RHODE ISLAND NUCLEAR SCIENCE CENTER
PROPOSED 3 MW OR HIGHER
EMERGENCY CORE COOLING SYSTEM PLAN

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APPENDICES

INTRODUCTION

The Rhode Island Nuclear Science Center research reactor has a design capability of 5 MW (thermal power) level. The current license level of operation is 2 MW. The recent conversion to the LEU fuel necessitated a Safety Analysis Review (SAR) which addressed a postulated loss of coolant. The Nuclear Regulatory Commission approved the SAR and related information for the 2 MW case.

This report addresses the 3 MW situation and the proposed emergency core cooling required. Since the original GE reactor design did not include provisions for emergency cooling, it was necessary to originate a design plan which would incorporate some of the positive features available at the site.

If the basic plan, herein described, is acceptable, a final refined version can be formulated in order to obtain a higher power license (3 MW) in the future.

LOSS OF COOLANT REVIEW

The SAR (Part B, Section X) calculated that the loss of coolant from the pool could occur through a 1/2" diameter hole in a beam port experiment and the 1" beam tube vent drain. The calculation from Section XIII, Appendix C of the SAR showed that a minimum of 3.76 gpm was needed to keep the core box full (assuming water was directly flowing into the core box). A typical calculation to determine what flow rate would be required to keep the pool full while the maximum draining is taking place is shown below:

$$F = .61A\left[2gH\right]^{1/2} = .61(006176)\left[2 \times 32.2 \times (139.917-114.463)\right]$$

$$F = .15 \times 7.48 \times 60 = 67.78 \text{ gal/min}$$

Using this equation, A "flow rate vs. elevation" table was developed (see Table A of this report). In addition to the normal make-up water system, the proposed ECCS is basically a "redundant" water supply line, a 2" line which serves as a deluge type of discharge to the pool (thereby eliminating an expensive piping system fabrication to the suspension frame and down to the core).

3 MW DECAY HEAT

The SAR (December 1992) for the 2 MW LEU core shows calculations for decay heat generation (Section X) during a LOCA such that it would take 10 1/2 hours to expose the core and that melting would not occur.

Assumption #5 included the remote possibility that the automatic fill line also did not operate upon loss of coolant.

Applying the decay heat curve to the 3 MW situation and knowing that the core must have sufficient cooling until such time that the decay heat has reduced to .049 BTU/sec.

For 3 MW $Po = \frac{3}{2} \times 6.187 = 9.28$ BTU/sec (plate)

$$Po = \frac{.049}{9.28} = .00528$$

From the decay curve (Table 5.1), the time after shutdown is about 7×10^4 seconds or 19.44 hours.

FACILITY WATER SUPPLY

The Wakefield Water Supply Company provides water to the University of Rhode Island Bay Campus. The Rhode Island Nuclear Science Center facility is located on the Bay Campus.

The water is supplied to the Bay Campus at 30 psi to the 30,000 gallon tanks. The tank booster pump delivers water at 55 psi to the distribution system. If pressure drops or more flow is needed the fire pump comes on boosting flow rate and pressure to 85 psi. All 3 pumps in the system have emergency generator backup. The Bay Campus demand (1992 records) is about 83 gallons/minute, including the reactor building. This means that a reserve supply in the tanks exists for 602 hours for normal Bay Campus demand.

A copy of the fire pump test results conducted for the system by Keily Associates, the design firm, is enclosed.

The reliability of the system was discussed in the SAR dated December 1992 in Section B, IX.

Refer to the plans in the appendix for the system piping.

KIELY ASSOCIATES LTD.
CONSULTANTS

LOUISQUISSET FREEWAY • MINERAL SPRING INTERCHANGE • P.O. BOX 6644, PROVIDENCE, RHODE ISLAND 02940 • TELEPHONE 724-8850

January 30, 1985

Otis C. Wyatt Jr., Chief
Narragansett Fire Department
40 Caswell Street
Narragansett, Rhode Island 02882

Re: Fire Pump Test
Graduate School of Oceanography
University of Rhode Island
Narragansett Bay CAmpus

Dear Chief Wyatt:

We would like to acknowledge and thank you and the members of your staff for their attendance and interest during the January 29, 1985 fire pump test at Narragansett Bay Campus, University of Rhode Island.

The Peerless fire pump, Model 8AF20P, nominal capacity of 2000 GPM vs 85 psi, 1775 RPM, 125 HP, 3P, 60C, equipped with a Firetrol Model FTA 1500/FTA 900 Controller, was discharged thru a Dieterich Model ANR permanent flowmeter and produced the following results:

2000 GPM - 2200 GPM at 85 psi
3000 GPM - 3200 GPM at 55 psi

It would be appreciated if you would attest to the observed results, by countersigning this correspondence and returning to our office at the above address.

We have enclosed, for your record and file, a copy of results of Test #169248, as performed by the Peerless Pump Company, manufacturer of the fire pump.

Very truly yours,

KIELY ASSOCIATES LTD

Daniel J Kiely
DJK/fa
enclosure
cc: Mr. Richard McGannon, GSO, URI
Mr George Erban, GSO, URI
Mr. Robert Stewart, URI

Attest:

Otis C. Wyatt Jr.

Otis C. Wyatt., Chief
Narragansett Fire
Department

PRESENT POOL FILL SYSTEM OPERATION

The existing pool is filled through the make-up line from the make-up demineralizer. The system has an automatic electrically operated valve which opens when the pool level float switch is activated due to a drop in pool level. The pool fill valve has a manual by-pass valve in case the electric valve fails. At the present time the electrically operated float switch and electrically operated valve "do not" have emergency power.

It is proposed that, for 3 MW or higher, these components should be tied into the facility emergency generator power supply system. Measurements reflect that the system can provide 25 gpm (minimum) to the pool.

PROPOSED EMERGENCY CORE COOLING SYSTEM OPERATION

(Refer to the Emergency Core Cooling System (ECCS) Schematics in the Appendix)

In addition to the present pool fill (make-up) system, major components of the ECCS will operate under AC power with emergency power backup from the emergency generator. This assures operation of electrical components with loss of AC power.

The reactor control system will require the addition of two scram circuits to be used for 3 MW or higher. The first is the ECCS water line pressure sensor which monitors the feed line. A drop in normal water pressure below a preset valve will scram the reactor.

The second scram function would be that of the automatic (AV) ECCS water line valve opening, either from a signal from the (LS) low pool level switch or an electrical malfunction.

The proposed pressure sensor, level sensor, automatic valve (position indication) components will have remote readout capability for both the control room and the Emergency Control Center (ECC). The line also contains a flow meter for actual flow measurement during testing or a pool fill event. This unit can also have a remote readout capability.

The (AV) has a manual override in case of the failure of the electrical activator. The manual valves #2 and #3 are used for a system by-pass flow test.

Manual valve #1 is used to isolate the system. It is to be locked open. It is proposed to provide "after hours" monitoring of the ECCS by integrating it to the facility surveillance system. All the other components are located in the reactor room.

Proposed activation of the opening of the ECCS AV is from the low pool switch. The unit has a low level setting (10"-254") which would be set for a drop in pool level of 6 feet (el. 133'4"). While filling the pool to a 3 feet rise (el. 136'4"), the unit would shut off and reset. This prevents an overflow situation.

ECCS WATER SUPPLY ANALYSIS

An analysis of the 4" supply with the proposed 2" line supply to the core, was performed using a computer program called "Service Sizer".[1]

The program has built-in piping tables, valve and fitting tables and fixture unit tables. Input to the pipe size calculation includes demand flow, demand pressure elevation difference, supply pressure, pipe length, other equivalent pipe length losses, numbers of value and fittings and also a permitted velocity. The program output includes calculated pipe size, actual velocity, head loss and demand pressure.

The pressure (supply) at the 4" pipe entering the building is based on the accompanying fire test report. Due to high pump pressure available, the proposed 2" line (ECCS) should have a pressure reducing value. A 55 psi setting is more than adequate for expected demand. The valve would prevent excessive line pressures when the Bay Campus fire pumps are in use or when testing is conducted.

The analysis was performed with a 55 psi supply pressure. The enclosed computer printout summarizes the results.

(1) Parkcon, Inc., 250 N. Center Street, P. O. Box 5980, Woodland Park, Colorado 8086-5980

TABLE A

HEAD ABOVE CENTER OF BEAM PORT	CALCULATED MAXIMUM FLOW RATE (GPM) FROM BEAM PORT
24.954	67.78
22	63.64
20	60.68
18	57.57
16	54.27
14	50.76
12	47
10	42.9
8	38.38
6	33.23
4	27.14
1.25 (top of core box)	15.17

It is assumed that (1) the gate valve to the beamport vent line is not shut

(2) The beamport "shutter" is not in the down position

--SIZING CALCULATION----------Printed On: 5/13/1994

Supply Location: Reactor building 4"supply line

55.0 psi, supply pressure available during demand

Demand Location: Reactor pool

47.0 gpm demand flowing at 37.0 psi pressure

--Head Loss Data----------

Elevation Difference: 30.0 ft (minus if demand location lower than supply)

Pipe Length: 150.0 ft Other Loss In Equivalent Pipe Length: ft

Number of Valves & Fittings:

:Corp Stop	:Curb Stop	3:Gate Valve	:Globe Valv	:Angle Valv
:Bfly Valve	:Swing Chk	1:Side Tee	:Straight T	10:Std Elbow
:Long Elbow	:45 Elbow	:	:	:

Backflow Prev: psi Water Meter: psi PRV: 1.0 psi Other: psi

--Design Calculation----------

Permitted Velocity: fps Pipe Type: CUM Calculated Pipe Size: 2 in

Actual Velocity: 4.8 fps Head Loss: 17.8 psi Pres at Demand: 37.2 psi

--DEMAND CALCULATION----------

Predominantly Flushometers: N Public Use: N

--Number of Fixtures----------

:Bathtub	.Bar Sink	:Bidet	:Clothes Washr
:Cuspidor	:Dishwasher	:Drinking Ftn	:Hose Bib
:Kitchen Sink	:Lavatory	:Laundry Tub	:Shower Head
:Service Sink	:Urinal Pedest	:Urinal Wall	:Urinal Tank
:Wash Sink	:WC Flushometr	:WC Tank	:
:	:	:	:

Additional: fixture units Total: fixture units

Continuous Demand: gpm Fixture Demand: gpm

Total Demand: gpm

CONCLUSIONS

A postulated "Loss of Coolant" accident to power levels above the existing 2 MW licensed power level would lead to possible reactor core damage due to heat generation. The decay analysis defines the need for additional emergency cooling water during decay times up to 20 hours after shutdown at 3 MW. The existing pool feed system is capable of supplying about 25 gpm, enough water to maintain the entire reactor pool at about 2 feet above the core box (see Table A). The proposed emergency core cooling system could provide about 47 gpm, enough water to maintain the pool level at about 10 1/2 feet above the core box at maximum water loss. Together the two systems could provide about 62 gpm. In the unlikely case of a simultaneous loss of coolant accident and termination of water to the Wakefield Water Company, the Bay Campus storage tanks are capable of supplying reserve water for an extended time sufficient to reduce decay time to below the minimum for core damage.

The above analysis is conservative in a number of areas. The LOCA assumes maximum drainage times with no operator actions to close the beamport shutter, close the vent line drain, etc. The water supply and the proposed ECCS are safeguarded from electrical power loss with emergency power backup.

It is our conclusion that the proposed system can sustain the proper level of cooling required and maintain acceptable levels of reliability within minimum risk.

ECCS MAJOR EQUIPMENT AND COMPONENTS

(1) Pressure Switch
Omega, PSW-327

(2) Level Switch
Omega, LV-222

(3) Flow Meter System
Omega FTB-109

(4) Manual Valve
Apollo 71-108

(5) Automatic Valve
2" Apollo 71-108 with EVA-Acuator

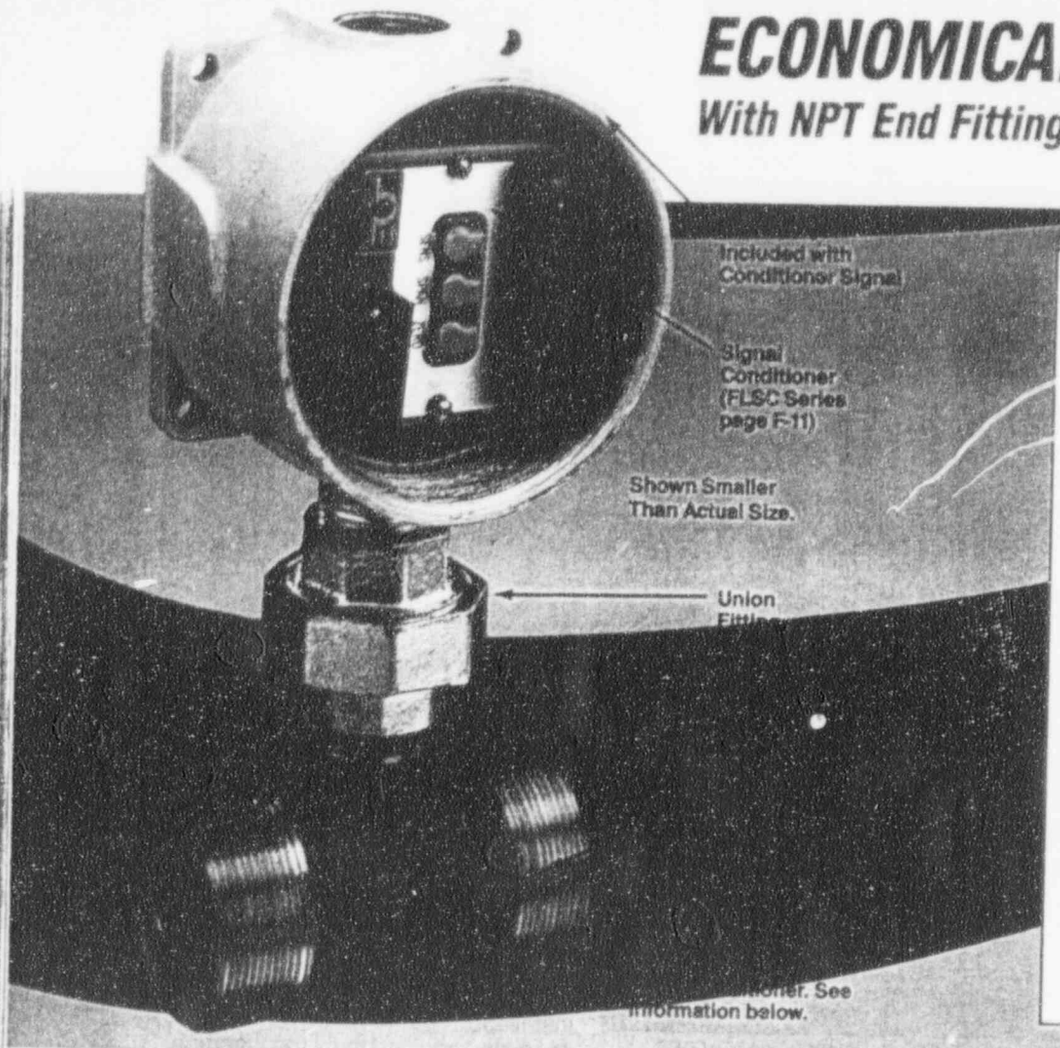
(6) Pressure Reducing Valve
2" Series 25 AUB

(7) Piping and Fittings
2" 304 Stainless Steel

(8) Miscellaneous
Switches, Gauges, Indicators, etc.

ECONOMICAL BALL BEARIN

With NPT End Fittings



- ± ½% Accuracy of Readi
- Ball Bearing Design for Economy
- Non-Metallic Bearing Retainers for Long Life
- Replacement Bearings Field Installable Without Loss of Calibration
- Disassembles Quickly for Easy Maintenance
- Deflector Cones Stabilize the Low Mass Rotor for Increased Bearing Life
- 4 to 20 mA, 0-5 V, and Scal Frequency Outputs Availab

From

$1368

Complete System as Shown

The FTB-100 Series Turbine Meters have a sealed ball bearing design for high accuracy (± ½% of reading, not full scale) performance at an economical cost. The non-metallic bearing retainers minimize friction, and therefore allow these meters to be used with clean fluids that have poor lubricating properties (i.e. water). Ball bearings also give the widest linear flow range, particularly in the larger turbines. Bearing replacement and clean-up are fast and easy since all the internal parts are easily accessible by removing a single nut.

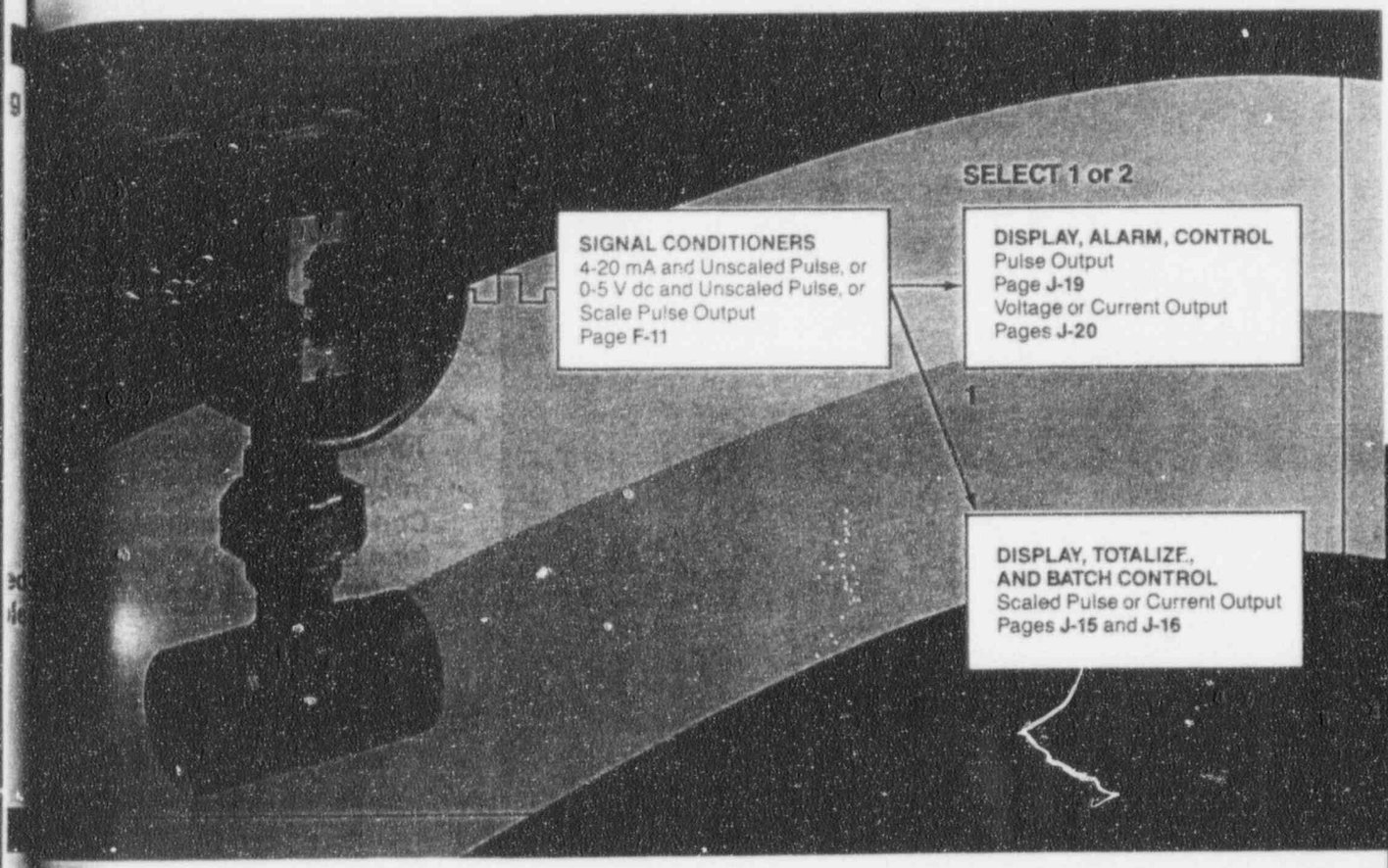
These turbine flowmeters have a low mass rotor design which allows for rapid dynamic response, and can be used in pulsating flow applications. The deflector cones eliminate downstream thrust on the rotor and allow hydrodynamic positioning of the rotor between the deflector cones. This provides wider rangeability and longer bearing life than that of conventional turbine flowmeters. Integral flow straightening tubes minimize the effects of upstream flow turbulence.

FTB-101	$1368	$1478	$1368	$1478	$1360	$1360
FTB-102	1368	1478	1368	1478	1360	1360
FTB-103	1368	1478	1368	1478	1360	1360
FTB-104	1368	1478	1368	1478	1360	1360
FTB-105	1368	1478	1368	1478	1360	1360
FTB-106	1402	1512	1402	1512	1394	1394
FTB-107	1474	1584	1474	1584	1466	1466
FTB-108	1523	1633	1523	1633	1515	1515
FTB-109	1726	1836	1726	1836	1718	1718
FTB-110	1989	2099	1989	2099	1981	1981
FTB-111	2141	2251	2141	2251	2133	2133

Ordering Example: To order a scaled system, which includes: Signal Conditioner, Enclosure, Turbine Meter and Fitting, as shown above, specify Model No. SYS/FTB-101/FLSC-18B, $1368.

TURBINE FLOWMETER SYSTEMS

FTB-100 Series



The FTB-100 Turbine Meters are available with integral signal conditioners which provide scaled and unscaled frequencies, 4-20 mA, or 0-5 volt outputs. They are shown on page F-11. Units without the integral signal conditioner are supplied with their mating connector for two wire hook-up.

SPECIFICATIONS:

Accuracy: ±½% of reading
Repeatability: ±0.1% of reading
Maximum Temperature Range: −450 to +450°F
Maximum Intermittent Overrange: 150% of maximum range
Minimum Output Amplitude: 30 mV Peak to Peak Unscaled Pulse

Materials of Construction: Body: 304 stainless steel; Rotor: 17-4 PH steel; Bearings: 440C stainless steel

For fluids other than water, refer to Pages F-5 thru F-7 and consult Engineering Department.

To Order (Specify Model Number)

HIGHLIGHTED MODELS STOCKED FOR FAST DELIVERY

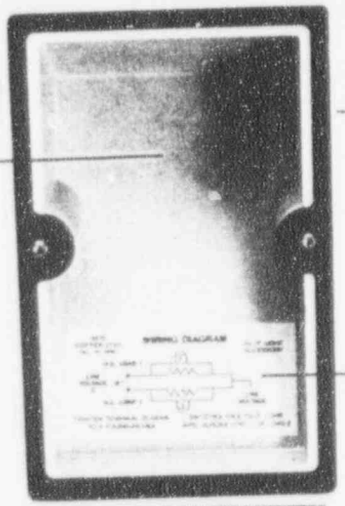
FTB-101	$991	.35-3.5	½"	5000	3.0	2.45"	13,000
FTB-102	991	.75-7.5	½"	5000	5.0	2.45"	10,000
FTB-103	991	1.25-9.5	½"	5000	5.2	2.45"	6,000
FTB-104	991	1.75-16	¾"	5000	3.0	2.75"	4,100
FTB-105	991	2.5-29	¾"	4250	5.0	3.25"	2,200
FTB-106	1025	4-60	1"	3850	5.1	3.50"	640
FTB-107	1097	6-93	1¼"	3850	4.3	3.88"	410
FTB-108	1146	8-130	1½"	3000	3.0	4.38"	230
FTB-109	1349	15-225	2"	2500	3.3	4.75"	120
FTB-110	1612	25-400	2½"	2250	4.0	6.06"	62
FTB-111	1764	40-650	3"	2000	4.0	7.50"	55

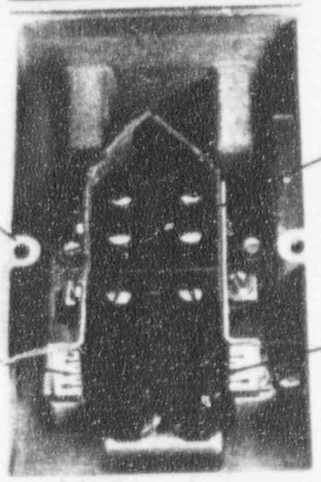
NEMA 4X WATERTIGHT PRESSURE SWITCH

For Harsh or Corrosive Environments

- Low Pressure Ranges 30" Hg Vac to 150" H_2O
- High Pressure Ranges 15 to 3000 PSI
- Buna-N or 316SS Diaphragm
- 10A SPDT Switch
- Tamper/vibration resistant setpoint adjustment 20 to 100% range
- Fixed or Adjustable deadband

Ideal for use in harsh and corrosive environments, the PSW-300 Series Pressure Switches feature stainless steel or Buna-N diaphragm-sealed piston or diaphragm actuators that provide repeatability of ±1% of range. Standard design allows easy access to switches. For versatility, single setpoint with fixed deadband, single setpoint with adjustable deadband or dual independently adjustable setpoints may be chosen.



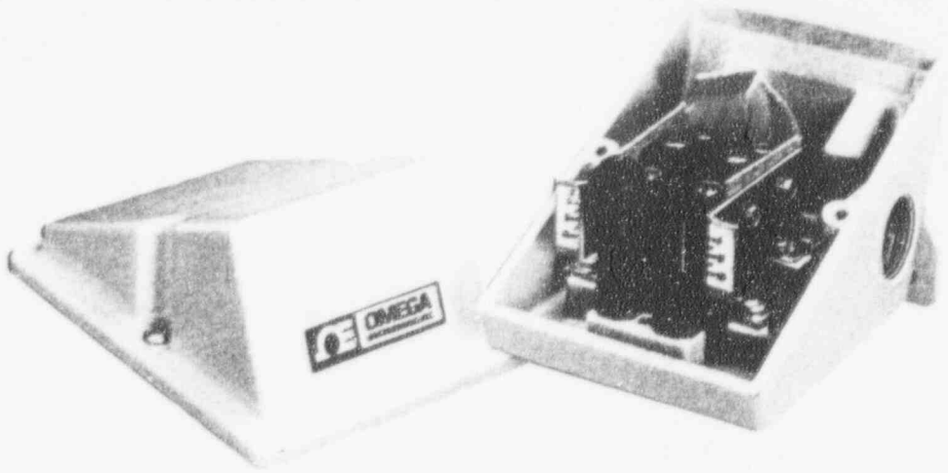


SPECIFICATIONS

Approval: UL listed, CSA certified
Storage Temp: −20 to 150°F
Ambient Temp. Limits: −20 to 150°F. Set point typically shifts ±1% of range per 50°F of temperature change.
Enclosure: NEMA, 4X watertight and corrosion resistant
Setpoint Repeatability: ±1% of range
Switch Output: 1 or 2 SPDT switch may be wired "normally open" or "normally closed"
Electrical Rating: 10 A: 125/250 V ac; 0.5 A, 125 V dc, 0.25 A. 250 V ac, 15 A: 125/250 Vac
Enclosure: Epoxy coated aluminum, gasketed
Weight: 2 lb
Electrical Connection: ¾ NPT female
Pressure Connection: ¼ NPT female; for vacuum to 600 PSI: ½" NPT Male/¼ NPT female for 1000 and 3000 PSI
Connection Material: Vac through in. H_2O ranges; carbon steel: All PSI ranges; 316SS
Oxygen Service: Specify Option X6B for special cleaning.

MADE USA

From $205



To Order (Specify Model Number) **HIGHLIGHTED MODELS STOCKED FOR FAST DELIVERY**

MODEL	PRICE	ADJUSTABLE RANGE ENGLISH	ADJUSTABLE RANGE METRIC	DEAD BAND ENGLISH UNITS	PROOF PRESSURE	SWITCH
Single Set Point, Adjustable Deadband Buna-N Diaphragm, O-Ring and 1/4 NPTF Connection						
PSW-301	$235	−6 to −30 IN Hg Vac	−20 to −100kPa	6 to 24	250 PSI	10A SPDT
PSW-302	235	6 to 30 IN H_2O	1.5 to 7.5 kPa	4 to 27	20 PSI	10A SPDT
PSW-303	235	12 to 60 IN H_2O	3 to 15 kPa	5 to 54	20 PSI	10A SPDT
PSW-304	235	30 to 150 IN H_2O	7.4 to 37 kPa	18 to 135	20 PSI	10A SPDT
PSW-305	205	3 to 15 PSI	20 to 100 kPa	2.5 to 13	500 PSI	10A SPDT
PSW-306	205	6 to 30 PSI	40 to 200 kPa	3 to 18	500 PSI	10A SPDT
PSW-307	205	20 to 100 PSI	140 to 700 kPa	10 to 90	1000 PSI	10A SPDT
PSW-308	205	40 to 200 PSI	280 to 1400 kPa	18 to 180	1000 PSI	10A SPDT
PSW-309	205	80 to 400 PSI	.56 to 2.8 MPa	45 to 360	2400 PSI	10A SPDT
PSW-310	260	200 to 1000 PSI	1.4 to 7 MPa	160 to 900	12000 PSI	10A SPDT
PSW-311	260	600 to 3000 PSI	4.2 to 21 MPa	400 to 2600	12000 PSI	10A SPDT
Dual Set Point, Fixed Deadband Buna-N Diaphragm, O-Ring and 1/4 NPTF Connection						
PSW-321	$265	−6 to −30 IN Hg Vac	−20 to −100kPa	.7 to 1.4	250 PSI	TWO 15A SPDT
PSW-322	265	6 to 30 IN H_2O	1.5 to 7.5 kPa	.7 to 1.4	20 PSI	TWO 15A SPDT
PSW-323	265	12 to 60 IN H_2O	3 to 15 kPa	.7 to 1.8	20 PSI	TWO 15A SPDT
PSW-324	265	30 to 150 IN H_2O	7.4 to 37 kPa	2.1 to 4.2	20 PSI	TWO 15A SPDT
PSW-325	230	3 to 15 PSI	20 to 100 kPa	.7 to 1.4	500 PSI	TWO 15A SPDT
PSW-326	230	6 to 30 PSI	40 to 200 kPa	.7 to 2.1	500 PSI	TWO 15A SPDT
PSW-327	230	20 to 100 PSI	140 to 700 kPa	1.4 to 3.5	1000 PSI	TWO 15A SPDT
PSW-328	230	40 to 200 PSI	280 to 1400 kPa	1.4 to 5.6	1000 PSI	TWO 15A SPDT
PSW-329	230	80 to 400 PSI	.56 to 2.8 MPa	6 to 11	2400 PSI	TWO 15A SPDT
PSW-330	285	200 to 1000 PSI	1.4 to 7 MPa	10 to 42	12000 PSI	TWO 15A SPDT
PSW-331	285	600 to 3000 PSI	4.2 to 21 MPa	42 to 98	12000 PSI	TWO 15A SPDT
Dual Set Point, Fixed Deadband 316SS Diaphragm and 1/4 NPTF						
PSW-345	$290	3 to PSI	20 to 100kPa	.7 to 1.4	500 PSI	TWO 15A SPDT
PSW-346	290	6 to 30 PSI	40 to 200 kPa	1.7 to 2.8	500 PSI	TWO 15A SPDT
PSW-347	290	20 to 100 PSI	140 to 700 kPa	2.8 to 5.6	1000 PSI	TWO 15A SPDT
PSW-348	290	40 to 200 PSI	280 to 1400 kPa	4.2 to 11.2	1000 PSI	TWO 15A SPDT

Pressure Switch Options:
(Add Suffix to Part Number) Hermetically Sealed 5A 125/250 Vac Switch for Extra Protection in Severe Environments.
-S Single Set Point **$75.00**
-D Dual Set Point **$150.00**
-316 Stainless Steel Welded Pressure Activator -S 15 to 600 PSI, **$54.00**

DUAL-POINT LEVEL SWITCH

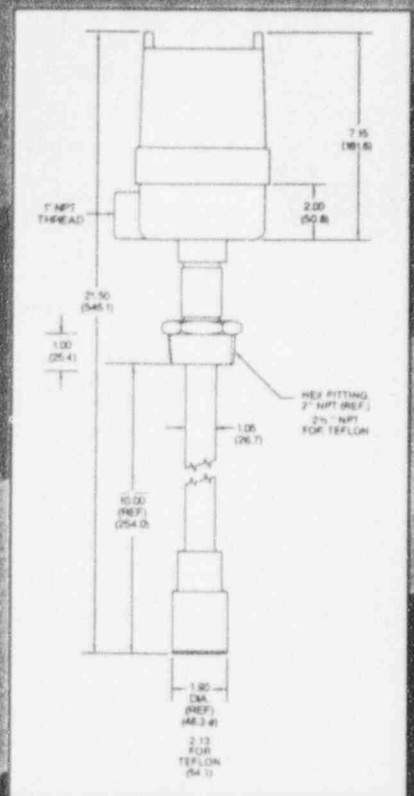
Non-Contact Ultrasonic Level Sensors

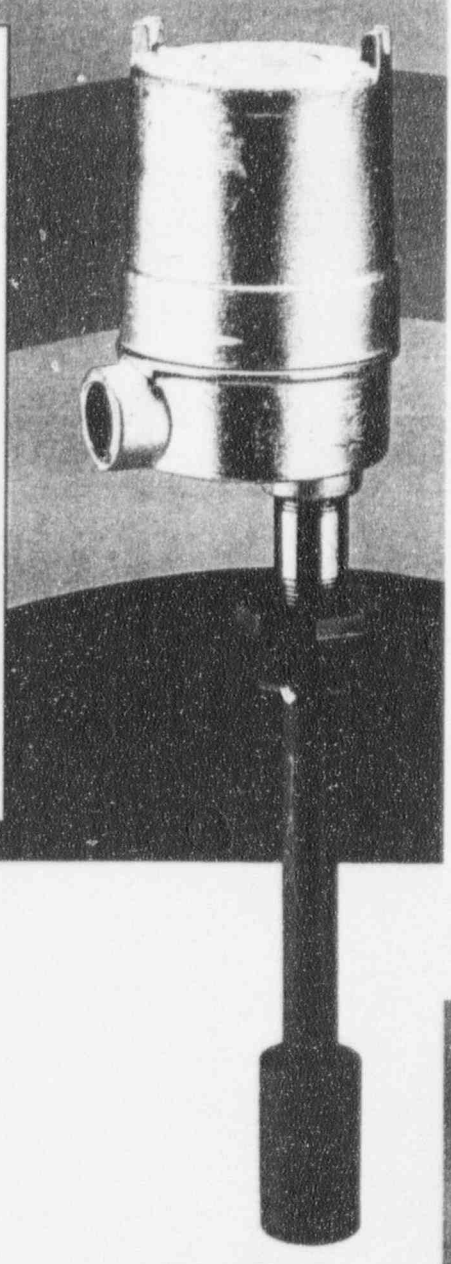
LV-220 Series

- Integral Electronics/ Non-contact Sensor Design
- No Reference Targets Required for Calibration
- Microprocessor Control
- Rugged Sensor Design in CPVC or Kynar®
- Dual SPDT Relays for Hi/Lo Failsafe Indication

Units designed for liquids with vapor pressures equal to or less than water. For other applications consult Engineering.

From
$1240





The LV-220 Series switches are microprocessor controlled non-contact dual point level devices. They use ultrasonic echo technology to measure levels accurately from 10" to 255" from the sensor face (25.4cm to 648cm). To eliminate costly down time, a built-in microprocessor eliminates the use of calibration targets and permits measurements with a repeatability of ⅛" to ¼". The LV-220 level switches are compact units combining sensor and electronics that can be installed or removed for service without special tools or instructions. Four operational modes are switch selectable: independent hi and low alarm, automatic fill, automatic empty and high/low level failsafe. For a wide range of chemical compatibility, the sensor is available in CPVC, Kynar® or Teflon®.

SPECIFICATIONS

Range: 10" to 180" (25.4 cm to 460 cm)
Repeatability: 1.25" typical
Operation Modes: Four switchable modes (only 2 relay outputs); Hi and Lo; AutoEmpty/Auto Fill (can be set for both Hi and Lo); Hi level Failsafe
Ultrasonic Frequency: 50 KHz
Beam Angle: Conical 12°(typical)
Enclosure Type: NEMA-4 watertight explosion-resistant: Class I, Group C & D; Class II, Group E, F, & G; Class III
Transducer Material: CPVC or Kynar®. Up to 50 PSIG (3.52 kg/cm²) operating pressure
Temperature Range: Sensor: –22°F to +158 F (–30°C to +70 °C)
Electronics: +10°F to 158°F (–12°C to 70°C), (operating)
Weight: 8 lb (3.6 kg)
Operating Power: 115V, 50/60 Hz; 230 V, 50/60 Hz or 24 Vdc optional
Switch Contacts: 2 SPDT Independent; 5 A at 24 Vdc; 3 A at 115 Vac; 2 A at 230 Vac (non-inductive load)
Power Consumption: 2 to 5 watts
Mounting: 2" NPT

HIGHLIGHTED MODELS STOCKED FOR FAST DELIVERY

How to Order

Model No.	Price	Sensor Construction
LV-221	$1240	CPVC
LV-222	1366	Kynar®

To order units with 24 Vdc power, add suffix -24V to model no. Add **$72** to cost. To order units with 230 Vac power, add suffix -230V to model no. Add **$100** to cost.
Ordering Example: LV-221-24V calls for a CPVC Type Level Switch with 24 Vdc Power. Price $1240 + 72 = **$1312.**

71-100 Series

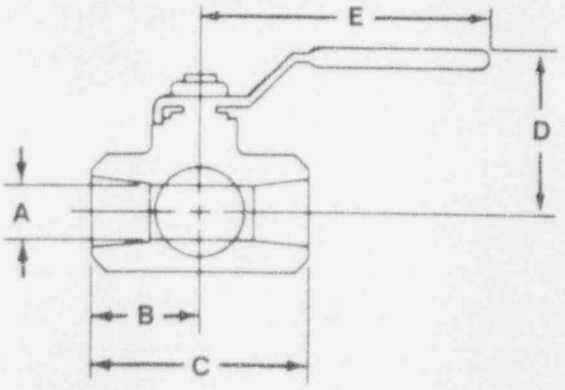
Bronze Apollo® With Mounting Pad

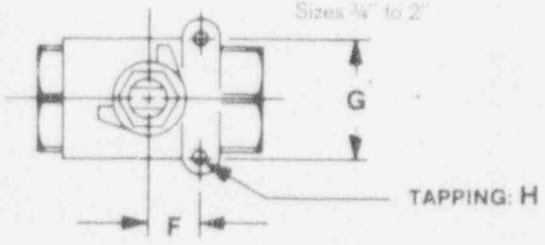
FEATURES

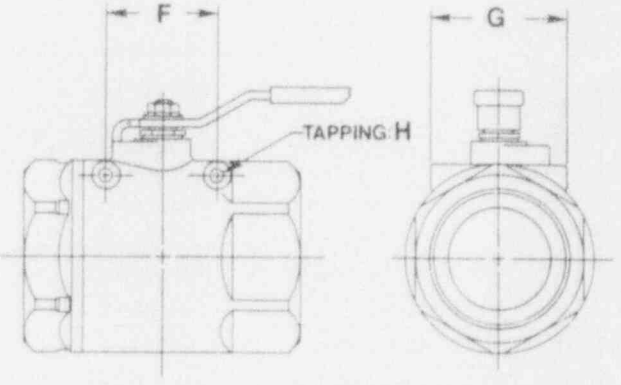
- Designed for deadman spring return handle, actuator mounting and panel mounting
- Reinforced TFE seats and stuffing box ring
- Meets WW—V—35C Type: II Composition: BZ Style: 3

OPTIONS

- Deadman spring return handle through 2"
- 316 stainless steel ball and stem
- Adjustable stop lever
- Static grounding devices
- Rough chrome plating
- Steel tee handles through 2"
- Round handles through 2"
- Original balancing stop
- Virgin TFE seats and seals







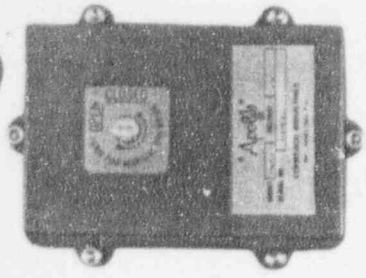
3" Size

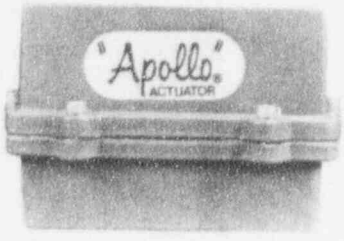
BRONZE — THREADED

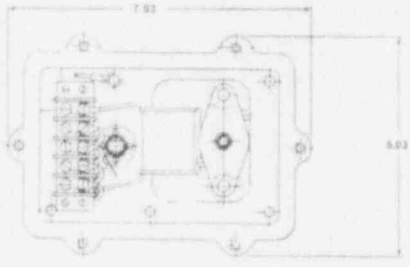
NUMBER	SIZE*	A	B	C	D	E	F	G	H
71-104	¾	.68	1.50	3.00	2.12	4.87	.87	1.37	10-24 NC
71-105	1	.87	1.68	3.37	2.25	4.87	.87	1.37	10-24 NC
71-106	1¼	1.00	2.00	4.00	2.62	5.50	.93	1.50	¼-20 NC
71-107	1½	1.25	2.18	4.37	3.05	8.00	.93	1.50	¼-20 NC
71-108	2	1.50	2.34	4.68	3.24	8.00	.93	1.50	¼-20 NC
71-100	3	2.50	3.37	6.75	4.12	8.00	2.75	3.37	¼-20 NC

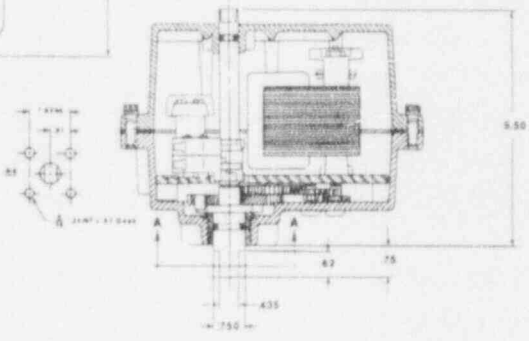
NOTE: Cv factor same as 70-100 Series. *For sizes other than shown, see 77-100 Series.

Apollo® EVA Series Electric Actuators









Highlights and Advantages

- Fast manual override standard on all unidirectional through shafted models. Simply turn the shaft in the normal rotational direction (up to 180°).
- Top of all shafts acts as valve position indicator on all through models.
- Permanently lubricated fully enclosed gear train.
- Precision cut, heat treated alloy steel gears for durability and structural integrity.
- Automatic thermal overload protection built into all AC motors.
- Rugged cast aluminum housing and cover; gasketed at joints and sealed at all penetrations for watertight NEMA 4 rating.
- Prewired terminal strip on all through shaft models.
- Built in open and closed position indicating limit switch contacts standard on all models.
- Compact and lightweight construction (7-8 lbs.).
- Choice of rugged simple shaded pole motor for unidirectional models and low current draw, capacitor start AC or permanent magnet DC motors for reversible units. All with the same output torque rating.

Specifications

Operating Temperature — 40° to 150° F
Entry — ½ NPT Conduit Connection
Enclosure — Watertight — NEMA 4
Limit Switches — Open and Closed Position Control and Indication 11 Amp @ 115v.
Duty Cycle — Unidirectional 15% below 100° F except 700 #IN Series 5% below 100° F. AC Reversible — 20 starts/hr. Capacitor limitation DC 25% below 100° F.
Mounting — AC reversible and DC no restrictions. AC unidirectional — Shaft must be horizontal or above. (Consult factory for shafts below horizontal).

Standard Options and Accessories

- **Voltages** — Unidirectional models 24, 115 & 220v 50/60 Hz. Ac & 12 & 24v DC. Reversible AC models 115v 50/60 Hz. DC models 12, 24 & 48v.
- **Limit Switches** — Can be ordered with one or two additional adjustable limit switches.
- **Potentiometer** — Can be ordered with a 1000 OHM, 2 watt, 10% linearity (reversible models only).
- **Heaters** — Thermostatically controlled strip heater element.
- **Extra Corrosion Resistant** — NEMA 4x enclosure includes corrosion resistant epoxy paint and stainless steel fasteners.
- For additional requirements contact your local representative.
- **NOTE:** In all applications each EVA Actuator must be controlled by an individual set of electrical contact poles.

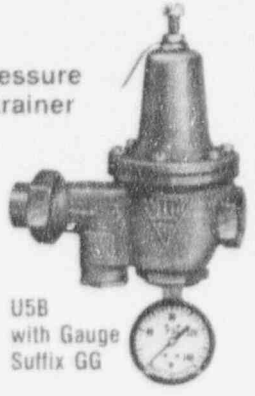
water pressure reducing valves

Series U5 and 25AUB meets the requirements of A.S.S.E. Std. 1003, ANSI A112.26.2, CSA Std. B356; Southern Standard Plumbing Code and is listed by IAPMO.

Series U5, U5B

STANDARD CAPACITY Water Pressure Reducing Valves with Integral Strainer

For residential, commercial and industrial applications. Furnished with union inlet connection with threaded tailpiece, for sizes ½" through 2". Suitable for initial pressures up to 300 lbs. Reduced pressure range 25-75 lbs. Set for 50 lbs. no flow pressure unless otherwise specified. Max. temperature 180°F.



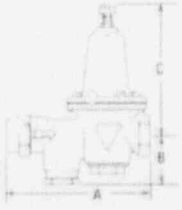
U5B with Gauge Suffix GG

OPTIONS ½"- 2" Suffix:

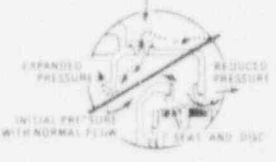
LP - low pressure range 10-35 lbs. Set for 30 lbs. no flow pressure. Max. pressure 200 lbs. Max. temp. 200°F.
HP - high pressure range 75-100 lbs. Set for 90 lbs. no flow pressure.
S - sweat union inlet connections.

OPTIONS ½"- 1":

Z3 - for waterworks pit installations. Has sealed spring cage and corrosion-resistant adjusting and cage screws
SC - sealed spring cage for hi-rise applications.
GG - with 160 lb. gauge and tapping.



U5B BY-PASS FEATURE



- Bronze body construction
- Stainless steel integral strainer
- Renewable stainless steel seat
- High temperature resisting diaphragm

Series U5B Sizes ½"- 2" - has built-in thermal expansion by-pass equalizing feature to relieve thermal expansion in closed systems.

However, to be effective, the pressure relief setting of a relief valve must be higher than the available supply main pressure to the reducing valve. Latest allowable working pressure standards for gas and electric water heaters is 150 lbs. which exceeds the majority of supply pressures.

Size	Inlet Connection	DIMENSIONS A	B	C	Weight
* ½"	Union	5¾"	1⅞"	5"	4 lbs.
* ¾"	Union	6⅜"	1⅞"	5⅜"	5 lbs.
* 1"	Union	6¾"	2"	6"	6 lbs.
1¼"	Union	8"	2¼"	6⅛"	9⅜ lbs.
1½"	Union	9½"	3"	6¾"	14⅜ lbs.
2"	Union	11"	3¼"	9"	23 lbs.

*U5 available in ½", ¾" and 1" size only.

FLOW CAPACITIES

Chart shows the flow capacities in gallons per minute based on average conditions and reduced pressure fall-off due to demand. For specific capacities under various flow conditions, refer to F-U5.

Capacities shown are based on a difference of 50 lbs. or more between the initial pressure and the regulator lock-up pressure. Where this difference is less than 50 lbs., deduct 20% from capacity shown.

Series	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
U5, U5B	17	27	40	50	64	100	–	–	–
25AUB	16	25	38	52	60	85	–	–	–
223	23	36	50	88	132	162	170	–	–
N223B	–	–	–	–	–	–	285	375	–
N223F	–	–	–	–	–	–	–	210	–
127W	–	–	–	–	–	–	–	250	300

For Additional Information, send for F-U5 or ES-25.

Series 25AUB

Bronze Body Water Pressure Regulator

For supply water pressures up to 300 lbs. and can be adjusted from 25 to 75 lbs. The standard setting is 50 lbs. The by-pass feature incorporated into these valves accurately controls build-up of system pressure and thermal expansion by equalizing the system and supply pressure when relief setting is in excess of available supply main pressure. Max. temp. 180°F.

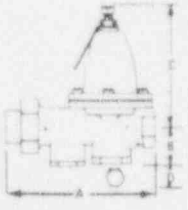
- Renewable stainless steel seat
- Stainless steel integral strainer
- High temperature resisting reinforced diaphragm for hot or cold water

25AUB with Gauge Suffix GG

OPTIONS (Suffix):

S - with sweat union inlet x NPT outlet
DU - with threaded union inlet and outlet
GG - with gauge tapping and 0-160 lb. gauge
SC - sealed spring cage for hi-rise applications
S-DU - Sweat union inlet and outlet
HP - High pressure range 75-125 lbs. Set for 90 lbs. no flow pressure.
Z3 - for waterworks pit installations. Has sealed spring cage and corrosion-resistant adjusting and cage screws ½"- 1"
Z7 - 400 lb. max. initial pressure ¾" only

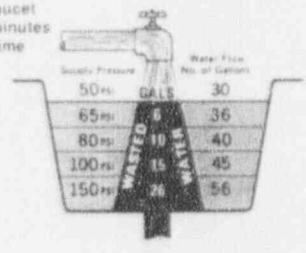
No.	Size (Inches)	DIMENSIONS (Inches) A	B	C	D	Weight
25AUB	½, ¾	5½	1¼	3⅞	2½	3½ lbs.
25AUB	1	6	2	4	2½	6½ lbs.
25AUB	1¼, 1½	8¾	2¼	5½	2½	10 lbs.
25AUB	2	9⅜	3¼	6¾	2½	15 lbs.



Save on energy — The EPA estimates that 30% of the water used in households is heated. Reducing consumption also saves on energy.

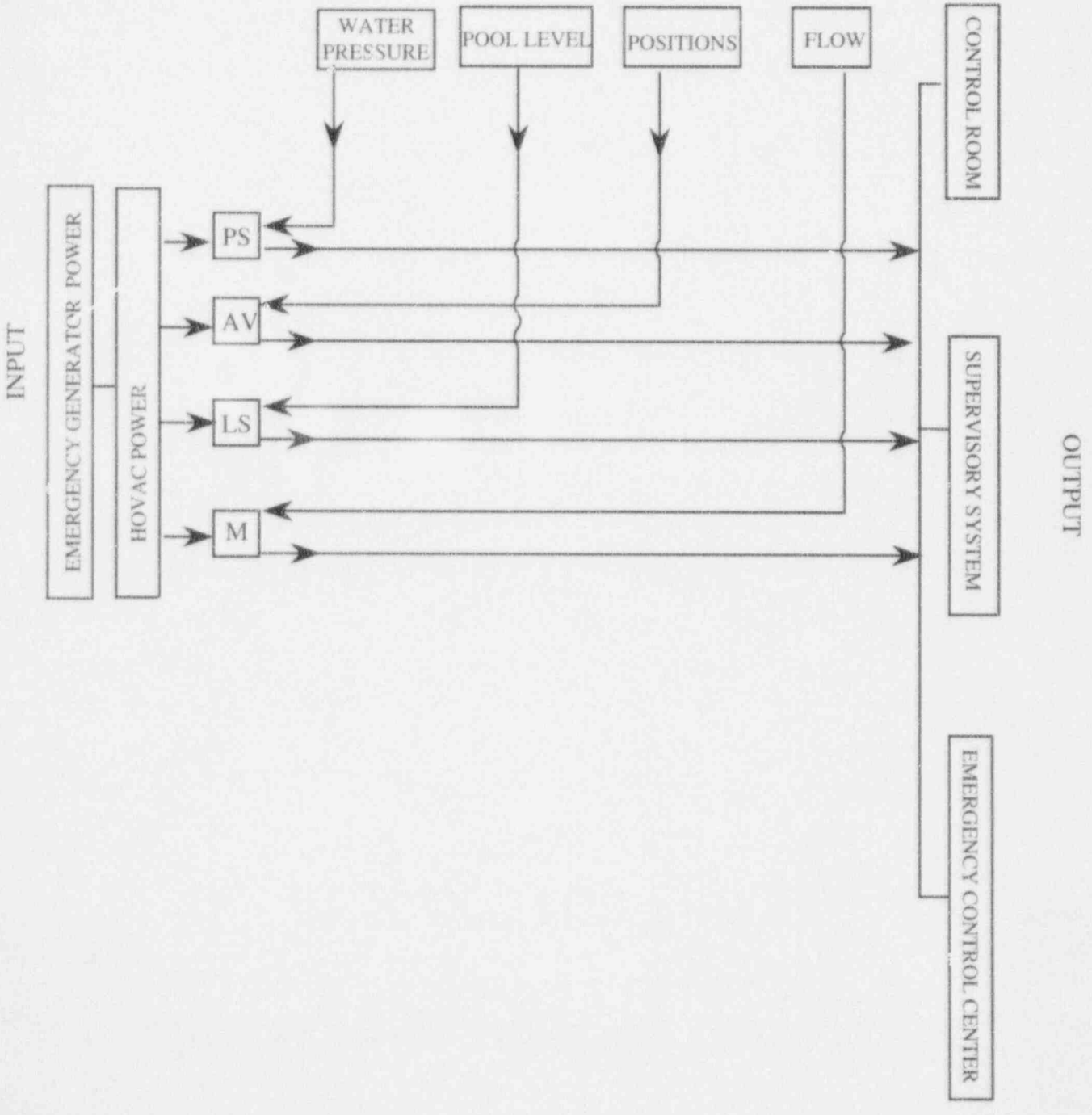
Save on wastewater — When we can save 1/3 of the water previously consumed, this also represents a similar saving of water which will not be going into the sewer system.

Note: Almost twice as much water flows at 150 lbs. than 50 lbs., most of which is wasted. Reducing the water pressure will result in saving because less water flows at lower pressure.

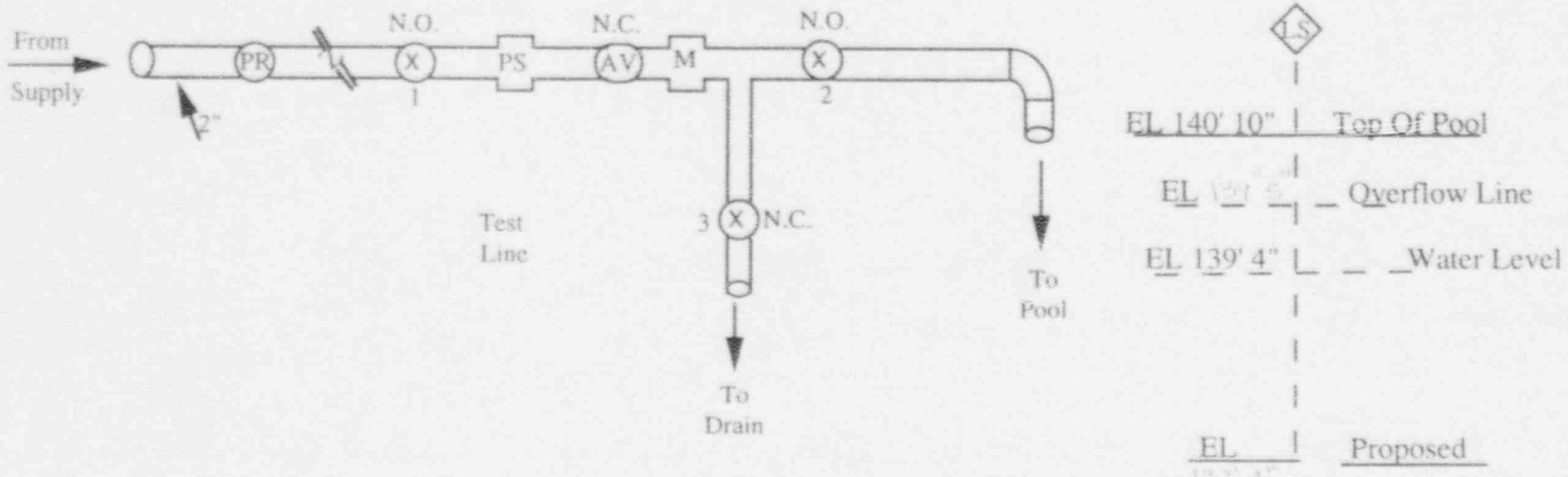


Write for our "23 Q&A's" brochure on water and energy savings.

ECC INSTRUMENT BLOCK DIAGRAM



EMERGENCY CORE COOLING SYSTEM SCHEMATIC



LEGEND

- (X) Shut off Valves - #1, #2, #3
- [PS] Pressure Switch
- (AV) Automatic Valve
- [M] Flow (Meter) Transmitter
- N.O. Normally open
- N.C. Normally closed
- (PR) Pressure Reducing Valve
- ◇LS◇ Level Sensor

PLANS

(1) URI Bay Campus Water System to Rhode Island Nuclear Science Center
RINSC Drawing #2130

(2) North Bunker Areas
RINSC Drawing #2005-C (Revised to show ECCS pipe routing)

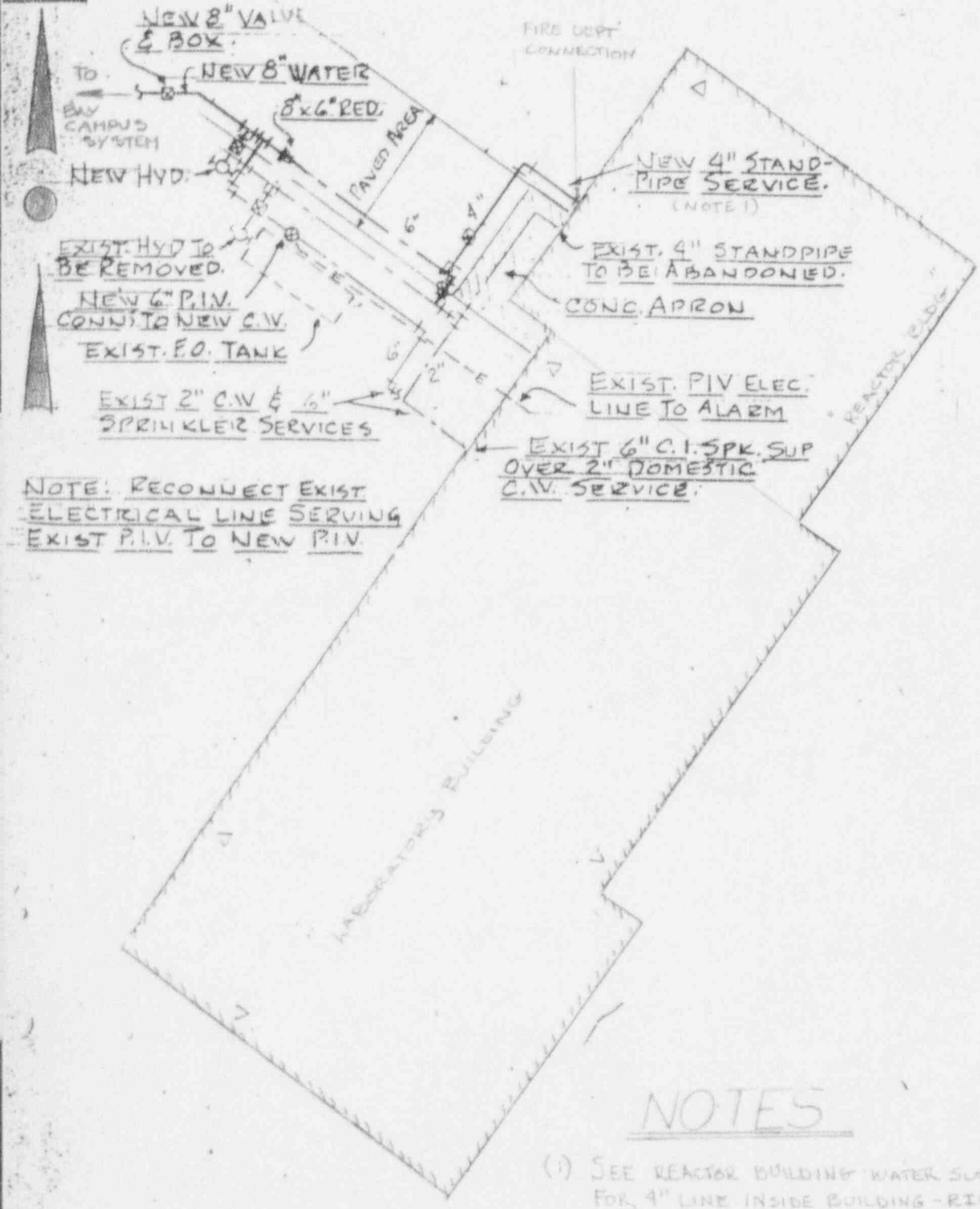
(3) Reactor Room ECCS Piping Plan
RINSC Drawing #2152

(4) Piping Plan - Reactor Building Supply
RINSC Drawing #2150

PIPING PLAN - REACTOR BUILDING SUPPLY

RINSE DWG # 2150

5



NOTE: RECONNECT EXIST ELECTRICAL LINE SERVING EXIST P.I.V. TO NEW P.I.V.

NOTES

(1) SEE REACTOR BUILDING WATER SUPPLY STAND PIPE DETAILS FOR 4" LINE INSIDE BUILDING - RINSE 2151

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SEE APERTURE CARDS

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