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DOCKET NUMBER	50-315
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DATE OF DOCUMENT	12/17/76
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TO: Mr. Benard C. Rusche

FROM: Indiana & Michigan Power Company, New York, New York, Mr. John Tillinghast

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PROP

INPUT FORM

DESCRIPTION

Ltr. notorized 12/17/76....w/attached.... re their 10/19/76 ltr. and our 8/13/76 ltr. concerning reactor vessel overpressurization events.

REACTOR VESSEL OVERPRESSURIZATION
DISTRIBUTION PER G. ZECH 10-21-76

(13-P)

PLANT NAME:
Cook Unit #1

ENCLOSURE

DO NOT REMOVE

ACKNOWLEDGED

SAFETY — FOR ACTION/INFORMATION 12/27/76 RJL

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12919 MIS ap4 GD

INDIANA & MICHIGAN POWER COMPANY

P. O. BOX 18
BOWLING GREEN STATION
NEW YORK, N. Y. 10004

December 17, 1976

Donald C. Cook Nuclear Plant Unit No. 1
Docket No. 50-315
DPR No. 58

Mr. Benard C. Rusche, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Rusche:

On October 19, 1976, we responded to your letter of August 13, 1976 addressing reactor vessel overpressurization events. In that response we stated that an analysis had been initiated to evaluate the effectiveness of the pressurizer power operated relief valves in mitigating overpressurization transients. We also noted in our letter the general design criteria for the mitigating system. Preliminary evaluations indicated that the pressurizer power operated relief valves would be adequate to mitigate overpressurization events except for inadvertent opening of the accumulator isolation valve. We stated that adequate administrative controls are available for assuring that certain valves are open during power operation and similar administrative controls would provide the necessary protection for the overpressurization event caused by the accumulator isolation valve opening. This letter is intended to provide additional clarification of our proposed course of action and design criteria for the intended mitigating system. To accomplish this clarification of our course of action and design criteria, a "Reference Mitigating System" is described.

We are proceeding with an analysis of overpressurization transient events by employing the LOFTRAN code. Modifications internal to the code are necessary which will require a development and verification effort. The modified LOFTRAN

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calculational model, when complete, will provide a technically justifiable and conservative means to determine the adequacy of a relief valve system in mitigating an overpressurization event. Until the calculational model is completed and the bounding analysis is performed, size requirements and setpoints for the relief system cannot be accurately established.

Although specific setpoints and relief capacity requirements of the mitigating system are not known at present, meaningful progress towards resolution of the reactor vessel overpressurization issue is being achieved by defining the design criteria requirements of the mitigating system. When the design criteria requirements are confirmed by the completion of the bounding analysis, plant specific design of modifications in accordance with these specified design criteria can be implemented promptly. The time interval to complete resolution of this issue is minimized by a parallel path of analysis and definition of design criteria and we are following this approach.

In your letter of August 13, formal guidance as to the acceptable design criteria was provided on page three. The letter stated:

> "The basic criteria to be applied in determining the adequacy of overpressurization protection are that no single equipment failure or single operator error will result in Appendix G limitations being exceeded."

We embraced this criterion in our letter of October 19, 1976. This criterion is the basis for the "Reference Mitigating System" which incorporates the following specific design features:

a. An existing wide-range pressure transmitter is proposed as the sensor. Additional bistable(s) will be added to provide an "open" signal to the power-operated relief valve(s). Figure 1 provides a logic diagram of the "Reference Mitigating System." Figure 2 presents an instrumentation loop diagram of the pressure monitoring and relief valve actuating equipment. The present control/protection grading of this instrument loop will be retained.

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

b. The power operated relief valves, as previously stated, will be utilized as the pressure relief mechanism. These relief valves are spring loaded closed requiring air to open which is presently supplied by a control air source. To assure operability upon the loss of control air which could initiate an overpressurization event by closure of the letdown isolation valves and disable the pressurizer power-operated relief valves, air accumulator(s) will be utilized. The air accumulator(s) will provide a sufficient air supply to the pressurizer power operated relief valve to allow five cycles of the valve following a loss of normal control air.

c. The present power supplies for the solenoid valves controlling air flow to the pressurizer power-operated relief valves will be retained. Installation of the "Reference Mitigating System" will not compromise the existing separation between DC power sources.

d. A keylock switch or an equivalent administratively controlled switch will be used to enable and disable the low setpoint of each relief valve. The enable/disable switches will conform to the separation criteria requirements for the DC buses for the Donald C. Cook Nuclear Plant.

e. Seismic design of the electronic equipment presently installed in the Donald C. Cook Nuclear Plant will be retained. Additional electronic equipment will be installed so as not to compromise the present seismic qualifications of existing safety systems.

f. The control air supply from the air accumulators will be seismically designed. The pressurizer power-operated relief valves are designed to withstand seismic loading equivalent to 3.0g in the horizontal direction and 2.0g in the vertical direction and retain their function during such loading. The valves will not be degraded by the system modification.

g. Testability will be provided. Verification of operability is possible prior to solid system, low temperature operation by use of the remotely operated isolation valve, enable/disable switch and normal electronics surveillance procedure methodology. Testing requirements will be incorporated in the operating procedures to assure performance prior to existence of plant conditions requiring operability of the mitigating system.

h. Figure 3 presents a typical electrical schematic diagram which would be used for each pressurizer power operated relief valve. The additional pressure channel's bistable contact or auxiliary relay contact and the enable/disable switch addressed in "d" above are included.

i. The loss of an instrument power bus will not result in an isolation of letdown flow and disabling of the "Reference Mitigating System."

These design criteria for the "Reference Mitigating System" should be agreed to by completion of the analysis to minimize the time until complete installation of an acceptable system is accomplished. We have inquired as to the availability of electrical and mechanical equipment required for the "Reference Mitigating System." According to vendors' estimates, delivery of additional equipment needed for the "Reference Mitigating System" could be expected within six months of order placement.

It is our desire to resolve this matter by the end of 1977. This goal and the fact that analysis completion is scheduled for the end of March 1977, equipment delivery may require an additional six months, and installation and testing at the Donald C. Cook Nuclear Plant will require more time, makes it imperative that the design criteria include sufficient flexibility to assure accomplishment of desired prevention of overpressurization transients. Two pressurizer relief valves may be necessary to mitigate the worse case overpressurization event to be analyzed in our bounding analysis.

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[illegible]

[illegible]

[illegible]

[illegible]

Contingencies of this nature were considered in selection of design criteria. The "Reference Mitigating System" design includes conformance to the guidelines of your August 13, 1976 letter, provides for the maximum pressure relief possible with available mechanical equipment, and could be installed by the end of 1977.

Following the installation of plant modifications and related administrative controls, the probability of ever exceeding Appendix G limits is significantly reduced. In the unlikely event that an overpressurization incident should occur, however, the installation of the subject mitigating system assures that the consequences of such an incident would be significantly reduced. As a result, any adverse consequences with respect to vessel integrity would be negligible. Because large safety margins exist between actual conditions observed during overpressurization incidents and conditions required to assure reactor vessel integrity, exceeding Appendix G limits does not imply loss of vessel integrity.

The impact on the vessel of an overpressurization incident can be best evaluated by performing specific analyses which employ reasonable assumptions in terms of flaw size, integrated neutron fluence, reactor vessel material properties and actual plant data available at the time of the event. This approach relates the stress field developed in the vicinity of the assumed flaw to the applied stress on the structure, material properties, and the size of the defect which would cause failure.

With the installation of the subject mitigating system, it is expected that overpressurization incidents will not occur. However, should such an event occur, we will not resume normal plant operation until we have taken the action required in our current Technical Specification 3/4.4.9. Further, a report of the incident will be filed with the Nuclear Regulatory Commission and an analysis will be available for review.

In our October 19, 1976 letter, we also stated that administrative controls were in force at the Donald C. Cook Nuclear Plant to prevent inadvertent overpressurization of the reactor coolant system by the safety injection accumulators.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

These administrative controls include closing the accumulator injection valves and locking out power to the valve motors during cooldown at Reactor Coolant System Pressure of 1000 psig. Specific procedural verification of valve status and motor breaker status, as now used to verify that the valves are open and power to the motors unavailable, is incorporated in the plant procedures to verify that the valves are closed and power to the motors unavailable.

The steady state flow capacities of typical pressurizer power operated relief valves and the mass injection rates for typical 4 loop Westinghouse plants are provided in Figures 4 and 5, respectively. It is noted that the steady state relief capacity of a single pressurizer power-operated relief valve is of the approximate capacity necessary to compensate for steady state safety injection flow. Although the steady state flow rates appear consistent, transient analyses are necessary to assure capability of the system. Figure 6 presents the typical flow vs. valve plug position relationships which will be incorporated in the analysis.

In summary, the "Reference Mitigating System" design incorporates the guidance of your letter, employs installed plant equipment to avoid equipment procurement delays to the extent possible and provides the maximum pressure relief available. The "Reference Mitigating System," with the ability to verify its functional status prior to establishment of plant conditions where operability of the system is required, coupled with increased administrative control requirements on the accumulator isolation valves, will provide assurance that consequences of an overpressurization event will be mitigated.

Our objective to have a system in operation by the end of 1977 will require NRC review and approval of our design criteria on a timely basis.

Very truly yours,

John Tillinghast
Vice President

Sworn and subscribed to before me on this 17th day of December 1976 in New York County, New York

Notary Public

KATHLEEN BARRY
NOTARY PUBLIC, State of New York
No. 41-4606792
Qualified in Queens County
Certificate filed in New York County
Commission expires March 30, 1977

cc: G. Charnoff
R. J. Vollen
R. C. Callen
P. W. Steketee
R. Walsh
R. S. Hunter
R. W. Jurgensen - Bridgman

FIGURE 1

LOGIC DIAGRAM

POWER OPERATED RELIEF VALVE

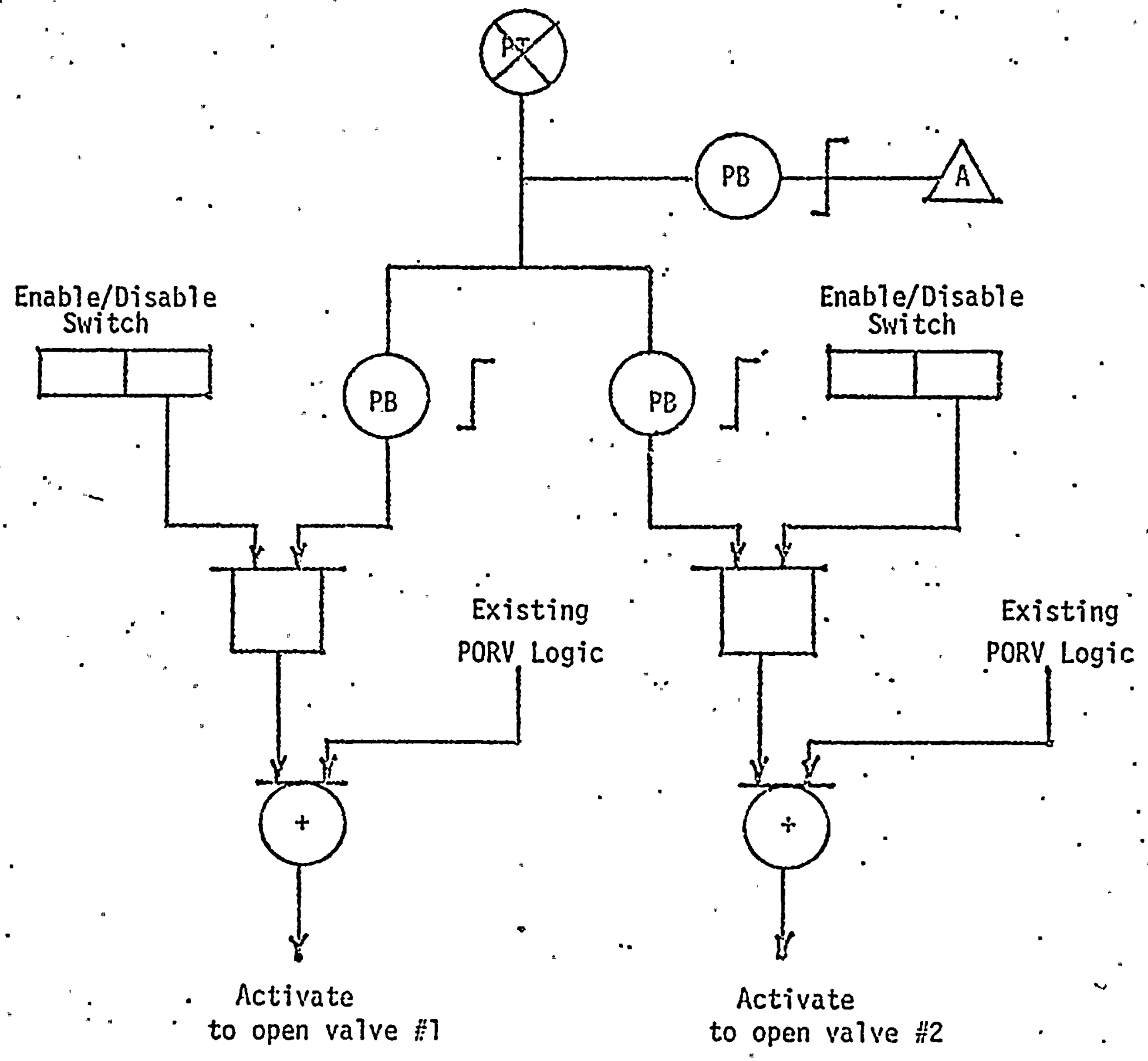


FIGURE 2

WIDE RANGE PRESSURE SIGNAL

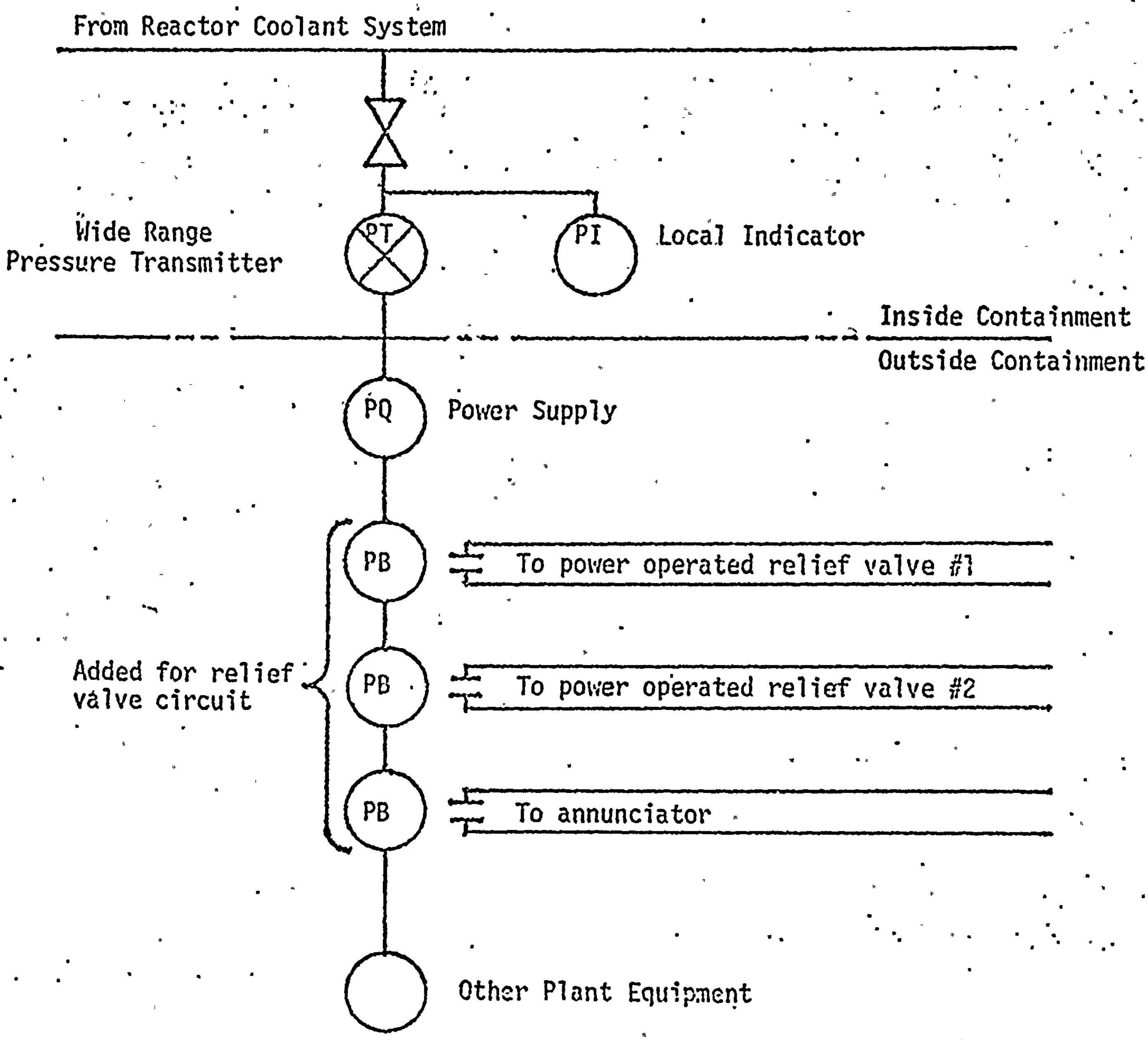
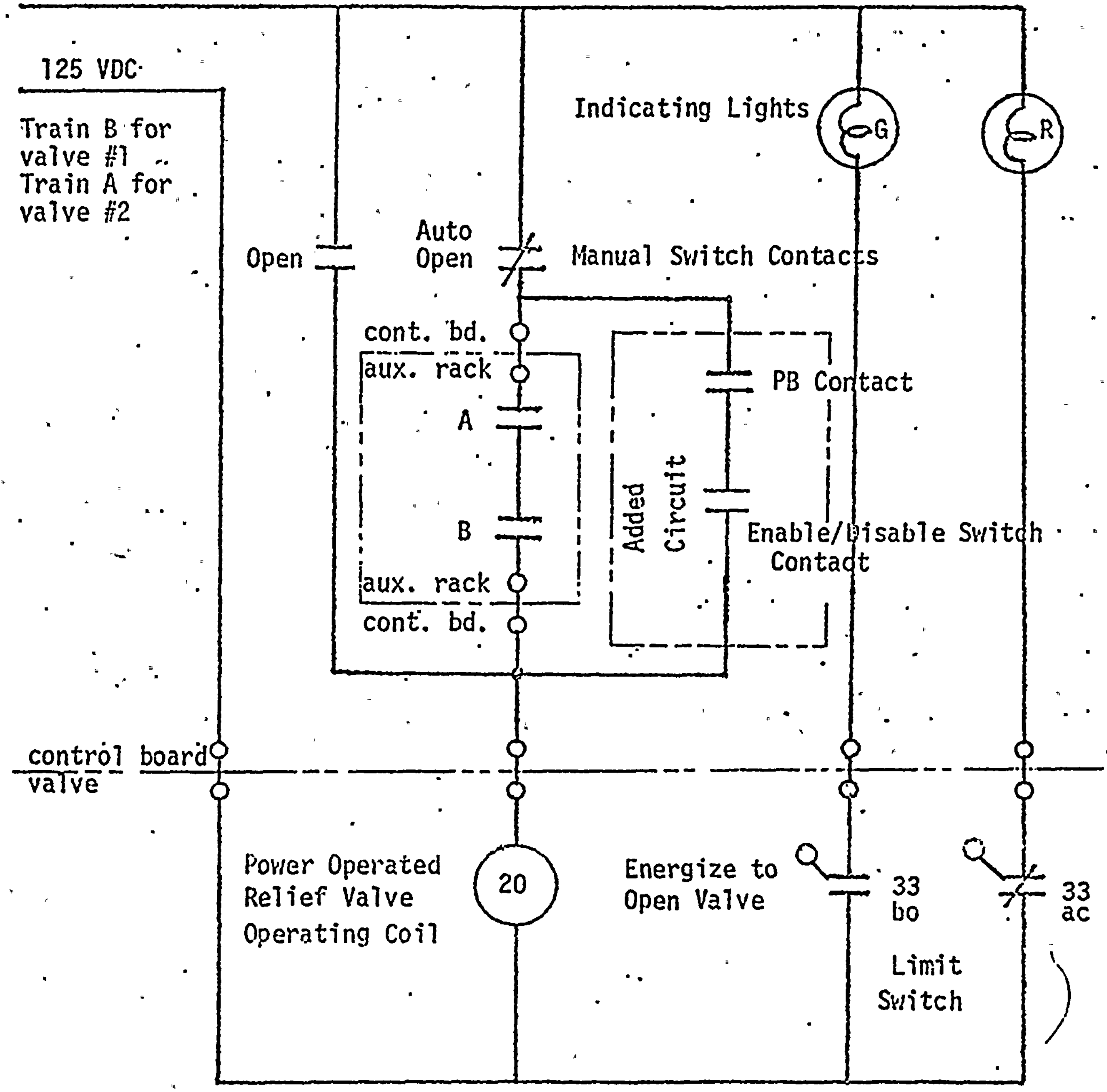


FIGURE 3

TYPICAL POWER OPERATED RELIEF VALVE CIRCUIT



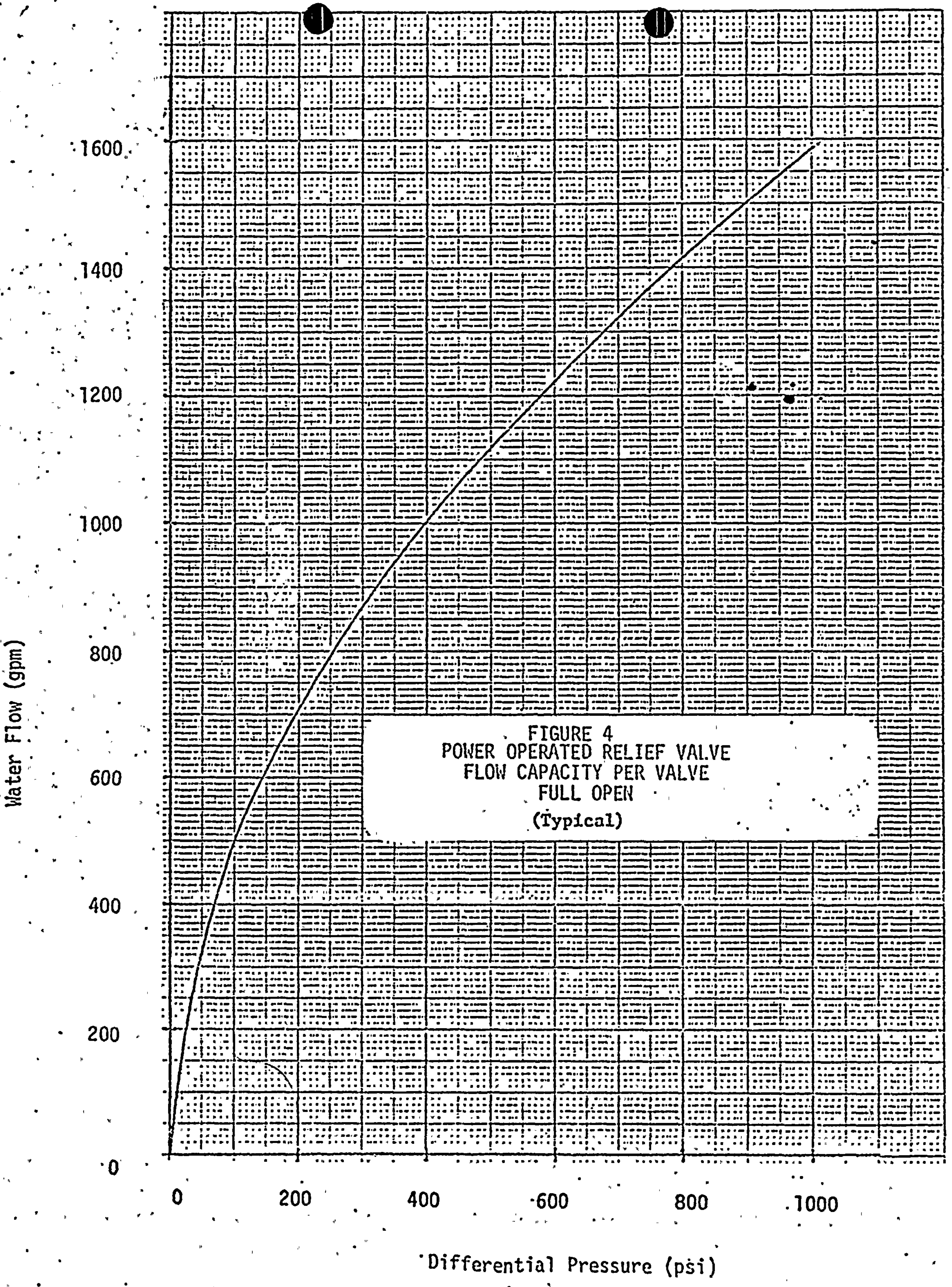


FIGURE 4
POWER OPERATED RELIEF VALVE
FLOW CAPACITY PER VALVE
FULL OPEN
(Typical)

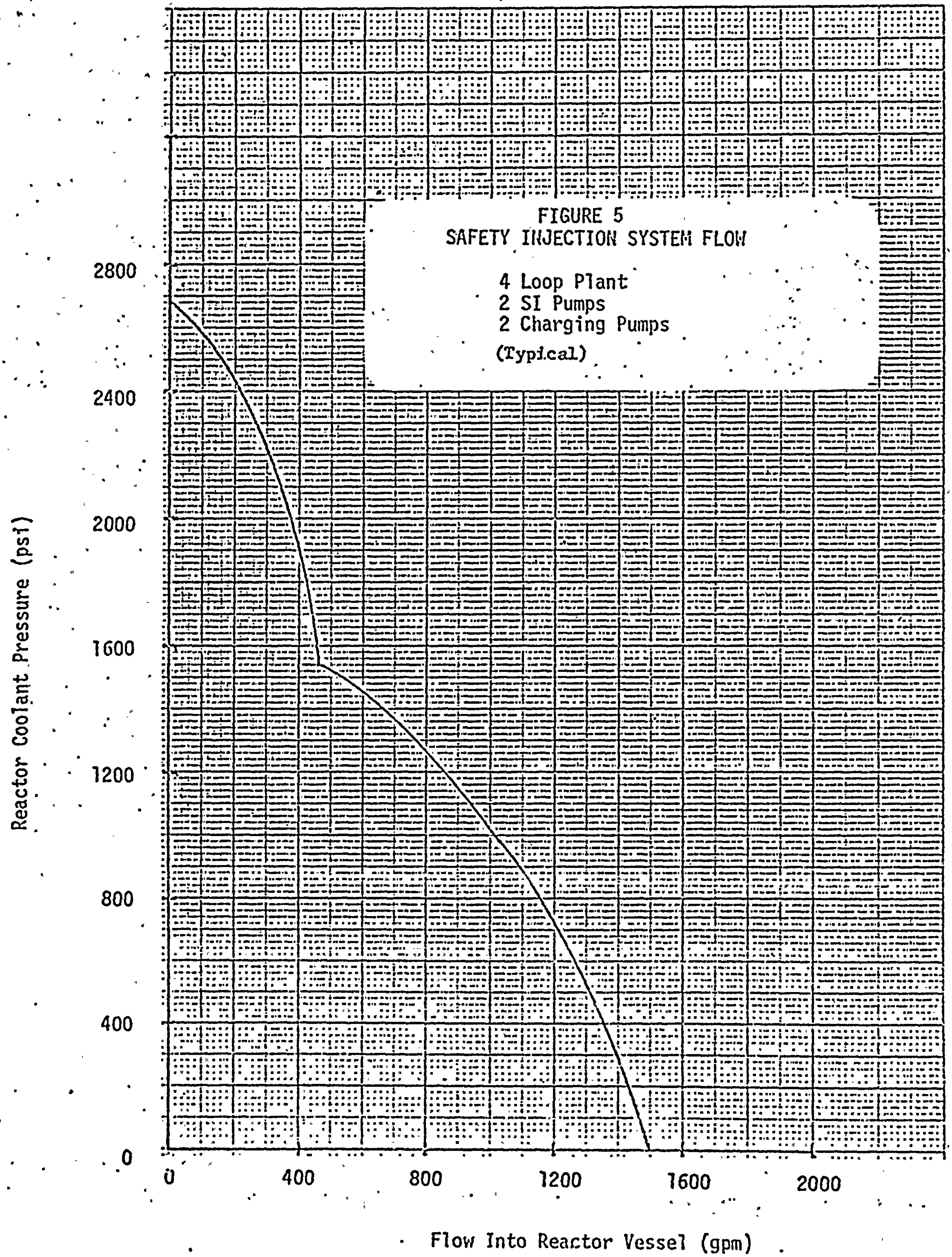


FIGURE 5
SAFETY INJECTION SYSTEM FLOW
4 Loop Plant
2 SI Pumps
2 Charging Pumps
(Typical)
Reactor Coolant Pressure (psi)
2800
2400
2000
1600
1200
800
400
0
0
400
800
1200
1600
2000
Flow Into Reactor Vessel (gpm)

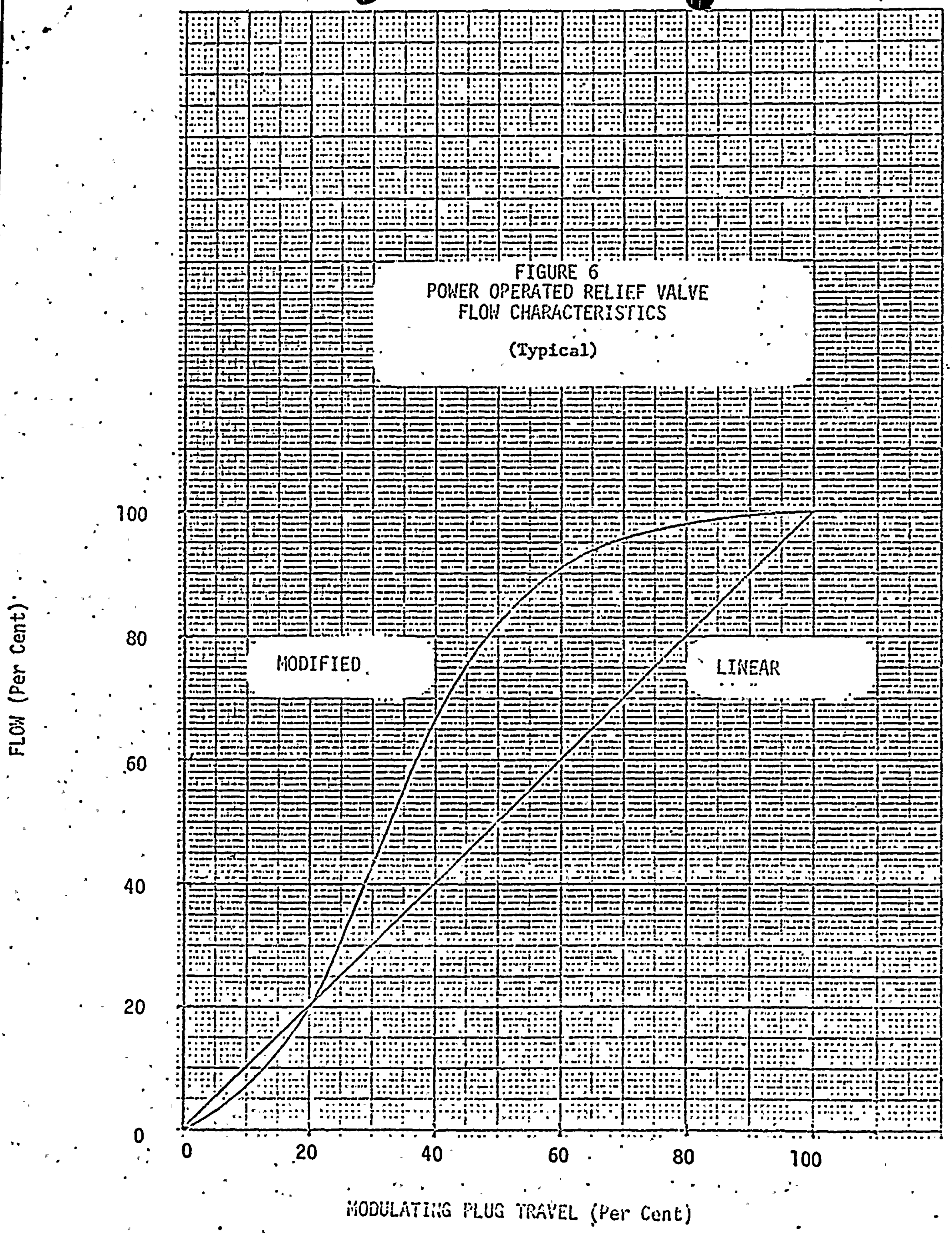


FIGURE 6
POWER OPERATED RELIEF VALVE
FLOW CHARACTERISTICS

(Typical)