000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66880E+07	647.27	644.65	643.95	420.17
5.40000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66880E+07	647.27	644.65	643.95	420.17
5.50000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66880E+07	647.27	644.66	643.96	420.17
5.60000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
5.70000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
5.80000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
5.90000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.00000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.10000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.20000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.30000	1.71500E+07	1.70921E+07	1.70831E+07	1.67882E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.40000	1.71500E+07	1.70921E+07	1.70831E+07	1.67883E+07	1.66881E+07	647.27	644.66	643.96	420.17
6.50000	1.71500E+07	1.70921E+07	1.70831E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
6.60000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
6.70000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
6.80000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
6.90000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.00000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.10000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.20000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.30000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.40000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.50000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.60000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.70000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.80000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
7.90000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.00000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.10000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.20000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.30000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.40000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.50000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.60000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.70000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.80000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
8.90000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.00000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.10000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.20000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.30000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.40000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.50000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.60000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.70000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.80000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17
9.90000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17

TIME (SEC)	VOIDG 400010000	VOIDG 500010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM	VLVAREA 550
5.00000	1.0000	1.0000	.99979	39.164	39.135	.75028	.29280
5.10000	1.0000	1.0000	.99979	39.163	39.134	.75027	.29280
5.20000	1.0000	1.0000	.99979	39.162	39.133	.75026	.29279
5.30000	1.0000	1.0000	.99979	39.161	39.132	.75024	.29279
5.40000	1.0000	1.0000	.99979	39.161	39.131	.75023	.29278
5.50000	1.0000	1.0000	.99979	39.160	39.131	.75022	.29278
5.60000	1.0000	1.0000	.99979	39.160	39.130	.75021	.29277
5.70000	1.0000	1.0000	.99979	39.159	39.130	.75020	.29277
5.80000	1.0000	1.0000	.99979	39.159	39.129	.75019	.29277
5.90000	1.0000	1.0000	.99979	39.158	39.129	.75019	.29276
6.00000	1.0000	1.0000	.99979	39.158	39.128	.75018	.29276
6.10000	1.0000	1.0000	.99979	39.158	39.128	.75017	.29276
6.20000	1.0000	1.0000	.99979	39.157	39.128	.75017	.29276
6.30000	1.0000	1.0000	.99979	39.157	39.127	.75016	.29275
6.40000	1.0000	1.0000	.99979	39.157	39.127	.75015	.29275
6.50000	1.0000	1.0000	.99979	39.156	39.127	.75015	.29275
6.60000	1.0000	1.0000	.99979	39.156	39.127	.75015	.29275
6.70000	1.0000	1.0000	.99979	39.156	39.126	.75014	.29275
6.80000	1.0000	1.0000	.99979	39.156	39.126	.75014	.29274
6.90000	1.0000	1.0000	.99979	39.155	39.126	.75013	.29274
7.00000	1.0000	1.0000	.99979	39.155	39.126	.75013	.29274
7.10000	1.0000	1.0000	.99979	39.155	39.126	.75013	.29274
7.20000	1.0000	1.0000	.99979	39.155	39.125	.75013	.29274
7.30000	1.0000	1.0000	.99979	39.155	39.125	.75012	.29274
7.40000	1.0000	1.0000	.99979	39.155	39.125	.75012	.29274
7.50000	1.0000	1.0000	.99979	39.155	39.125	.75012	.29274
7.60000	1.0000	1.0000	.99979	39.155	39.125	.75012	.29274
7.70000	1.0000	1.0000	.99979	39.154	39.125	.75012	.29274
7.80000	1.0000	1.0000	.99979	39.154	39.125	.75011	.29274
7.90000	1.0000	1.0000	.99979	39.154	39.125	.75011	.29273
8.00000	1.0000	1.0000	.99979	39.154	39.125	.75011	.29273
8.10000	1.0000	1.0000	.99979	39.154	39.125	.75011	.29273
8.20000	1.0000	1.0000	.99979	39.154	39.124	.75011	.29273
8.30000	1.0000	1.0000	.99979	39.154	39.124	.75011	.29273
8.40000	1.0000	1.0000	.99979	39.154	39.124	.75011	.29273
8.50000	1.0000	1.0000	.99979	39.154	39.124	.75011	.29273
8.60000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
8.70000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
8.80000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
8.90000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.00000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.10000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.20000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.30000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.40000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.50000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.60000	1.0000	1.0000	.99979	39.154	39.124	.75010	.29273
9.70000	1.0000	1.0000	.99979	39.153	39.124	.75010	.29273
9.80000	1.0000	1.0000	.99979	39.153	39.124	.75010	.29273
9.90000	1.0000	1.0000	.99979	39.153	39.124	.75010	.29273

ATTEMPTED ADV: TOT.= 1779 EDIT= 1779 MIN.DT= 2.441406E-05 SEC LAST DT= 6.250000E-03 SEC MS.ERR= 4.604240E-03 KG
REPEATED ADV: TOT.= 13 EDIT= 13 MAX.DT= 6.250000E-03 SEC CRNT.DT= 6.986877E-03 SEC TOT.MS= 2.93715 KG
SUCCESSFUL ADV: TOT.= 1766 EDIT= 1766 AVG.DT= 5.662514E-03 SEC ERR.EST= 1.850323E-05 M.RATN= 1.567587E-03
REQUESTED ADV: TOT.= 100 EDIT= 100 REQ.DT= 1.000000E-01 SEC CPU= 164.939 SEC TIME= 10.0000 SEC

TRIP NUMBER, TRIP TIME (SEC)
501 -1.000000 502 -1.000000 503 0.

VOL.NO.	PRESSURE (PA)	VOIDG	TEMPF (K)	TEMPG (K)	SAT. TEMP. (K)	NONCOND. VAPOR QUAL.	BORON DENS. (KG/M3)	UF (J/KG)	UG (J/KG)	VOL. FLAG
SYSTEM 1	MASS= 2.9372 KG		MASS ERROR= 4.60424E-03 KG			ERR.EST.= 5.74705E-06				
TV010	TMDPVOL	COMPONENT								
10-010000	1.71500E+07	1.0000	626.13	647.27	626.13	0.	0.	1.66772E+06	2.57474E+06	00
PST0	BRANCH	COMPONENT								
200-010000	1.70921E+07	1.0000	625.85	646.86	625.85	0.	0.	1.66537E+06	2.57418E+06	00
PST1	BRANCH	COMPONENT								
300-010000	1.70832E+07	1.0000	625.81	646.80	625.81	0.	0.	1.66501E+06	2.57412E+06	00
B400	BRANCH	COMPONENT								
400-010000	1.67883E+07	1.0000	624.39	644.66	624.39	0.	0.	1.65343E+06	2.57157E+06	00
B500	BRANCH	COMPONENT								
500-010000	1.66882E+07	1.0000	623.90	643.96	623.90	0.	0.	1.64967E+06	2.57101E+06	00
B600	BRANCH	COMPONENT								
600-010000	4.40864E+05	.99979	420.31	420.17	420.31	0.	0.	6.19436E+05	2.55573E+06	00
TV900	TMDPVOL	COMPONENT								
900-010000	1.00000E+05	1.0000	372.78	372.78	372.78	0.	0.	4.17407E+05	2.50606E+06	00

VOL.NO.	RHOF (KG/M3)	RHOG (KG/M3)	LIQ.V.VEL. (M/SEC)	VAP.V.VEL. (M/SEC)	SOUNDE (M/SEC)	STATIC QUAL.	TOT.HT.INP. (WATTS)	VAP.HT.INP. (WATTS)	VAPOR GEN. (KG/M3-SEC)
10-010000	562.02	91.807	4.26475E-02	4.26475E-02	482.31	1.0000	0.	0.	0.
200-010000	563.22	91.518	35.156	35.156	479.44	1.0000	0.	0.	0.
300-010000	563.40	91.470	35.216	35.216	477.23	1.0000	0.	0.	0.
400-010000	569.40	89.991	85.790	85.780	465.47	1.0000	0.	0.	0.
500-010000	571.39	89.463	86.594	86.593	482.87	1.0000	0.	0.	0.
600-010000	919.40	2.3717	292.93	146.59	441.99	.92456	0.	0.	-5.6676
900-010000	958.39	.59041	1.5210	1.5287	473.21	1.0000	0.	0.	0.

VOL.NO.	LRGST.MASS ERR. EDIT	LRGST.MASS ERR. TOTAL	REDUCE-QUALITY EDIT	REDUCE-QUALITY TOTAL	REDUCE-EXTRAP. EDIT	REDUCE-EXTRAP. TOTAL	REDUCE-MASS EDIT	REDUCE-MASS TOTAL	REDUCE-PROPTY. EDIT	REDUCE-PROPTY. TOTAL	MIN.COURANT EDIT	MIN.COURANT TOTAL	REDUCE-COURANT EDIT	REDUCE-COURANT TOTAL
10-010000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200-010000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300-010000	18	18	0	0	0	0	0	0	0	0	0	0	0	0
400-010000	53	53	0	0	0	0	0	0	0	0	1714	1714	0	0
500-010000	1695	1695	0	0	0	0	0	0	0	0	51	51	796	796
600-010000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
900-010000	0	0	0	0	0	0	0	0	0	0	0	0	0	0

JUN.NO.	FROM VOL.	TO VOL.	LIQ.J.VEL. (M/SEC)	VAP.J.VEL. (M/SEC)	MASS FLOW (KG/SEC)	JUN.AREA (M2)	THROAT RATIO	JUNCTION FLAGS	CHOKE FLAG	NO.ADVS.CHOKED EDIT	NO.ADVS.CHOKED TOTAL
SYSTEM 1											
PST0	BRANCH	COMPONENT									
200-010000	10-010000	200-010000	35.101	35.101	39.153	1.21500E-02	1.0000	00000	0	0	0
PST1	BRANCH	COMPONENT									
300-010000	200-010000	300-010000	35.211	35.211	39.153	1.21500E-02	1.0000	00000	0	0	0
B400	BRANCH	COMPONENT									
400-010000	300-010000	400-010000	85.091	85.091	39.147	5.03000E-03	1.0000	00000	0	0	0

B500	BRANCH	COMPONENT									
500-010000	400-010000	500-010000	86.481	86.481	39.141	5.03000E-03	1.0000	00000	0	0	0
SEBIM	VALVE	COMPONENT									
550-000000	500-010000	600-010000	86.976	86.976	39.124	5.03000E-03	.29273	00100	1	1766	1766
B600	BRANCH	COMPONENT									
600-010000	600-010000	900-010000	292.93	294.42	39.206	5.19230E-02	1.0000	00000	1	1610	1610

JUN.NO.	VOIDFJ	VOIDGJ	FROM	TO	FIJ (N-S2/M5)	FWALFJ	FWALGJ	FJUNF	FJUNR	FORMFJ	FORMGJ
200-010000	0.	1.0000	MST	MST	7.8314	0.	2.446E-02	0.	0.	0.	0.
300-010000	0.	1.0000	MST	MST	7.8268	0.	5.596E-02	.110	.110	0.	0.
400-010000	0.	1.0000	MST	MST	5.6471	0.	6.833E-02	0.	0.	0.	0.
500-010000	0.	1.0000	MST	MST	7.5423	0.	.135	.143	.143	0.	0.
550-000000	0.	1.0000	MST	ANM	7.5044	0.	.823	0.	0.	28.4	28.4
600-010000	2.10449E-04	.99979	ANM	MST	354.05	0.	.160	0.	0.	0.	0.

CONTROL VARIABLE EDIT

550	VLVAREA	SUM	.750097	551	VLVAREA	TRIPUNIT	.771700

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 500010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)	TEMPG 600010000 (K)
10.0000	1.71500E+07	1.70921E+07	1.70832E+07	1.67883E+07	1.66882E+07	647.27	644.66	643.96	420.17

TIME (SEC)	VOIDG 400010000	VOIDG 500010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM	VLVAREA 550
10.0000	1.0000	1.0000	.99979	39.153	39.124	.75010	.29273

TRANSIENT TERMINATED BY END OF TIME STEP CARDS.

NO PLOTS MADE

ERROR SUMMARY

ERROR	TIMES
0115	1624

APPENDIX 2

RESULTS OF SENSIVITIES STUDY

LISTING AC-1

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 500010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)	TEMPG 600010000 (K)
.794500	1.70900E+07	1.70302E+07	1.70158E+07	1.67140E+07	1.66278E+07	650.56	647.77	647.16	419.48
.794600	1.70900E+07	1.70305E+07	1.70164E+07	1.67142E+07	1.66245E+07	650.56	647.77	647.14	419.48
.794700	1.70900E+07	1.70307E+07	1.70171E+07	1.67147E+07	1.66327E+07	650.56	647.77	647.20	419.47
.794800	1.70900E+07	1.70309E+07	1.70177E+07	1.67153E+07	1.66365E+07	650.56	647.78	647.23	419.47
.794900	1.70900E+07	1.70312E+07	1.70183E+07	1.67162E+07	1.66304E+07	650.56	647.78	647.18	419.47
.795000	1.70900E+07	1.70314E+07	1.70189E+07	1.67172E+07	1.66316E+07	650.56	647.79	647.19	419.47
.795100	1.70900E+07	1.70315E+07	1.70195E+07	1.67183E+07	1.66252E+07	650.56	647.80	647.14	419.48
.795200	1.70900E+07	1.70317E+07	1.70200E+07	1.67196E+07	1.66221E+07	650.56	647.81	647.12	419.48
.795300	1.70900E+07	1.70318E+07	1.70205E+07	1.67209E+07	1.66308E+07	650.56	647.82	647.19	419.47
.795400	1.70900E+07	1.70320E+07	1.70210E+07	1.67224E+07	1.66350E+07	650.56	647.83	647.22	419.47
.795500	1.70900E+07	1.70321E+07	1.70215E+07	1.67239E+07	1.66308E+07	650.56	647.84	647.19	419.47
.795600	1.70900E+07	1.70321E+07	1.70219E+07	1.67255E+07	1.66379E+07	650.56	647.86	647.24	419.47
.795700	1.70900E+07	1.70322E+07	1.70224E+07	1.67272E+07	1.66409E+07	650.56	647.87	647.27	419.47
.795800	1.70900E+07	1.70323E+07	1.70228E+07	1.67289E+07	1.66323E+07	650.56	647.88	647.20	419.47
.795900	1.70900E+07	1.70323E+07	1.70233E+07	1.67305E+07	1.66209E+07	650.56	647.89	647.11	419.48
.796000	1.70900E+07	1.70324E+07	1.70237E+07	1.67320E+07	1.66153E+07	650.56	647.91	647.06	419.48
.796100	1.70900E+07	1.70325E+07	1.70241E+07	1.67334E+07	1.66119E+07	650.56	647.92	647.04	419.48
.796200	1.70900E+07	1.70325E+07	1.70245E+07	1.67346E+07	1.66187E+07	650.56	647.93	647.09	419.48
.796300	1.70900E+07	1.70326E+07	1.70249E+07	1.67357E+07	1.66184E+07	650.56	647.93	647.09	419.48
.796400	1.70900E+07	1.70327E+07	1.70253E+07	1.67366E+07	1.66288E+07	650.56	647.94	647.17	419.47
.796500	1.70900E+07	1.70328E+07	1.70257E+07	1.67375E+07	1.66340E+07	650.56	647.95	647.21	419.47
.796600	1.70900E+07	1.70329E+07	1.70261E+07	1.67383E+07	1.66317E+07	650.56	647.95	647.19	419.47
.796700	1.70900E+07	1.70330E+07	1.70265E+07	1.67390E+07	1.66411E+07	650.56	647.96	647.27	419.47
.796800	1.70900E+07	1.70331E+07	1.70268E+07	1.67397E+07	1.66454E+07	650.56	647.96	647.30	419.47
.796900	1.70900E+07	1.70332E+07	1.70272E+07	1.67403E+07	1.66405E+07	650.56	647.97	647.26	419.47
.797000	1.70900E+07	1.70334E+07	1.70275E+07	1.67409E+07	1.66469E+07	650.56	647.97	647.31	419.47
.797100	1.70900E+07	1.70335E+07	1.70279E+07	1.67414E+07	1.66485E+07	650.56	647.98	647.33	419.47
.797200	1.70900E+07	1.70337E+07	1.70282E+07	1.67419E+07	1.66354E+07	650.56	647.98	647.22	419.47
.797300	1.70900E+07	1.70338E+07	1.70285E+07	1.67423E+07	1.66292E+07	650.56	647.98	647.18	419.47
.797400	1.70900E+07	1.70340E+07	1.70288E+07	1.67424E+07	1.66237E+07	650.56	647.99	647.13	419.48
.797500	1.70900E+07	1.70342E+07	1.70291E+07	1.67424E+07	1.66182E+07	650.56	647.99	647.09	419.48
.797600	1.70900E+07	1.70343E+07	1.70293E+07	1.67422E+07	1.66090E+07	650.56	647.98	647.01	419.49
.797700	1.70900E+07	1.70345E+07	1.70295E+07	1.67417E+07	1.66068E+07	650.56	647.98	647.00	419.49
.797800	1.70900E+07	1.70346E+07	1.70297E+07	1.67411E+07	1.66133E+07	650.56	647.98	647.05	419.48
.797900	1.70900E+07	1.70347E+07	1.70299E+07	1.67402E+07	1.66030E+07	650.56	647.97	646.97	419.49
.798000	1.70900E+07	1.70348E+07	1.70300E+07	1.67391E+07	1.65998E+07	650.56	647.96	646.94	419.49
.798100	1.70900E+07	1.70349E+07	1.70301E+07	1.67378E+07	1.65932E+07	650.56	647.95	646.89	419.50
.798200	1.70900E+07	1.70350E+07	1.70301E+07	1.67363E+07	1.65941E+07	650.56	647.94	646.90	419.50
.798300	1.70900E+07	1.70351E+07	1.70301E+07	1.67348E+07	1.66068E+07	650.56	647.93	647.00	419.49
.798400	1.70900E+07	1.70351E+07	1.70300E+07	1.67332E+07	1.66169E+07	650.56	647.91	647.08	419.49
.798500	1.70900E+07	1.70352E+07	1.70299E+07	1.67316E+07	1.66204E+07	650.56	647.90	647.10	419.49
.798600	1.70900E+07	1.70352E+07	1.70296E+07	1.67301E+07	1.66306E+07	650.56	647.89	647.19	419.48
.798700	1.70900E+07	1.70352E+07	1.70293E+07	1.67288E+07	1.66376E+07	650.56	647.88	647.24	419.48
.798800	1.70900E+07	1.70351E+07	1.70290E+07	1.67276E+07	1.66361E+07	650.56	647.87	647.23	419.48
.798900	1.70900E+07	1.70350E+07	1.70285E+07	1.67267E+07	1.66470E+07	650.56	647.87	647.32	419.48
.799000	1.70900E+07	1.70349E+07	1.70280E+07	1.67261E+07	1.66540E+07	650.56	647.86	647.37	419.47
.799100	1.70900E+07	1.70348E+07	1.70275E+07	1.67257E+07	1.66548E+07	650.56	647.86	647.38	419.47
.799200	1.70900E+07	1.70347E+07	1.70269E+07	1.67256E+07	1.66589E+07	650.56	647.86	647.41	419.47
.799300	1.70900E+07	1.70345E+07	1.70262E+07	1.67257E+07	1.66505E+07	650.56	647.86	647.34	419.48
.799400	1.70900E+07	1.70343E+07	1.70256E+07	1.67259E+07	1.66389E+07	650.56	647.86	647.25	419.48

TIME (SEC)	VOIDG 400010000	VOIDG 500010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM	VLVAREA 550
.794500	1.0000	1.0000	.99982	38.508	37.481	1.0000	.29269
.794600	1.0000	1.0000	.99982	38.518	38.772	1.0000	.29269
.794700	1.0000	1.0000	.99982	38.527	36.960	1.0000	.29269
.794800	1.0000	1.0000	.99982	38.534	37.650	1.0000	.29269
.794900	1.0000	1.0000	.99982	38.540	39.166	1.0000	.29269
.795000	1.0000	1.0000	.99982	38.545	38.020	1.0000	.29269
.795100	1.0000	1.0000	.99982	38.548	39.229	1.0000	.29269
.795200	1.0000	1.0000	.99982	38.550	38.695	1.0000	.29269
.795300	1.0000	1.0000	.99982	38.551	36.849	1.0000	.29269
.795400	1.0000	1.0000	.99982	38.552	37.549	1.0000	.29269
.795500	1.0000	1.0000	.99982	38.552	38.865	1.0000	.29269
.795600	1.0000	1.0000	.99982	38.551	37.086	1.0000	.29269
.795700	1.0000	1.0000	.99982	38.550	37.739	1.0000	.29269
.795800	1.0000	1.0000	.99982	38.549	39.483	.99997	.29269
.795900	1.0000	1.0000	.99982	38.547	39.993	.99989	.29269
.796000	1.0000	1.0000	.99982	38.545	39.105	.99990	.29269
.796100	1.0000	1.0000	.99982	38.542	38.767	.99995	.29269
.796200	1.0000	1.0000	.99982	38.540	37.243	1.0000	.29269
.796300	1.0000	1.0000	.99982	38.536	38.333	1.0000	.29269
.796400	1.0000	1.0000	.99982	38.533	36.671	1.0000	.29269
.796500	1.0000	1.0000	.99982	38.529	37.472	1.0000	.29269
.796600	1.0000	1.0000	.99982	38.524	38.665	1.0000	.29269
.796700	1.0000	1.0000	.99982	38.519	36.837	1.0000	.29269
.796800	1.0000	1.0000	.99982	38.513	37.659	1.0000	.29269
.796900	1.0000	1.0000	.99982	38.507	39.026	1.0000	.29269
.797000	1.0000	1.0000	.99982	38.499	37.346	1.0000	.29269
.797100	1.0000	1.0000	.99982	38.491	38.067	1.0000	.29269
.797200	1.0000	1.0000	.99982	38.482	40.229	.99990	.29269
.797300	1.0000	1.0000	.99982	38.473	39.274	.99989	.29269
.797400	1.0000	1.0000	.99982	38.462	39.203	.99989	.29269
.797500	1.0000	1.0000	.99982	38.451	39.209	.99989	.29269
.797600	1.0000	1.0000	.99982	38.439	39.802	.99983	.29269
.797700	1.0000	1.0000	.99982	38.427	38.716	.99988	.29269
.797800	1.0000	1.0000	.99982	38.413	37.477	1.0000	.29269
.797900	1.0000	1.0000	.99982	38.400	39.997	.99992	.29269
.798000	1.0000	1.0000	.99982	38.385	38.938	.99995	.29269
.798100	1.0000	1.0000	.99982	38.371	39.480	.99992	.29269
.798200	1.0000	1.0000	.99982	38.356	38.380	1.0000	.29269
.798300	1.0000	1.0000	.99982	38.341	36.638	1.0000	.29269
.798400	1.0000	1.0000	.99982	38.326	37.080	1.0000	.29269
.798500	1.0000	1.0000	.99982	38.310	38.009	1.0000	.29269
.798600	1.0000	1.0000	.99982	38.296	36.940	1.0000	.29269
.798700	1.0000	1.0000	.99982	38.281	37.447	1.0000	.29269
.798800	1.0000	1.0000	.99982	38.267	38.738	1.0000	.29269
.798900	1.0000	1.0000	.99982	38.254	36.827	1.0000	.29269
.799000	1.0000	1.0000	.99982	38.242	37.462	1.0000	.29269
.799100	1.0000	1.0000	.99982	38.230	38.327	1.0000	.29269
.799200	1.0000	1.0000	.99982	38.220	37.816	1.0000	.29269
.799300	1.0000	1.0000	.99982	38.211	39.677	.99995	.29269
.799400	1.0000	1.0000	.99982	38.204	40.110	.99986	.29269

LISTING A2-2

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 500010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)	TEMPG 600010000 (K)
1.71750	1.71500E+07	1.71082E+07	1.71018E+07	1.68887E+07	1.68221E+07	647.27	645.40	644.94	414.19
1.71800	1.71500E+07	1.71083E+07	1.71018E+07	1.68885E+07	1.68115E+07	647.27	645.39	644.86	414.19
1.71850	1.71500E+07	1.71083E+07	1.71018E+07	1.68883E+07	1.68157E+07	647.27	645.39	644.90	414.19
1.71900	1.71500E+07	1.71082E+07	1.71017E+07	1.68883E+07	1.68179E+07	647.27	645.39	644.91	414.19
1.71950	1.71500E+07	1.71082E+07	1.71016E+07	1.68887E+07	1.68214E+07	647.27	645.40	644.94	414.19
1.72000	1.71500E+07	1.71082E+07	1.71016E+07	1.68893E+07	1.68204E+07	647.27	645.40	644.93	414.19
1.72050	1.71500E+07	1.71082E+07	1.71017E+07	1.68903E+07	1.68245E+07	647.27	645.41	644.96	414.19
1.72100	1.71500E+07	1.71083E+07	1.71019E+07	1.68906E+07	1.68181E+07	647.27	645.41	644.91	414.19
1.72150	1.71500E+07	1.71084E+07	1.71022E+07	1.68912E+07	1.68244E+07	647.27	645.41	644.96	414.19
1.72200	1.71500E+07	1.71085E+07	1.71024E+07	1.68905E+07	1.68119E+07	647.27	645.41	644.87	414.19
1.72250	1.71500E+07	1.71085E+07	1.71024E+07	1.68895E+07	1.68145E+07	647.27	645.40	644.89	414.19
1.72300	1.71500E+07	1.71085E+07	1.71023E+07	1.68888E+07	1.68174E+07	647.27	645.40	644.91	414.19
1.72350	1.71500E+07	1.71085E+07	1.71020E+07	1.68885E+07	1.68181E+07	647.27	645.39	644.91	414.19
1.72400	1.71500E+07	1.71083E+07	1.71017E+07	1.68887E+07	1.68207E+07	647.27	645.40	644.93	414.19
1.72450	1.71500E+07	1.71082E+07	1.71014E+07	1.68889E+07	1.68184E+07	647.27	645.40	644.92	414.19
1.72500	1.71500E+07	1.71082E+07	1.71013E+07	1.68895E+07	1.68224E+07	647.27	645.40	644.95	414.19
1.72550	1.71500E+07	1.71082E+07	1.71013E+07	1.68894E+07	1.68146E+07	647.27	645.40	644.89	414.19
1.72600	1.71500E+07	1.71082E+07	1.71014E+07	1.68895E+07	1.68206E+07	647.27	645.40	644.93	414.19
1.72650	1.71500E+07	1.71082E+07	1.71015E+07	1.68886E+07	1.68098E+07	647.27	645.39	644.85	414.19
1.72700	1.71500E+07	1.71082E+07	1.71015E+07	1.68878E+07	1.68141E+07	647.27	645.39	644.88	414.19
1.72750	1.71500E+07	1.71082E+07	1.71013E+07	1.68871E+07	1.68132E+07	647.27	645.38	644.88	414.19
1.72800	1.71500E+07	1.71082E+07	1.71011E+07	1.68871E+07	1.68189E+07	647.27	645.38	644.92	414.19
1.72850	1.71500E+07	1.71081E+07	1.71009E+07	1.68869E+07	1.68119E+07	647.27	645.38	644.87	414.19
1.72900	1.71500E+07	1.71080E+07	1.71008E+07	1.68873E+07	1.68187E+07	647.27	645.38	644.92	414.19
1.72950	1.71500E+07	1.71080E+07	1.71007E+07	1.68869E+07	1.68096E+07	647.27	645.38	644.85	414.19
1.73000	1.71500E+07	1.71079E+07	1.71006E+07	1.68868E+07	1.68153E+07	647.27	645.38	644.89	414.19
1.73050	1.71500E+07	1.71079E+07	1.71006E+07	1.68866E+07	1.68124E+07	647.27	645.38	644.87	414.19
1.73100	1.71500E+07	1.71079E+07	1.71007E+07	1.68871E+07	1.68200E+07	647.27	645.38	644.93	414.19
1.73150	1.71500E+07	1.71079E+07	1.71008E+07	1.68869E+07	1.68099E+07	647.27	645.38	644.85	414.19
1.73200	1.71500E+07	1.71080E+07	1.71009E+07	1.68869E+07	1.68146E+07	647.27	645.38	644.89	414.19
1.73250	1.71500E+07	1.71080E+07	1.71009E+07	1.68870E+07	1.68153E+07	647.27	645.38	644.89	414.19
1.73300	1.71500E+07	1.71080E+07	1.71011E+07	1.68877E+07	1.68205E+07	647.27	645.39	644.93	414.19
1.73350	1.71500E+07	1.71081E+07	1.71013E+07	1.68882E+07	1.68160E+07	647.27	645.39	644.90	414.19
1.73400	1.71500E+07	1.71081E+07	1.71015E+07	1.68893E+07	1.68231E+07	647.27	645.40	644.95	414.19
1.73450	1.71500E+07	1.71082E+07	1.71017E+07	1.68892E+07	1.68116E+07	647.27	645.40	644.87	414.19
1.73500	1.71500E+07	1.71083E+07	1.71019E+07	1.68888E+07	1.68150E+07	647.27	645.40	644.89	414.19
1.73550	1.71500E+07	1.71083E+07	1.71020E+07	1.68887E+07	1.68177E+07	647.27	645.40	644.91	414.19
1.73600	1.71500E+07	1.71083E+07	1.71019E+07	1.68889E+07	1.68198E+07	647.27	645.40	644.93	414.19
1.73650	1.71500E+07	1.71083E+07	1.71019E+07	1.68893E+07	1.68211E+07	647.27	645.40	644.94	414.19
1.73700	1.71500E+07	1.71083E+07	1.71019E+07	1.68900E+07	1.68218E+07	647.27	645.41	644.94	414.19
1.73750	1.71500E+07	1.71083E+07	1.71020E+07	1.68906E+07	1.68222E+07	647.27	645.41	644.94	414.19
1.73800	1.71500E+07	1.71084E+07	1.71022E+07	1.68912E+07	1.68220E+07	647.27	645.41	644.94	414.19
1.73850	1.71500E+07	1.71085E+07	1.71024E+07	1.68915E+07	1.68219E+07	647.27	645.42	644.94	414.19
1.73900	1.71500E+07	1.71085E+07	1.71026E+07	1.68916E+07	1.68211E+07	647.27	645.42	644.94	414.19
1.73950	1.71500E+07	1.71086E+07	1.71027E+07	1.68915E+07	1.68211E+07	647.27	645.42	644.94	414.19
1.74000	1.71500E+07	1.71087E+07	1.71028E+07	1.68913E+07	1.68197E+07	647.27	645.41	644.93	414.19
1.74050	1.71500E+07	1.71087E+07	1.71027E+07	1.68910E+07	1.68203E+07	647.27	645.41	644.93	414.19
1.74100	1.71500E+07	1.71086E+07	1.71025E+07	1.68905E+07	1.68177E+07	647.27	645.41	644.91	414.19
1.74150	1.71500E+07	1.71086E+07	1.71023E+07	1.68902E+07	1.68200E+07	647.27	645.41	644.93	414.18
1.74200	1.71500E+07	1.71085E+07	1.71019E+07	1.68894E+07	1.68141E+07	647.27	645.40	644.88	414.19

TIME (SEC)	VOIDG 400010000	VOIDG 500010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM	VLVAREA 550
1.71750	1.0000	1.0000	.99983	33.320	33.049	1.0000	.24781
1.71800	1.0000	1.0000	.99983	33.314	33.639	1.0000	.24781
1.71850	1.0000	1.0000	.99983	33.309	33.186	1.0000	.24781
1.71900	1.0000	1.0000	.99983	33.306	33.243	1.0000	.24781
1.71950	1.0000	1.0000	.99983	33.303	33.191	1.0000	.24781
1.72000	1.0000	1.0000	.99983	33.301	33.314	1.0000	.24781
1.72050	1.0000	1.0000	.99983	33.299	33.142	1.0000	.24781
1.72100	1.0000	1.0000	.99983	33.295	33.463	1.0000	.24781
1.72150	1.0000	1.0000	.99983	33.288	33.060	1.0000	.24781
1.72200	1.0000	1.0000	.99983	33.279	33.660	1.0000	.24781
1.72250	1.0000	1.0000	.99983	33.269	33.213	1.0000	.24781
1.72300	1.0000	1.0000	.99983	33.260	33.197	1.0000	.24781
1.72350	1.0000	1.0000	.99983	33.253	33.260	1.0000	.24781
1.72400	1.0000	1.0000	.99983	33.250	33.186	1.0000	.24781
1.72450	1.0000	1.0000	.99983	33.251	33.333	1.0000	.24781
1.72500	1.0000	1.0000	.99983	33.254	33.122	1.0000	.24781
1.72550	1.0000	1.0000	.99983	33.258	33.497	1.0000	.24781
1.72600	1.0000	1.0000	.99983	33.258	33.064	1.0000	.24781
1.72650	1.0000	1.0000	.99983	33.259	33.605	1.0000	.24781
1.72700	1.0000	1.0000	.99983	33.259	33.148	1.0000	.24781
1.72750	1.0000	1.0000	.99983	33.259	33.317	1.0000	.24781
1.72800	1.0000	1.0000	.99983	33.262	33.096	1.0000	.24781
1.72850	1.0000	1.0000	.99983	33.266	33.500	1.0000	.24781
1.72900	1.0000	1.0000	.99983	33.272	33.061	1.0000	.24781
1.72950	1.0000	1.0000	.99983	33.280	33.576	1.0000	.24781
1.73000	1.0000	1.0000	.99983	33.288	33.115	1.0000	.24781
1.73050	1.0000	1.0000	.99983	33.295	33.389	1.0000	.24781
1.73100	1.0000	1.0000	.99983	33.302	33.050	1.0000	.24781
1.73150	1.0000	1.0000	.99983	33.308	33.616	1.0000	.24781
1.73200	1.0000	1.0000	.99983	33.313	33.160	1.0000	.24781
1.73250	1.0000	1.0000	.99983	33.316	33.285	1.0000	.24781
1.73300	1.0000	1.0000	.99983	33.319	33.129	1.0000	.24781
1.73350	1.0000	1.0000	.99983	33.320	33.433	1.0000	.24781
1.73400	1.0000	1.0000	.99983	33.319	33.055	1.0000	.24781
1.73450	1.0000	1.0000	.99983	33.315	33.651	1.0000	.24781
1.73500	1.0000	1.0000	.99983	33.310	33.201	1.0000	.24781
1.73550	1.0000	1.0000	.99983	33.304	33.217	1.0000	.24781
1.73600	1.0000	1.0000	.99983	33.298	33.231	1.0000	.24781
1.73650	1.0000	1.0000	.99983	33.292	33.239	1.0000	.24781
1.73700	1.0000	1.0000	.99983	33.287	33.247	1.0000	.24781
1.73750	1.0000	1.0000	.99983	33.282	33.248	1.0000	.24781
1.73800	1.0000	1.0000	.99983	33.276	33.256	1.0000	.24781
1.73850	1.0000	1.0000	.99983	33.268	33.249	1.0000	.24781
1.73900	1.0000	1.0000	.99983	33.258	33.264	1.0000	.24781
1.73950	1.0000	1.0000	.99983	33.247	33.241	1.0000	.24781
1.74000	1.0000	1.0000	.99983	33.235	33.279	1.0000	.24781
1.74050	1.0000	1.0000	.99983	33.224	33.217	1.0000	.24781
1.74100	1.0000	1.0000	.99983	33.214	33.318	1.0000	.24781
1.74150	1.0000	1.0000	.99983	33.207	33.162	1.0000	.24781
1.74200	1.0000	1.0000	.99983	33.204	33.424	1.0000	.24781

LISTING AE-3

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	TEMPG 10010000 (K)	TEMPG 200010000 (K)	VOIDG 200010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	VOIDGJ 550000000	EMASS (KG)
6.00000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.528	1.0000	-3.75876E-02
6.02000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.841	35.861	1.0000	-3.74455E-02
6.04000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.528	1.0000	-3.75815E-02
6.06000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74394E-02
6.08000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.528	1.0000	-3.75754E-02
6.10000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74334E-02
6.12000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.528	1.0000	-3.75693E-02
6.14000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74274E-02
6.16000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.528	1.0000	-3.75633E-02
6.18000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74215E-02
6.20000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75574E-02
6.22000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74156E-02
6.24000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75516E-02
6.26000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74098E-02
6.28000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75457E-02
6.30000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.840	35.861	1.0000	-3.74041E-02
6.32000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75400E-02
6.34000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73984E-02
6.36000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75343E-02
6.38000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73927E-02
6.40000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75286E-02
6.42000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73871E-02
6.44000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75230E-02
6.46000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73816E-02
6.48000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.529	1.0000	-3.75175E-02
6.50000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73761E-02
6.52000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.530	1.0000	-3.75120E-02
6.54000	1.71500E+07	1.71495E+07	641.21	641.26	1.0000	35.839	35.861	1.0000	-3.73706E-02
6.56000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.530	1.0000	-3.75066E-02
6.58000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.839	35.861	1.0000	-3.73653E-02
6.60000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.530	1.0000	-3.75012E-02
6.62000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73599E-02
6.64000	1.71500E+07	1.71496E+07	641.21	641.26	1.0000	32.584	32.530	1.0000	-3.74959E-02
6.66000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73546E-02
6.68000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.530	1.0000	-3.74906E-02
6.70000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73494E-02
6.72000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.530	1.0000	-3.74854E-02
6.74000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73442E-02
6.76000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.530	1.0000	-3.74802E-02
6.78000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73391E-02
6.80000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.530	1.0000	-3.74750E-02
6.82000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73340E-02
6.84000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.531	1.0000	-3.74700E-02
6.86000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73289E-02
6.88000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.531	1.0000	-3.74649E-02
6.90000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.838	35.861	1.0000	-3.73240E-02
6.92000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.531	1.0000	-3.74599E-02
6.94000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.837	35.861	1.0000	-3.73190E-02
6.96000	1.71500E+07	1.71496E+07	641.21	641.25	1.0000	32.584	32.531	1.0000	-3.74550E-02
6.98000	1.71500E+07	1.71495E+07	641.21	641.25	1.0000	35.837	35.861	1.0000	-3.73141E-02

TIME (SEC)	UFJ 550000000 (J/KG)	UGJ 550000000 (J/KG)	VELFJ 550000000 (M/SEC)	VELGJ 550000000 (M/SEC)	RHOFJ 550000000 (KG/M3)	RHOGJ 550000000 (KG/M3)	SOUNDE 200010000 (M/SEC)	QUALS 200010000	QUALE 200010000
6.00000	1.66770E+06	2.53744E+06	.19780	.19780	562.03	97.019	455.86	1.0000	1.0000
6.02000	1.66769E+06	2.53743E+06	.21807	.21807	562.03	97.019	455.85	1.0000	1.0000
6.04000	1.66770E+06	2.53743E+06	.19780	.19780	562.03	97.019	455.85	1.0000	1.0000
6.06000	1.66769E+06	2.53743E+06	.21807	.21807	562.03	97.019	455.84	1.0000	1.0000
6.08000	1.66770E+06	2.53743E+06	.19780	.19780	562.03	97.020	455.85	1.0000	1.0000
6.10000	1.66769E+06	2.53743E+06	.21807	.21807	562.03	97.020	455.84	1.0000	1.0000
6.12000	1.66770E+06	2.53743E+06	.19780	.19780	562.03	97.020	455.84	1.0000	1.0000
6.14000	1.66769E+06	2.53743E+06	.21807	.21807	562.03	97.020	455.83	1.0000	1.0000
6.16000	1.66770E+06	2.53743E+06	.19780	.19780	562.03	97.021	455.84	1.0000	1.0000
6.18000	1.66769E+06	2.53742E+06	.21807	.21807	562.03	97.020	455.83	1.0000	1.0000
6.20000	1.66770E+06	2.53742E+06	.19780	.19780	562.03	97.021	455.83	1.0000	1.0000
6.22000	1.66769E+06	2.53742E+06	.21807	.21807	562.03	97.021	455.82	1.0000	1.0000
6.24000	1.66770E+06	2.53742E+06	.19780	.19780	562.03	97.021	455.83	1.0000	1.0000
6.26000	1.66769E+06	2.53742E+06	.21807	.21807	562.03	97.021	455.82	1.0000	1.0000
6.28000	1.66770E+06	2.53742E+06	.19780	.19780	562.03	97.022	455.83	1.0000	1.0000
6.30000	1.66769E+06	2.53741E+06	.21807	.21807	562.03	97.022	455.81	1.0000	1.0000
6.32000	1.66770E+06	2.53741E+06	.19780	.19780	562.03	97.022	455.82	1.0000	1.0000
6.34000	1.66769E+06	2.53741E+06	.21806	.21806	562.03	97.022	455.81	1.0000	1.0000
6.36000	1.66770E+06	2.53741E+06	.19780	.19780	562.03	97.023	455.82	1.0000	1.0000
6.38000	1.66769E+06	2.53741E+06	.21806	.21806	562.03	97.022	455.80	1.0000	1.0000
6.40000	1.66770E+06	2.53741E+06	.19780	.19780	562.03	97.023	455.81	1.0000	1.0000
6.42000	1.66769E+06	2.53741E+06	.21806	.21806	562.03	97.023	455.80	1.0000	1.0000
6.44000	1.66770E+06	2.53741E+06	.19780	.19780	562.03	97.023	455.81	1.0000	1.0000
6.46000	1.66769E+06	2.53740E+06	.21806	.21806	562.03	97.023	455.79	1.0000	1.0000
6.48000	1.66770E+06	2.53740E+06	.19780	.19780	562.03	97.024	455.80	1.0000	1.0000
6.50000	1.66769E+06	2.53740E+06	.21806	.21806	562.03	97.023	455.79	1.0000	1.0000
6.52000	1.66770E+06	2.53740E+06	.19780	.19780	562.03	97.024	455.80	1.0000	1.0000
6.54000	1.66769E+06	2.53740E+06	.21806	.21806	562.03	97.024	455.79	1.0000	1.0000
6.56000	1.66770E+06	2.53740E+06	.19780	.19780	562.03	97.025	455.79	1.0000	1.0000
6.58000	1.66769E+06	2.53740E+06	.21806	.21806	562.03	97.024	455.78	1.0000	1.0000
6.60000	1.66770E+06	2.53740E+06	.19780	.19780	562.03	97.025	455.79	1.0000	1.0000
6.62000	1.66769E+06	2.53739E+06	.21806	.21806	562.03	97.025	455.78	1.0000	1.0000
6.64000	1.66770E+06	2.53739E+06	.19780	.19780	562.03	97.025	455.79	1.0000	1.0000
6.66000	1.66769E+06	2.53739E+06	.21806	.21806	562.03	97.025	455.77	1.0000	1.0000
6.68000	1.66770E+06	2.53739E+06	.19780	.19780	562.03	97.026	455.78	1.0000	1.0000
6.70000	1.66769E+06	2.53739E+06	.21806	.21806	562.03	97.025	455.77	1.0000	1.0000
6.72000	1.66770E+06	2.53739E+06	.19780	.19780	562.03	97.026	455.78	1.0000	1.0000
6.74000	1.66769E+06	2.53739E+06	.21806	.21806	562.03	97.026	455.76	1.0000	1.0000
6.76000	1.66770E+06	2.53739E+06	.19780	.19780	562.03	97.026	455.77	1.0000	1.0000
6.78000	1.66769E+06	2.53738E+06	.21806	.21806	562.03	97.026	455.76	1.0000	1.0000
6.80000	1.66770E+06	2.53738E+06	.19780	.19780	562.03	97.027	455.77	1.0000	1.0000
6.82000	1.66769E+06	2.53738E+06	.21805	.21805	562.03	97.026	455.76	1.0000	1.0000
6.84000	1.66770E+06	2.53738E+06	.19780	.19780	562.03	97.027	455.76	1.0000	1.0000
6.86000	1.66769E+06	2.53738E+06	.21805	.21805	562.03	97.027	455.75	1.0000	1.0000
6.88000	1.66770E+06	2.53738E+06	.19780	.19780	562.03	97.027	455.76	1.0000	1.0000
6.90000	1.66769E+06	2.53738E+06	.21805	.21805	562.03	97.027	455.75	1.0000	1.0000
6.92000	1.66770E+06	2.53738E+06	.19780	.19780	562.03	97.028	455.76	1.0000	1.0000
6.94000	1.66769E+06	2.53738E+06	.21805	.21805	562.03	97.027	455.74	1.0000	1.0000
6.96000	1.66770E+06	2.53737E+06	.19780	.19780	562.03	97.028	455.75	1.0000	1.0000
6.98000	1.66769E+06	2.53737E+06	.21805	.21805	562.03	97.028	455.74	1.0000	1.0000

TIME (SEC)	UG 200010000 (J/KG)	RHOG 200010000 (KG/M3)	RHO 200010000 (KG/M3)	SATTEMP 200010000 (K)	P 200010000 (PA)	FLOREG 200010000	VAPGEN 200010000 (KG/M3-SEC)	CSUBPG 200010000 (J/KG-K)	DTDP 200010000 (K/PA)
6.00000	2.53744E+06	97.019	97.019	626.13	1.71496E+07	9.0000	0.	8401.9	4.76844E-06
6.02000	2.53743E+06	97.019	97.019	626.13	1.71495E+07	9.0000	0.	8402.0	4.76846E-06
6.04000	2.53743E+06	97.019	97.019	626.13	1.71496E+07	9.0000	0.	8402.0	4.76844E-06
6.06000	2.53743E+06	97.019	97.019	626.13	1.71495E+07	9.0000	0.	8402.1	4.76846E-06
6.08000	2.53743E+06	97.020	97.020	626.13	1.71496E+07	9.0000	0.	8402.1	4.76844E-06
6.10000	2.53743E+06	97.020	97.020	626.13	1.71495E+07	9.0000	0.	8402.2	4.76846E-06
6.12000	2.53743E+06	97.020	97.020	626.13	1.71496E+07	9.0000	0.	8402.2	4.76844E-06
6.14000	2.53743E+06	97.020	97.020	626.13	1.71495E+07	9.0000	0.	8402.2	4.76846E-06
6.16000	2.53743E+06	97.021	97.021	626.13	1.71496E+07	9.0000	0.	8402.3	4.76844E-06
6.18000	2.53742E+06	97.020	97.020	626.13	1.71495E+07	9.0000	0.	8402.3	4.76846E-06
6.20000	2.53742E+06	97.021	97.021	626.13	1.71496E+07	9.0000	0.	8402.4	4.76844E-06
6.22000	2.53742E+06	97.021	97.021	626.13	1.71495E+07	9.0000	0.	8402.4	4.76846E-06
6.24000	2.53742E+06	97.021	97.021	626.13	1.71496E+07	9.0000	0.	8402.5	4.76844E-06
6.26000	2.53742E+06	97.021	97.021	626.13	1.71495E+07	9.0000	0.	8402.5	4.76846E-06
6.28000	2.53742E+06	97.022	97.022	626.13	1.71496E+07	9.0000	0.	8402.5	4.76844E-06
6.30000	2.53741E+06	97.022	97.022	626.13	1.71495E+07	9.0000	0.	8402.6	4.76846E-06
6.32000	2.53741E+06	97.022	97.022	626.13	1.71496E+07	9.0000	0.	8402.6	4.76844E-06
6.34000	2.53741E+06	97.022	97.022	626.13	1.71495E+07	9.0000	0.	8402.7	4.76846E-06
6.36000	2.53741E+06	97.023	97.023	626.13	1.71496E+07	9.0000	0.	8402.7	4.76844E-06
6.38000	2.53741E+06	97.022	97.022	626.13	1.71495E+07	9.0000	0.	8402.8	4.76846E-06
6.40000	2.53741E+06	97.023	97.023	626.13	1.71496E+07	9.0000	0.	8402.8	4.76844E-06
6.42000	2.53741E+06	97.023	97.023	626.13	1.71495E+07	9.0000	0.	8402.8	4.76846E-06
6.44000	2.53741E+06	97.023	97.023	626.13	1.71496E+07	9.0000	0.	8402.9	4.76844E-06
6.46000	2.53740E+06	97.023	97.023	626.13	1.71495E+07	9.0000	0.	8402.9	4.76846E-06
6.48000	2.53740E+06	97.024	97.024	626.13	1.71496E+07	9.0000	0.	8403.0	4.76844E-06
6.50000	2.53740E+06	97.023	97.023	626.13	1.71495E+07	9.0000	0.	8403.0	4.76846E-06
6.52000	2.53740E+06	97.024	97.024	626.13	1.71496E+07	9.0000	0.	8403.0	4.76844E-06
6.54000	2.53740E+06	97.024	97.024	626.13	1.71495E+07	9.0000	0.	8403.1	4.76846E-06
6.56000	2.53740E+06	97.025	97.025	626.13	1.71496E+07	9.0000	0.	8403.1	4.76844E-06
6.58000	2.53740E+06	97.024	97.024	626.13	1.71495E+07	9.0000	0.	8403.2	4.76846E-06
6.60000	2.53740E+06	97.025	97.025	626.13	1.71496E+07	9.0000	0.	8403.2	4.76844E-06
6.62000	2.53739E+06	97.025	97.025	626.13	1.71495E+07	9.0000	0.	8403.2	4.76846E-06
6.64000	2.53739E+06	97.025	97.025	626.13	1.71496E+07	9.0000	0.	8403.3	4.76844E-06
6.66000	2.53739E+06	97.025	97.025	626.13	1.71495E+07	9.0000	0.	8403.3	4.76846E-06
6.68000	2.53739E+06	97.026	97.026	626.13	1.71496E+07	9.0000	0.	8403.4	4.76844E-06
6.70000	2.53739E+06	97.025	97.025	626.13	1.71495E+07	9.0000	0.	8403.4	4.76846E-06
6.72000	2.53739E+06	97.026	97.026	626.13	1.71496E+07	9.0000	0.	8403.4	4.76844E-06
6.74000	2.53739E+06	97.026	97.026	626.13	1.71495E+07	9.0000	0.	8403.5	4.76846E-06
6.76000	2.53739E+06	97.026	97.026	626.13	1.71496E+07	9.0000	0.	8403.5	4.76844E-06
6.78000	2.53738E+06	97.026	97.026	626.13	1.71495E+07	9.0000	0.	8403.6	4.76846E-06
6.80000	2.53738E+06	97.027	97.027	626.13	1.71496E+07	9.0000	0.	8403.6	4.76844E-06
6.82000	2.53738E+06	97.026	97.026	626.13	1.71495E+07	9.0000	0.	8403.6	4.76846E-06
6.84000	2.53738E+06	97.027	97.027	626.13	1.71496E+07	9.0000	0.	8403.7	4.76844E-06
6.86000	2.53738E+06	97.027	97.027	626.13	1.71495E+07	9.0000	0.	8403.7	4.76846E-06
6.88000	2.53738E+06	97.027	97.027	626.13	1.71496E+07	9.0000	0.	8403.7	4.76844E-06
6.90000	2.53738E+06	97.027	97.027	626.13	1.71495E+07	9.0000	0.	8403.8	4.76846E-06
6.92000	2.53738E+06	97.028	97.028	626.13	1.71496E+07	9.0000	0.	8403.8	4.76844E-06
6.94000	2.53738E+06	97.027	97.027	626.13	1.71495E+07	9.0000	0.	8403.9	4.76846E-06
6.96000	2.53737E+06	97.028	97.028	626.13	1.71496E+07	9.0000	0.	8403.9	4.76844E-06
6.98000	2.53737E+06	97.028	97.028	626.13	1.71495E+07	9.0000	0.	8403.9	4.76846E-06

LISTING A2-4

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	TEMPG 10010000 (K)	TEMPG 200010000 (K)	VOIDG 200010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	VOIDGJ 550000000	CNTRLVAR 550 VLVAREA SUM
5.00000	1.71500E+07	1.71495E+07	630.90	630.96	1.0000	35.126	35.096	1.0000	.76114
5.10000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.125	35.096	1.0000	.76155
5.20000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.125	35.096	1.0000	.76196
5.30000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.124	35.096	1.0000	.76237
5.40000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.124	35.096	1.0000	.76278
5.50000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.123	35.096	1.0000	.76319
5.60000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.123	35.096	1.0000	.76360
5.70000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.122	35.096	1.0000	.76401
5.80000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.122	35.096	1.0000	.76442
5.90000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.121	35.096	1.0000	.76483
6.00000	1.71500E+07	1.71495E+07	630.90	630.95	1.0000	35.121	35.096	1.0000	.76524
6.10000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.121	35.096	1.0000	.76565
6.20000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.120	35.096	1.0000	.76607
6.30000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.120	35.097	1.0000	.76648
6.40000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.120	35.097	1.0000	.76689
6.50000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.119	35.097	1.0000	.76730
6.60000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.119	35.097	1.0000	.76771
6.70000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.118	35.097	1.0000	.76812
6.80000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.118	35.097	1.0000	.76853
6.90000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.118	35.097	1.0000	.76894
7.00000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.117	35.097	1.0000	.76935
7.10000	1.71500E+07	1.71495E+07	630.90	630.94	1.0000	35.117	35.097	1.0000	.76976
7.20000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.117	35.097	1.0000	.77017
7.30000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.117	35.097	1.0000	.77058
7.40000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.116	35.097	1.0000	.77099
7.50000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.116	35.098	1.0000	.77140
7.60000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.116	35.098	1.0000	.77181
7.70000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.115	35.098	1.0000	.77222
7.80000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.115	35.098	1.0000	.77263
7.90000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.115	35.098	1.0000	.77304
8.00000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.115	35.098	1.0000	.77345
8.10000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.114	35.098	1.0000	.77386
8.20000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.114	35.098	1.0000	.77427
8.30000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.114	35.098	1.0000	.77468
8.40000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.114	35.098	1.0000	.77509
8.50000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.113	35.098	1.0000	.77550
8.60000	1.71500E+07	1.71495E+07	630.90	630.93	1.0000	35.113	35.098	1.0000	.77591
8.70000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.113	35.098	1.0000	.77632
8.80000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.113	35.098	1.0000	.77673
8.90000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.112	35.098	1.0000	.77714
9.00000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.112	35.099	1.0000	.77755
9.10000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.112	35.099	1.0000	.77796
9.20000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.112	35.099	1.0000	.77837
9.30000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.112	35.099	1.0000	.77878
9.40000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.77919
9.50000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.77960
9.60000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.78001
9.70000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.78042
9.80000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.78083
9.90000	1.71500E+07	1.71495E+07	630.90	630.92	1.0000	35.111	35.099	1.0000	.78124

TIME (SEC)	VLVAREA 550	EMASS (KG)
0.	7.35398E-04	0.
.100000	7.35398E-04	6.66547E-02
.200000	7.35398E-04	6.49751E-02
.300000	7.35398E-04	6.31136E-02
.400000	7.35398E-04	6.14216E-02
.500000	7.35398E-04	5.98647E-02
.600000	7.35398E-04	5.84084E-02
.700000	7.35398E-04	5.70292E-02
.800000	7.35398E-04	5.57118E-02
.900000	7.35398E-04	5.44448E-02
1.00000	7.35398E-04	5.32207E-02
1.10000	7.35398E-04	5.20344E-02
1.20000	7.35398E-04	5.08817E-02
1.30000	7.35398E-04	4.97597E-02
1.40000	7.35398E-04	4.86659E-02
1.50000	7.35398E-04	4.75982E-02
1.60000	7.35398E-04	4.65551E-02
1.70000	7.35398E-04	4.55352E-02
1.80000	7.35398E-04	4.45373E-02
1.90000	7.35398E-04	4.35605E-02
2.00000	7.35398E-04	4.26039E-02
2.10000	7.35398E-04	4.16668E-02
2.20000	7.35398E-04	4.07485E-02
2.30000	7.35398E-04	3.98485E-02
2.40000	7.35398E-04	3.89662E-02
2.50000	7.35398E-04	3.81011E-02
2.60000	7.35398E-04	3.72529E-02
2.70000	7.35398E-04	3.64211E-02
2.80000	7.35398E-04	3.56053E-02
2.90000	7.35398E-04	3.48052E-02
3.00000	7.35398E-04	3.40204E-02
3.10000	7.35398E-04	3.32507E-02
3.20000	7.35398E-04	3.24957E-02
3.30000	7.35398E-04	3.17550E-02
3.40000	7.35398E-04	3.10286E-02
3.50000	7.35398E-04	3.03159E-02
3.60000	7.35398E-04	2.96168E-02
3.70000	7.35398E-04	2.89311E-02
3.80000	7.35398E-04	2.82584E-02
3.90000	7.35398E-04	2.75985E-02
4.00000	7.35398E-04	2.69512E-02
4.10000	7.35398E-04	2.63162E-02
4.20000	7.35398E-04	2.56934E-02
4.30000	7.35398E-04	2.50824E-02
4.40000	7.35398E-04	2.44830E-02
4.50000	7.35398E-04	2.38951E-02
4.60000	7.35398E-04	2.33184E-02
4.70000	7.35398E-04	2.27527E-02
4.80000	7.35398E-04	2.21977E-02
4.90000	7.35398E-04	2.16534E-02

LISTING C A2-5

TIME (SEC)	P 10010000 (PA)	P 200010000 (PA)	P 300010000 (PA)	P 400010000 (PA)	P 560010000 (PA)	P 600010000 (PA)	TEMPG 10010000 (K)	TEMPG 400010000 (K)	TEMPG 500010000 (K)
1.69250	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75840E+05	9.86891E+05	594.15	591.82	591.20
1.69300	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75839E+05	9.86891E+05	594.15	591.82	591.20
1.69350	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75839E+05	9.86891E+05	594.15	591.82	591.20
1.69400	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75839E+05	9.86891E+05	594.15	591.82	591.20
1.69450	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86892E+05	594.15	591.82	591.20
1.69500	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86892E+05	594.15	591.82	591.20
1.69550	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86893E+05	594.15	591.82	591.20
1.69600	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86894E+05	594.15	591.82	591.20
1.69650	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86894E+05	594.15	591.82	591.20
1.69700	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86895E+05	594.15	591.82	591.20
1.69750	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86896E+05	594.15	591.82	591.20
1.69800	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75838E+05	9.86897E+05	594.15	591.82	591.20
1.69850	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75839E+05	9.86898E+05	594.15	591.82	591.20
1.69900	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75839E+05	9.86899E+05	594.15	591.82	591.20
1.69950	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75840E+05	9.86900E+05	594.15	591.82	591.20
1.70000	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75840E+05	9.86902E+05	594.15	591.82	591.20
1.70050	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75841E+05	9.86903E+05	594.15	591.82	591.20
1.70100	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75841E+05	9.86904E+05	594.15	591.82	591.20
1.70150	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75842E+05	9.86906E+05	594.15	591.82	591.20
1.70200	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75843E+05	9.86907E+05	594.15	591.82	591.20
1.70250	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75844E+05	9.86909E+05	594.15	591.82	591.20
1.70300	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75845E+05	9.86910E+05	594.15	591.82	591.20
1.70350	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75846E+05	9.86912E+05	594.15	591.82	591.20
1.70400	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75847E+05	9.86914E+05	594.15	591.82	591.20
1.70450	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75848E+05	9.86916E+05	594.15	591.82	591.20
1.70500	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75849E+05	9.86917E+05	594.15	591.82	591.20
1.70550	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75851E+05	9.86919E+05	594.15	591.82	591.20
1.70600	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75852E+05	9.86921E+05	594.15	591.82	591.20
1.70650	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75853E+05	9.86923E+05	594.15	591.82	591.20
1.70700	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75855E+05	9.86925E+05	594.15	591.82	591.20
1.70750	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75856E+05	9.86927E+05	594.15	591.82	591.20
1.70800	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75858E+05	9.86929E+05	594.15	591.82	591.20
1.70850	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75859E+05	9.86931E+05	594.15	591.82	591.20
1.70900	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75861E+05	9.86933E+05	594.15	591.82	591.20
1.70950	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75863E+05	9.86935E+05	594.15	591.82	591.20
1.71000	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75864E+05	9.86937E+05	594.15	591.82	591.20
1.71050	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75866E+05	9.86939E+05	594.15	591.82	591.20
1.71100	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75868E+05	9.86942E+05	594.15	591.82	591.20
1.71150	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75870E+05	9.86944E+05	594.15	591.82	591.20
1.71200	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75872E+05	9.86946E+05	594.15	591.82	591.20
1.71250	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75873E+05	9.86948E+05	594.15	591.82	591.20
1.71300	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75875E+05	9.86950E+05	594.15	591.82	591.20
1.71350	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75877E+05	9.86953E+05	594.15	591.82	591.20
1.71400	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75879E+05	9.86955E+05	594.15	591.82	591.20
1.71450	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75881E+05	9.86957E+05	594.15	591.82	591.20
1.71500	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75883E+05	9.86959E+05	594.15	591.82	591.20
1.71550	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75885E+05	9.86961E+05	594.15	591.82	591.20
1.71600	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75887E+05	9.86963E+05	594.15	591.82	591.20
1.71650	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75890E+05	9.86966E+05	594.15	591.82	591.20
1.71700	1.00000E+07	9.96524E+06	9.95951E+06	9.78239E+06	9.75892E+05	9.86968E+05	594.15	591.82	591.20

TIME (SEC)	TEMPG 600010000 (K)	VOIDG 400010000	VOIDG 500010000	VOIDG 560010000	VOIDG 600010000	MFLOWJ 200010000 (KG/SEC)	MFLOWJ 400010000 (KG/SEC)	MFLOWJ 550000000 (KG/SEC)	CNTRLVAR 550 VLVAREA SUM
1.69250	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69300	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69350	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69400	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69450	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69500	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69550	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69600	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69650	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69700	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69750	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69800	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69850	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69900	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.69950	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70000	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70050	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70100	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70150	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70200	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70250	452.78	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70300	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70350	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70400	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70450	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70500	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70550	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70600	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70650	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70700	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70750	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70800	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70850	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70900	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.70950	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71000	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71050	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71100	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71150	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71200	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71250	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71300	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71350	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71400	452.79	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71450	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71500	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71550	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71600	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71650	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000
1.71700	452.80	1.0000	1.0000	.99951	.99895	22.755	22.755	22.755	1.0000

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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

This report presents a code assessment study based on full size relief and assisted safety valve (called SEBIM) tests performed on the CUMULUS valve test rig operated by Electricite de France (EDF).

The increased awareness that the pressurizer safety and relief valves are not reliable under water blowdown conditions, has led to the design, testing and installation of so called assisted safety valves of which the SEBIM (TM) valves are an example. These valves, used in tandem, are gradually replacing the safety and relief valves on pressurizers in some European PWR's.

Before installation at the plant, the Belgian safety authorities requested a thorough full scale testing of these valves on a test rig (CUMULUS) equipped with sufficient diagnostics to measure the characteristics of the valve.

The Belgian architect-engineering firm TRACTEBEL was called upon to specify, order and test these valves for installation at the DOEL 1 and DOEL 2 power plants.

These tests do not provide sufficient data of high quality to justify an assessment study of the code RELAP-5 MOD-2 CYCLE 36 in the ICAP framework which is the subject of this report.

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