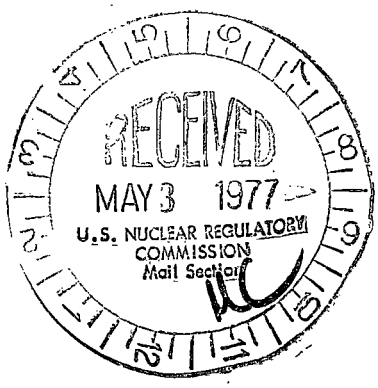
PSE&G

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 Phone 201/622-7000

April 25, 1977 Regulatory File Cy.



Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Attention: Mr. George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Dear Mr Lear:

SALEM GENERATING STATION UNIT NO. 1
ANALYSIS OF DEGRADED GRID VOLTAGE CONDITION
DOCKET NO. 50-272, LICENSE NO. DPR-70

In response to your request, we have completed an evaluation of the effect that degraded grid voltage would have on plant operation and equipment. Our analysis indicates plant auxiliary systems will perform satisfactorily under such conditions.

Attached is the information requested in Enclosure No. 2 of your March 16, letter.

Very truly yours,

Frank P. Librizzi
General Manager -
Electric Production

7712 50318

The Energy People

ENCLOSURE NO. 1
SALEM NUCLEAR GENERATING STATION, UNIT NO. 1
RESPONSE TO NRC REQUEST FOR INFORMATION
MILLSTONE ELECTRICAL PROBLEM

Question 1a

Describe the plant conditions under which the plant auxiliary systems (safety related and non-safety related) will be supplied by offsite power. Include an estimate of the fraction of normal plant operating time in which this is the case.

Response

To summarize the Salem FSAR, Sections 8.3.1 through 8.3.3, all plant auxiliary systems are supplied by offsite power from our 500kV transmission system via the 500-13kV and 13-4kV Station Power Transformers whenever the generator is not synchronized to the system. During start-up, after the generator is synchronized to the 500kV system, the non-safety related group busses are manually transferred to the 25-4-4kV Auxiliary Power Transformer fed from the generator bus. All vital busses feeding safety related equipment remain connected to the 500kV transmission system through the Station Power Transformers. It is estimated that during normal plant operation, including start-up and shutdown, non-safety related busses are supplied by offsite power less than 5% of the time and safety related busses are supplied by offsite power 100% of the time.

Question 1b

The voltage used to describe the grid distribution system is usually a "nominal" value. Define the normal operating range of your grid system voltage and the corresponding voltage values at the safety related busses.

Response

The 500kV bus at Salem is maintained between 525 and 540kV under normal operating conditions. Voltage values on the vital busses feeding safety related equipment corresponding to these transmission system voltages are listed in Table 1.

TABLE 1

	Full Load	No Load
500kV Transmission System	525kV	540kV
Vital Bus 1A (4160V)	4486V	4486V
Vital Bus 1A (460V)	480V	493V
Vital Bus 1A (230V)	234V	246V
Vital Bus 1B (4160V)	4486V	4486V
Vital Bus 1B (460V)	485V	493V
Vital Bus 1B (230V)	242V	246V
Vital Bus 1C (4160V)	4486V	4486V
Vital Bus 1C (460V)	485V	493V
Vital Bus 1C (230V)	242V	246V

The 4160V vital busses are fed from 13-4kV Station Power Transformers which are equipped with automatic load tap changing mechanisms set to maintain the 4kV busses at a predetermined value.

Question 1c

The transformers utilized in power systems for providing the required voltage at the various system distribution levels are normally provided with taps to allow voltage adjustment. Provide the results of an analysis of your design to determine if the voltage profiles at the safety related busses are satisfactory for the full load and no load conditions on the system and the range of grid voltage.

Response

The range of the load tap changers on the 13-4kV Station Power Transformers is adequate to maintain the vital bus voltages shown in Table 1 for both full load and no load conditions over both the normal operating range (525-540kV) and also the minimum and maximum operating limits (500-550kV) of the 500kV transmission system at Salem.

Question 1d

Assuming the facility auxiliary loads are being carried by the station generator, provide the voltage profiles at the safety busses for grid voltage at the normal maximum value, the normal minimum value, and at the degraded conditions (high or low voltage, current, etc.) which would require generator trip.

Response

Vital busses feeding safety related loads are never carried directly by the station generator.

Question 1e

Identify the sensor location and provide the trip setpoint for your facility's loss of Offsite Power (undervoltage trip) instrumentation. Include the basis for your trip setpoint selection.

Response

The Salem vital 4kV system consists of three busses which can be fed from either of two offsite sources (11 and 12 Station Power Transformers) as shown on Figure 8.3-4 of the Salem FSAR. Each vital bus is capable of automatically transferring to the opposite transformer if one of the transformers fails. This transfer mechanism involves the use of a relay on each transformer secondary (27-11 and 27-12) and a relay on each 4kV bus (83-1A, 83-1B, 83-1C).

"Blackout" detection is provided by the use of an additional relay on each bus (27-1A, 27-1B, 27-1C) which sends bus undervoltage signals to the Safeguards Equipment Control (SEC) for each diesel through auxiliary relays. Each 27-1 relay energizes three auxiliary relays to provide independent signals for each SEC. The SEC units provide a "Blackout" logic signal if two of the three vital busses experience undervoltage.

The setpoint for determining a blackout is 2870 volts. This value was selected to coordinate with the bus transfer relays and insure that a transfer is attempted prior to initiating the blackout signal. The setting also insures that the diesels are signalled to start in a time frame compatible with the response time requirements of engineered safety features motors. The maximum allowable time to generate a blackout signal is 4 seconds from the start of voltage decay.

Question 1f

Assuming operation on offsite power and degradation of the grid system voltage, provide the voltage values at the safety related busses corresponding to the maximum value of grid voltage and the degraded grid voltage corresponding to the undervoltage trip setpoint.

Response

Table 2 lists the maximum allowable 500kV transmission system voltage and corresponding 4160V vital bus voltage and also the 4160V vital bus undervoltage trip setpoint and corresponding 500kV transmission system voltage.

TABLE 2

Transmission System Voltage	4160V Vital Bus Voltage
550kV	4486V
295kV	2870V

Question 1g

Utilizing the safety related bus voltage values identified in (f), evaluate the capability of all safety related loads, including related control circuitry and instrumentation, to perform their safety functions. Include a definition of the voltage range over which the safety related components, and non-safety related components, can operate continuously in the performance of their design function.

Response

The minimum and maximum safety related bus voltages are tabulated with the allowable equipment voltage ranges in Table 3. The equipment voltages listed represent the operating characteristics of the most restrictive component on a given bus.

TABLE 3

System	Operating Range Min.	Max.	Equipment Voltage Range	
4160V	4486V	4486V	3740V	4570V
460V	480V	493V	414V	505V
230V	234V	246V	207V	253V
120V	119V	121V	100V	130V

Question 1h

Describe the bus voltage monitoring and abnormal voltage alarms available in the control room.

Response

The three 4kV vital busses, 1A, B and C, have their respective voltages monitored at the main control console by three independent volt meters. In addition, each 4kV vital bus has a separate "under-voltage" alarm on the overhead annunciator located in the control room.

The 13kV group bus voltages are monitored at the control console in the control room.

Question 2

The functional safety requirement of the undervoltage trip is to detect the loss of offsite power system voltage and initiate the onsite power system. Describe the load shedding feature of your design (required prior to transferring to the onsite systems) and the capability of the onsite systems to perform their function if the load shedding feature is maintained after the diesel generators are connected to their respective safety busses. Describe the basis (if any) for retention or reinstatement of the load shedding function after the diesel generators are connected to their respective busses.

Response

The load shedding function is performed by the Safeguard Equipment Control System (SEC) provided for each safety bus. Upon receipt of undervoltage signals, the SEC initiates load shedding by tripping the preferred supply bus infeed breakers, diesel-generator breaker, and all 4kV feeder breakers. These trip signals last five seconds and are removed at that time in anticipation of load breaker closure signals to be sequenced by the SEC.

The load shedding feature is removed and cannot be re-initiated during load sequencing even if subsequent undervoltage signals should occur during the diesel loading. This function is automatically controlled by the SEC logic which recognizes and remembers the existence of the initiating event.

The load shedding feature is only reinstated when the SEC units are reset for subsequent operator action. This action allows

the operator to regain manual control of bus loads which had been deliberately disabled by the SEC at the onset of the event. SEC reset also allows the SEC units to be returned to their normal state of readiness to provide protection against other events. The reset action, by its nature, would reinstate the logic which performs the load shedding function. The SEC units are not reset until load sequencing activities are completed and the onsite power system is operating with steady loads.

Question 3

Define the facility operating limits (real and reactive power, voltage, frequency and other) established by the grid stability analyses cited in the FSAR. Describe the operating procedures or other provisions presently in effect for assuring that your facility is being operated within these limits.

Response

Operating instructions currently dictate that generator voltage be maintained between 101 and 105% of rated, that frequency be maintained between 59.75 and 60.25 Hz, and that real and reactive power be maintained within the limits described in Figures 1 and 2. These operating limits are documented in formal operating instructions which are in the hands of both the Station Shift Supervisor and the Electric Dispatcher for their use during operation.

Question 4

Provide a description of any proposed actions or modifications to your facility based on the results of the analyses performed in response to items 1-3 above.

Response

Our analyses indicates satisfactory station auxiliary system performance for all operating conditions and no modifications are required or proposed at this time.

JEE/pk

FIGURE 1

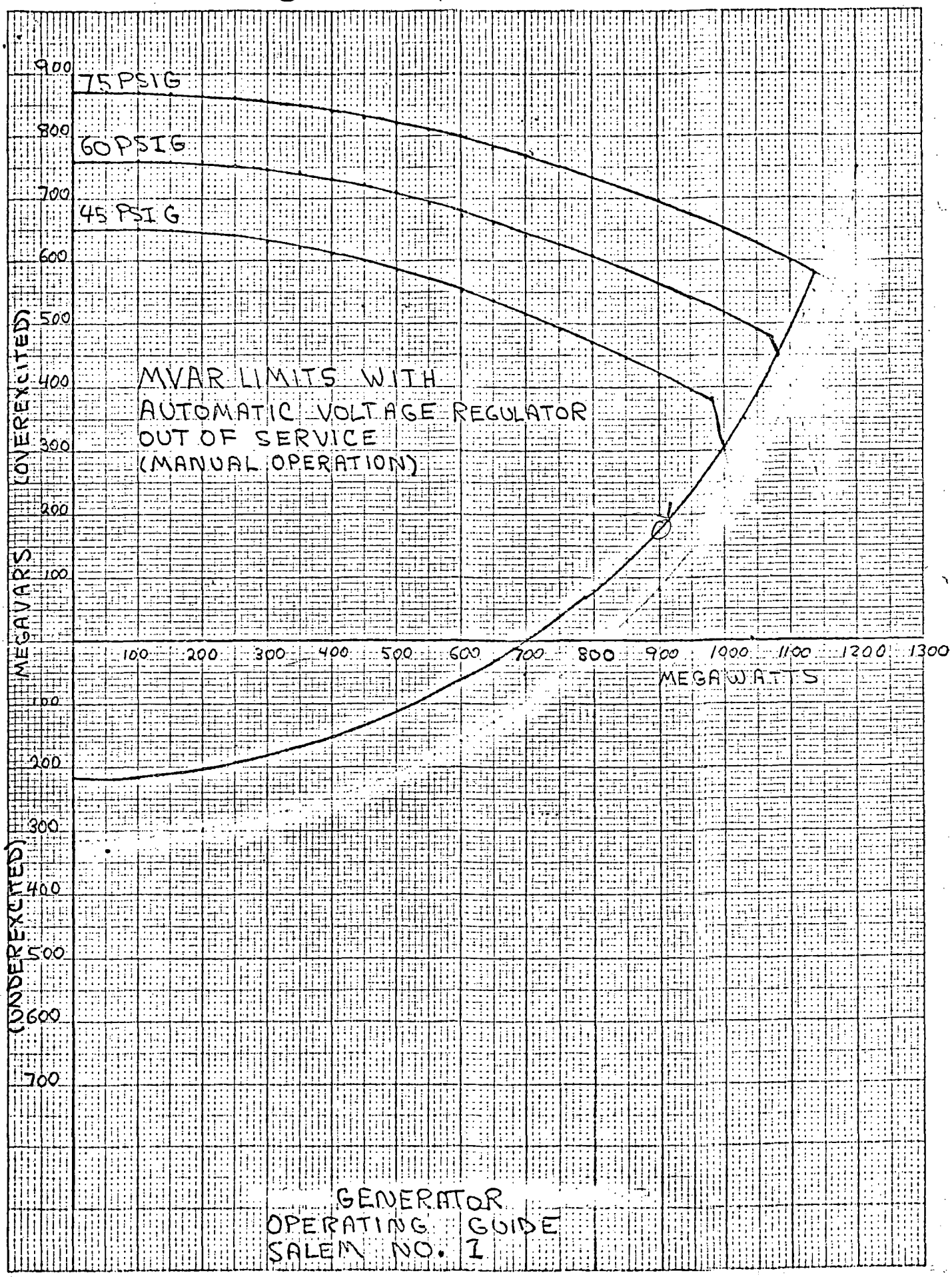


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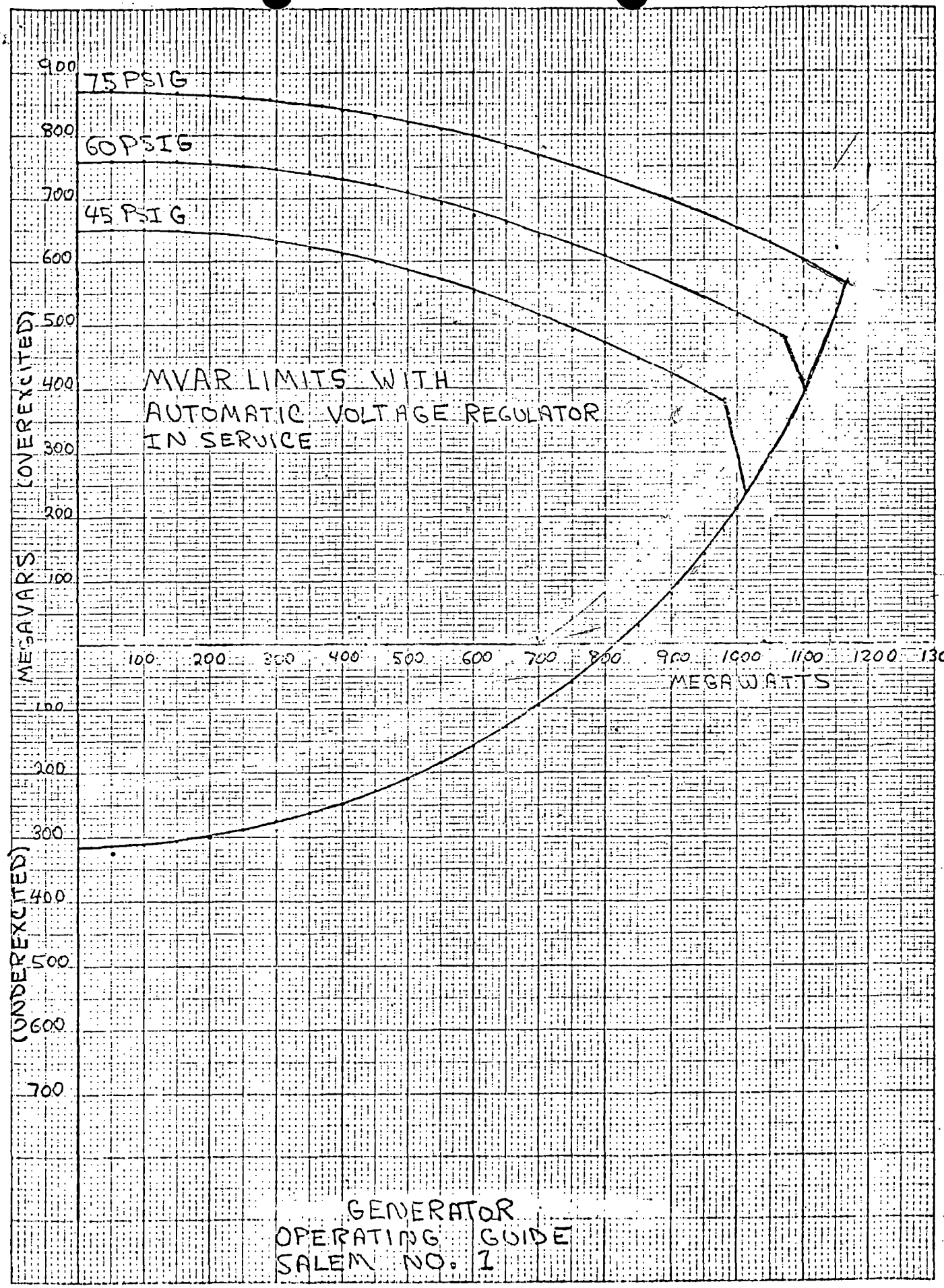
FIGURE 2



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20 Squares to the Inch