Attachment 13

TITLE: TECHNICAL SERVICES PROCEDURE NO. 30, EVALUATION OF SHIM MOTOR WATTAGE CHARACTERISTICS

ISSUANCE AUTHORIZED BY			
PORC REVIEW			EFFECTIVE DATE

1.0 PURPOSE

This procedure describes the methods used to obtain wattage recordings, review the recordings, identify anomalies, establish "in" rod position and document the recordings.

2.0 APPLICABILITY

This procedure applies to the Technical Services Department's periodic responsibilities with regard to monitoring shim motor performance. All in-reactor rod movement will be done by the Reactor Operator with the Shift Supervisor's concurrence as indicated in SOP 12. Technical Services' responsibility will include monitoring of the watt recorder on the MCC and requesting the desired rod motion per SOP 12 through the Reactor Operator/Shift Supervisor. Adequate shutdown margins must be maintained at all times as indicated in the Cycle Safety Analysis or by GAUGE calculation.

3.0 OBJECTIVES

To establish a data base of shim motor characteristics. To establish condition of absorber strings and/or drive mechanism under anomalous conditions. To determine rod "in" position in the event analog and digital ("in" limit switches or position potentiometers) indication is lost, or to verify existing indication.

4.0 PROCEDURE

4.1 Initial Conditions

4.1.1 Recording wattmeter is connected to the CRDMCC with the region(s) to be tested.

4.1.2 If the wattmeter is not connected to the desired CRDMCC obtain a TCR through the Results Department and request an electrician to connect as required.

4.1.3 Insure the wattmeter is operational. (Turn power "on", check to see pen is correctly set and inking, and adequate chart paper is installed, or perform other checks as appropriate for the instrument.)

Zero the instrument or otherwise identify "zero" level, once the wattrecorder is on. All following references to wattage are with respect to this "zero" level, if the wattrecorder is not exactly zeroed.

4.1.4 Verify the wattmeter calibration date and record on TSP-30A.

4.1.5 Obtain a calibrated stopwatch and record calibration date if a timed shim sequence is to be performed.

4.1.6 Attach a voltmeter (multammeter) in the voltage measurement mode across the individual phase-ground terminals for phases A, B, and C. Record voltages on TSP-30A (see diagram TSP-30C).

4.2 Procurement of Data

4.2.1 Request Shift Supervisor's permission to perform shim motor wattage test. Identify Region involved and reason. Testing will normally only be done while shutdown. For normal CRDOA configurations the requirements of SOP 12-02 must be met:

Not more than 2 CRDOA absorber pairs at positions other than fully inserted, including those of any CRDOA removed from the reactor (i.e., if any CRDOA is removed, its absorber pairs must be considered fully withdrawn).

For other configurations (examples, (1) low CRDOA in a high region, (2) ICRD reinstalled, etc.) not explicitly covered by the cycle SAR, a GAUGE run verifying the shutdown margin (≥ 0.01) must be performed prior to rod movement.

Review Attachment B to become familiar with watt recorder interpretation.

4.2.2 Request Reactor Operator to notify Shift Supervisor and then exercise or shim the desired control rod pair in reactor. If monitoring is to be done on a CRDOA in the HSF, request the Maintenance Refueling Supervisor or designee to exercise control rods.

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4.2.3 For each CRDOA to be monitored for trending/monitoring purposes, it is desired to obtain recordings of one full in and one full out movement. Record control rod position at start, finish, and at appropriate places deemed necessary. Additional recordings, such as running the control rods "out" and "in" in twenty inch increments may also be obtained. All position information may be marked on the recording chart.

4.2.4 To establish "in" rod position with watt recorder perform the following while obtaining watt recordings:

Sequence a

a) Scram the rod pair (pull the fuse, scram the Reactor, etc., as appropriate).

b) Obtain a calibrated stopwatch and prepare to time. Shim "out" for 15 seconds. (This will not have a significant effect on core reactivity since the total rod travel will be about 16 inches.)

Record time of "out" shim:

_____	_____	_____
a	b	c

c) Shim "in" for the exact time recorded above. The rod pair should again be at the fully inserted position.

d) Scram the rod pair.

Sequence b

e) Repeat steps 4.2.4 b)-4.2.4 d) above.

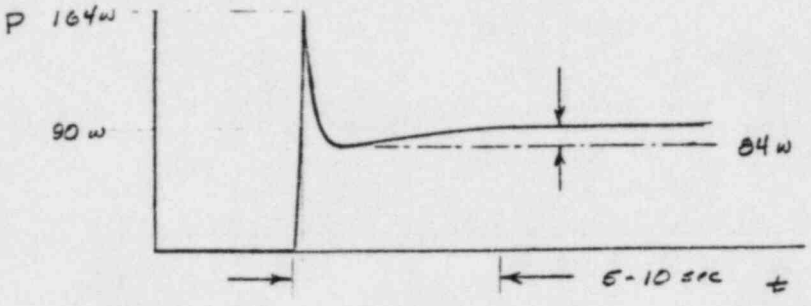
Sequence c

f) Repeat steps 4.2.4 b)-4.2.4 d) above.

4.3 Evaluation of Data

4.3.1. "In" Position Evaluation

a) For an inserted rod pair, the cable drum must wrap to raise the rod pair. As this occurs motor load will increase. For the "out" shims above, observe a wattage trace which shows an increasing 'steady' value after the starting peak occurs, as seen below.



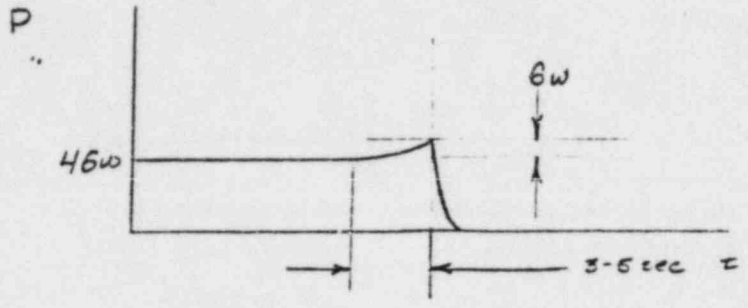
Record the minimum wattage for each "out" shim:

1a	1b	1c

Record final wattage for each "out" shim:

2a	2b	2c

b) For the "in" shims, observe an increase in the steady wattage towards the end of the shim as the drum unwraps, as seen below:



Record the nominal wattage after the starting peak for each "in" shim:

3a	3b	3c

Record the final wattage for each "in" shim:

4a	4b	4c

c) If the above observations are made, and if for items 1 and 2, cases a through c,

$$5 = \frac{2 - 1}{2} \times 100\% > 5\%, \text{ and}$$

for items 3 and 4, cases a through c

$$6 = \frac{4 - 3}{4} \times 100\% > 5\%,$$

the rod maybe considered "in"; continue to step 4.6 below.

Record:

5a	5b	5c	(> 5%)

6a	6b	6c	(> 5%)

d) An exact repetition of the above sequences, 4.2.4 a)-f) and 4.3.1 a)-c) may be done as many times as desired. Any sequence for which the above conditions are met may be used to conclude that the rod pair is "in".

4.4 Detailed "In" Rod Position Test and Evaluation

a. Theory

Both the peak wattage and decay time for an outward shim starting at the fully inserted position varies from those of a shim starting with the drum sheave wrapped. This is due to the decreased power to establish motion, in conjunction with a quicker decay to the final steady value due to the more rapid acceleration when the rods are not immediately required to rise upon shim initiation. Decay time is the time to reach a minimum wattage value during the shim, or the time to reach a value within 2 watts of the final extrapolated steady value, or the time of the shim, whichever is shorter.

b. Data Procurement

NOTE: Any RWP or incomplete shim will require repeating the test sequence.

Sequence a

i) The control rod pair is scrammed; reset the scram breaker. Start the wattrecorder when ready.

ii) Shim outward for 15 seconds; wait 10 seconds.

iii) Perform ii) again, exactly.

iv) Perform ii) again, exactly.

v) Shim inward for 15 seconds; wait 10 seconds.

vi) Perform v) again, exactly.

vii) Perform v) again, exactly.

Sequence b

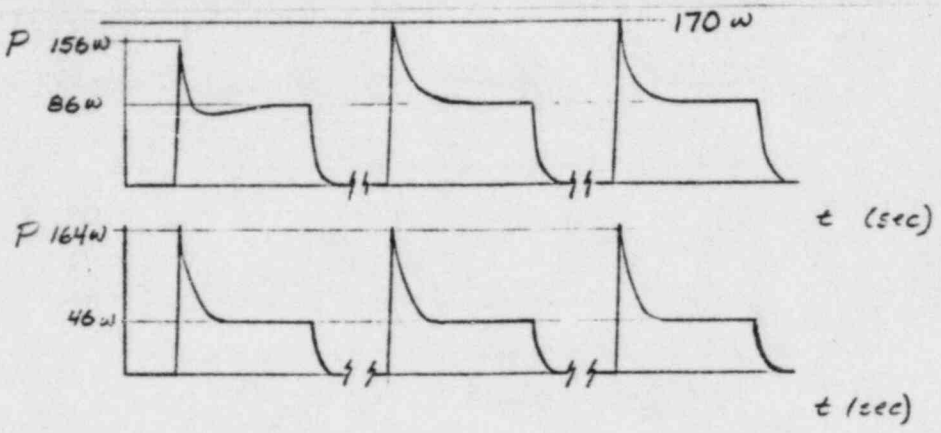
viii) Repeat steps i) - vii) above.

Sequence c

ix) Repeat steps i) - vii) above.

c. Evaluation

i) The wattage record will indicate three sequences, each a series of 3 "out" shims and 3 "in" shims, of exactly the same duration.



ii) Record the wattage peaks of each shim, consecutively, below:

Sequence a

"out" shims

shim 1 _____ (1a) shim 2 _____ (2a) shim 3 _____ (3a)

"in" shims

shim 4 _____ (4a) shim 5 _____ (5a) shim 6 _____ (6a)

Sequence b

"out" shims

shim 1 _____ (1b) shim 2 _____ (2b) shim 3 _____ (3b)

"in" shims

shim 4 _____ (4b) shim 5 _____ (5b) shim 6 _____ (6b)

Sequence c

"out" shims

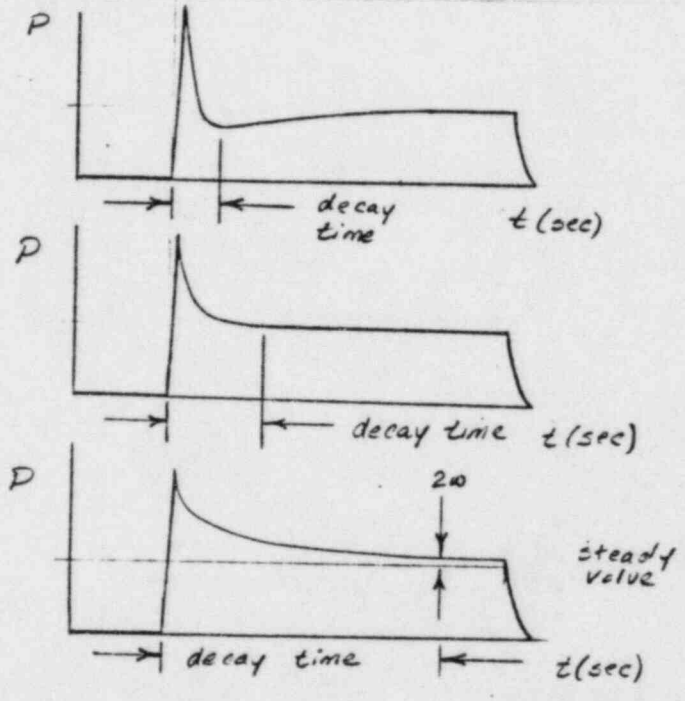
shim 1 _____ 1c shim 2 _____ 2c shim 3 _____ 3c

"in" shims

shim 4 _____ 4c shim 5 _____ 5c shim 6 _____ 6c

iii) Record the decay time of each shim, consecutively.

Decay time: time to reach a minimum or stable value (within 2 watts of extrapolated final steady value), or time of the shim, whichever is smaller.



Sequence a

"out" shims

shim 1 _____ 1'a shim 2 _____ 2'a shim 3 _____ 3'a

"in" shims

shim 4 _____ 4'a shim 5 _____ 5'a shim 6 _____ 6'a

Sequence b

"out" shims

shim 1 _____ 1'b shim 2 _____ 2'b shim 3 _____ 3'b

"in" shims

shim 4 _____ 4'b shim 5 _____ 5'b shim 6 _____ 6'b

Sequence c

"out" shims

shim 1 _____ 1'c shim 2 _____ 2'c shim 3 _____ 3'c

"in" shims

shim 4 _____ 4'c shim 5 _____ 5'c shim 6 _____ 6'c

iv) For each sequence,
average ii) items 2-3 $\frac{2 + 3}{2} = 7$

and average iii) items 2'-6' $\frac{2' + 3' + 4' + 5' + 6'}{5} = 8$

Sequence a

Record 7 and 8: _____ 7a _____ 8a

Sequence b

Record 7 and 8: _____ 7b _____ 8b

Sequence c

Record 7 and 8: _____ 7c _____ 8c

v) If for each sequence,

$$9 = \frac{7 - 1}{7} \times 100\% \geq 5\%$$

and

$$10 = \frac{8 - 1'}{8} \times 100\% \geq 50\%,$$

the rod pair may be considered "in"; continue to step 4.6.

Sequence a

Record 9 and 10: _____ (>5%) _____ (≥50%)
9a 10a

Sequence b

Record 9 and 10: _____ (>5%) _____ (≥50%)
9b 10b

Sequence c

Record 9 and 10: _____ (>5%) _____ (≥50%)
9c 10c

If the result is negative, notify the Shift Supervisor and Technical Services Engineering Supervisor that "The control rod pair in Region (give Region) cannot be considered inserted"; continue to step 4.5 if directed.

4.5 Absolute "In" Position Evaluation

NOTE: This test should only be performed if both the analog/digital position pots are not correctly indicating and the "in" limit switches are not picking, or there is evidence that the multijaws coupling connecting these indicating devices is failed, causing readings inconsistent with the rod motion, or if there is an absolute need for independent verification of rod pair position.

Because this activity places a high risk on breaking the multijaws coupling, Station Manager approval is required to proceed.

Approval to proceed:

_____ _____
Station Manager Date/Time

This is the most definitive wattage test for determining "in" position.

a. Theory

A shim in which the motor raises the control rod pair, nominally referred to as outward shim, performed by shimming in the "out" direction, differs from an inward shim due to the differences in the peak and steady wattages, for the case where the cable drum is wound approximately ¼ turn so that the moment arm is developed.

At the fully inserted position, the moment arm is zero, as the rod pair hangs free from the drum attached by the anchor ends. At this point, the transient peak for an "out" or "in" shim is the same, although under normal conditions only an "out" shim may be accomplished, as the picking of the "in" limit switches precludes shimming in the inward direction.

Note that if the "in" limit switches fail or are opened up, shimming in the inward direction is again possible, except that now the cable is wrapping around the drum sheave in the reverse direction. Hence the shim motor is essentially performing a raising transient, which requires more wattage than an insertion transient.

Thus the shim motor wattage transient will appear as if an "out" shim is being performed, even though the shim is in the "in" direction.

The crux of this test is to observe the change in the motor transient performance that will occur if the rods are at the fully inserted position.

b. Data Procurement

NOTE: Any RWP or incomplete shim will require repeating the test sequence.

WARNING: The following sequence must be performed exactly to minimize risk of jamming the assembly.

Sequence a

i) The control rod pair is scrammed; reset the scram breaker. Start the wattrecorder when ready.

ii) Shim "out" for 10 seconds; wait ≥ 10 seconds.

Shim time: _____ (a) _____ (b) _____ (c)

iii) Shim "in" for 10 seconds; wait ≥ 10 seconds.

Shim time: _____ (a) _____ (b) _____ (c)

iv) Shim "in" for 10 seconds; wait ≥ 10 seconds.

Shim time: _____ (a) _____ (b) _____ (c)

v) Shim "out" for 10 seconds; wait ≥ 30 seconds.

Shim time: _____ (a) _____ (b) _____ (c)

Sequence b

vi) Repeat i) through v), exactly.

Sequence c

vii) Repeat i) through v), exactly.

c. Analysis

i) Determine the final wattage values for the shims in item b. ii); if no steady value was obtained, note.

_____ (1a) _____ (1b) _____ (1c)

ii) Determine the steady wattage for the shims in item b. iii). This will correspond to the minimum wattage seen during these shims.

_____ (2a) _____ (2b) _____ (2c)

iii) Calculate for i) and ii), items a through c above

$$3 = \frac{1 - 2}{1} \times 100\%$$

iv) Determine the final wattage for the shims in item b. iv); if no steady value was obtained, note.

_____ _____ _____
4a 4b 4c

v) Determine the steady wattage for the shims in item b. v). This will correspond to the minimum wattage seen during these shims.

_____ _____ _____
5a 5b 5c

vi) Calculate for iv) and v) items a through c.

$$6 = \frac{4 - 5}{4} \times 100\%$$

vii) If for items a through c,

$3 > +25\%$

and

$6 > +25\%$

Record 3 and 6, items a through c, below:

_____ _____ _____ (>+25%)
3a 3b 3c

_____ _____ _____ (>+25%)
6a 6b 6c

Then the rod pair may be considered "in"; continue to step 4.2.5 a 5).

If the result is negative notify the Shift Supervisor and Technical Services Engineering Supervisor that "The control rod pair in Region (give Region) cannot be considered inserted"; continue to step 4.6.

4.6 Disable Rod Motion

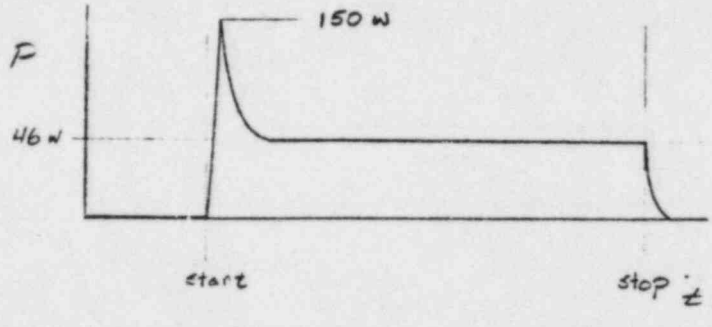
To insure no rod motion for shutdown margin purposes, instruct the Reactor Operator to pull the fuses on that Region and write a System Status Tag precluding rod motion for that rod pair.

4.7 Transient Evaluation

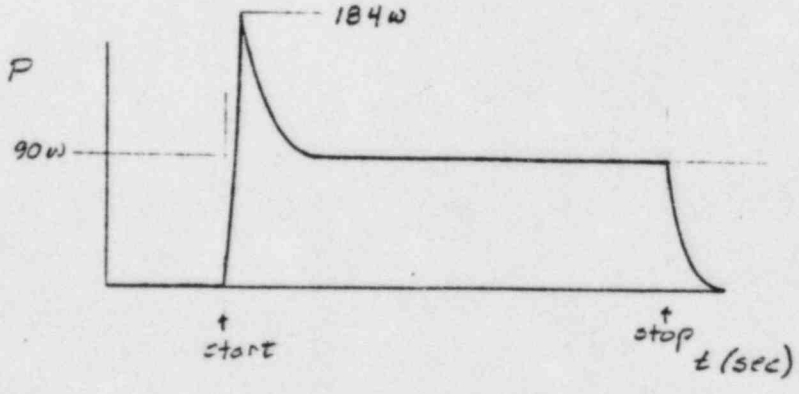
4.7.1 Normal Operation

a) For shims that begin/end at more than 10 inches position, the wrapping/unwrapping behavior in a. is not observed.

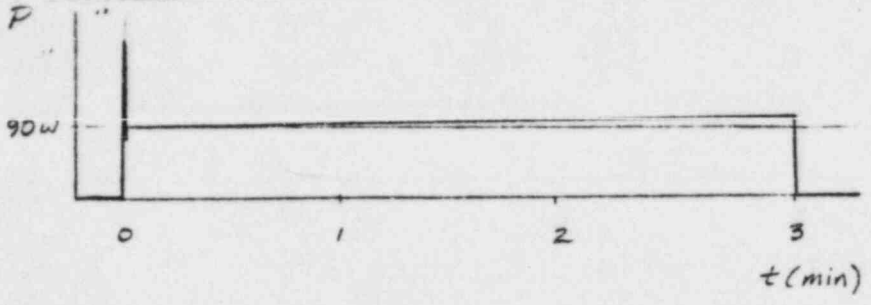
b) For the "in" shims, observe an increase in wattage at the initiation followed by decay to a steady value over the next 10 seconds. Nominally the wattage should peak at 140-150 watts and decay to 40-50 watts.



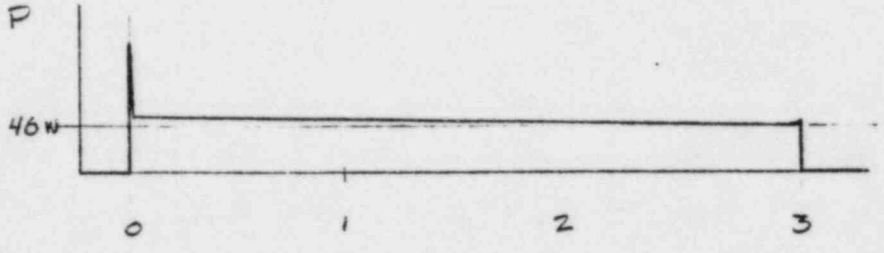
c) For the "out" shims, observe an increase in wattage at the initiation followed by decay to a steady value over the next 10 seconds. Nominally the wattage should peak at 160-180 watts and decay to 80-100 watts.



d) Over the duration of a continuous "out" shim from the fully inserted position, a gradual rise in wattage is seen of ~6 watts, due to the spiral wrapping of the drum sheave slightly changing the sheave moment arm.

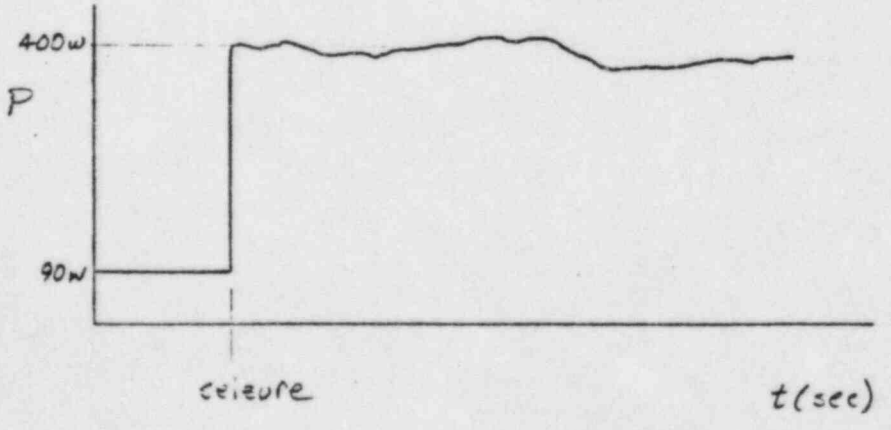


e) Over the duration of a continuous "in" shim from the fully withdrawn position, a gradual decline in wattage is seen of ~6 watts due to the unwrapping of the drum sheave.



4.7.2 Rotor Seizure

a) Rotor (hence drive mechanism) seizure is indicated by nearly instantaneous changes in wattage of very large magnitude. Should these be observed, rod motion should be stopped and evaluation of circumstances performed.



4.8 Documentation

Upon completion of monitoring, record the region that was tested or indicate HSF if conducted there, the CRDOA serial number, primary coolant temperature and moisture level as available. This information can be recorded on the wattage recording. Sign and date the chart recording and attach to this procedure. This information is recorded on Attachment TSP-30A.

4.9 Review

Review the recordings for unusual wattage. Normal steady readings are 90 watts during withdrawal and 44 watts during insertion; transient peaks should be 70 to 95 watts.

Normal readings are 90 ± 20 watts out
44 ± 20 watts in

4.10 Notification

If abnormal readings are obtained notify the Technical Services Engineering Supervisor.

4.11 Historical CRDOA Data

File copies of anomalous chart recordings with the Technical Services Control Rod Historical Information. Complete the Evaluation Summary and forward to the Technical Services Engineering Supervisor for review.

4.12 Records

Transmit the original attachment and chart recordings to Record Storage; retain copies in Technical Services files for review. Also transmit completed evaluations and recordings for any position evaluations.

5.0 REFERENCES

SOP 12

GA-9806, Operation and Maintenance Manual, CRDOA

WATTMETER USE TO DETERMINE INSERTED ABSORBER STRING POSITION, Engineering Analysis by Jim Eggebroten

6.0 ATTACHMENTS

Attach. TSP-30A, Evaluation Summary Sheet

Attach. TSP-30B, Typical Transient Analysis Sheet

Attach. TSP-30C, Sample Transient Records

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EVALUATION SUMMARY SHEET

Engineer/Technician: _____ Date: _____

QC Representative: _____

Wattmeter Identification: _____ Calibration Date: _____

Stopwatch Identification: _____ Calibration Date: _____

Voltmeter (Multameter)
Identification: _____ Calibration Date: _____

Location (check) Reactor ____ HSF ____

If Reactor: Region _____

Moisture (if available) _____ _____ppm _____°F

Inst (MM9305, MM9306, MM9307) _____

T Circ Inlet _____°F

CRDOA SN (if available) _____

Phase-to-ground voltages during shim: A _____ B _____ C _____
(Not required for position determination.)

SUMMARY OF OBSERVATIONS

_____

_____

_____

_____

_____

Completed By: _____ Date: _____

_____ Date: _____
Technical Services
Engineering Supervisor
("In" position verification and abnormal readings, only.)

Make a copy for Technical Services files and forward originals to Records Storage.

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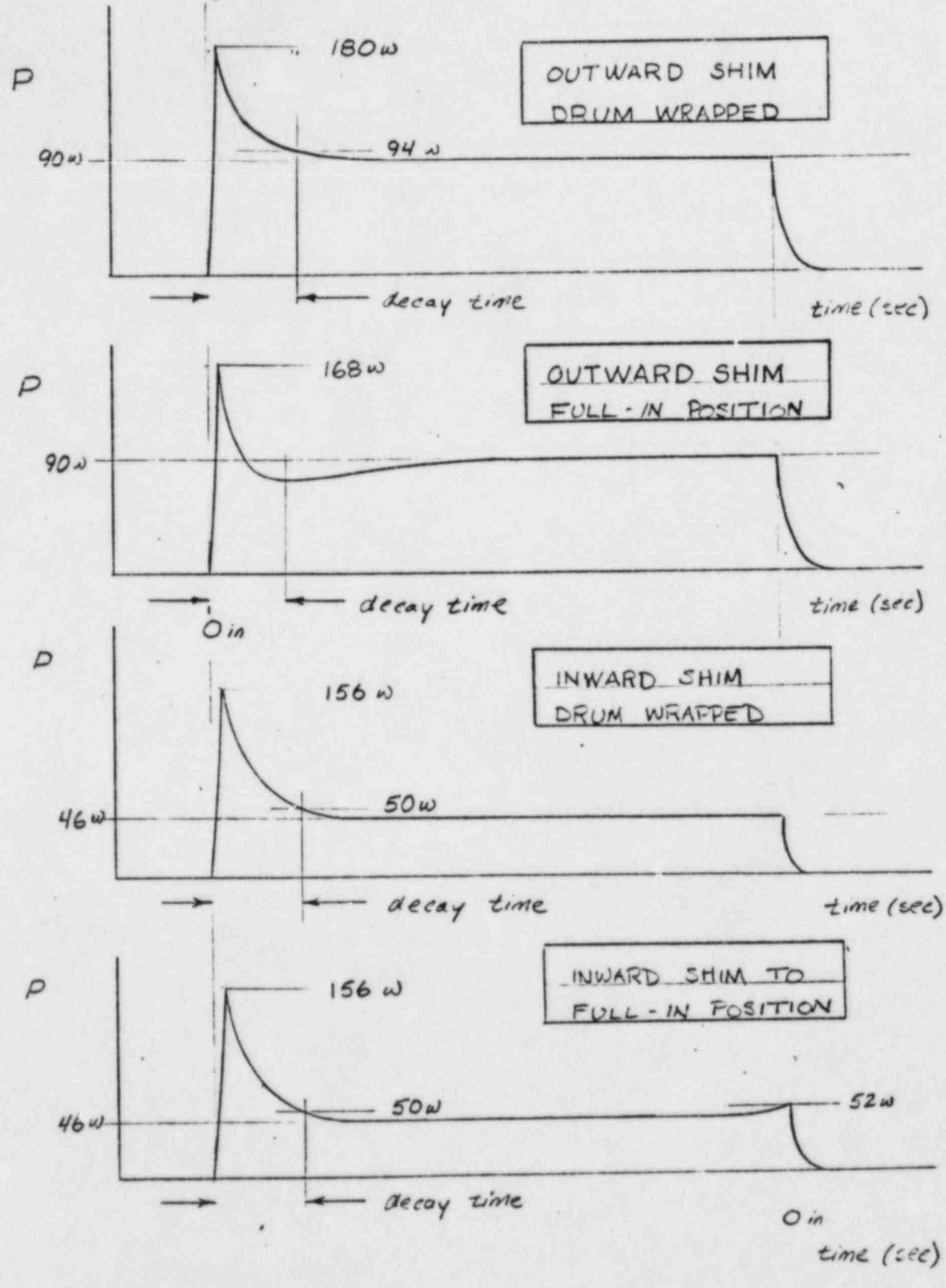
WATTMETER INTERPRETATION



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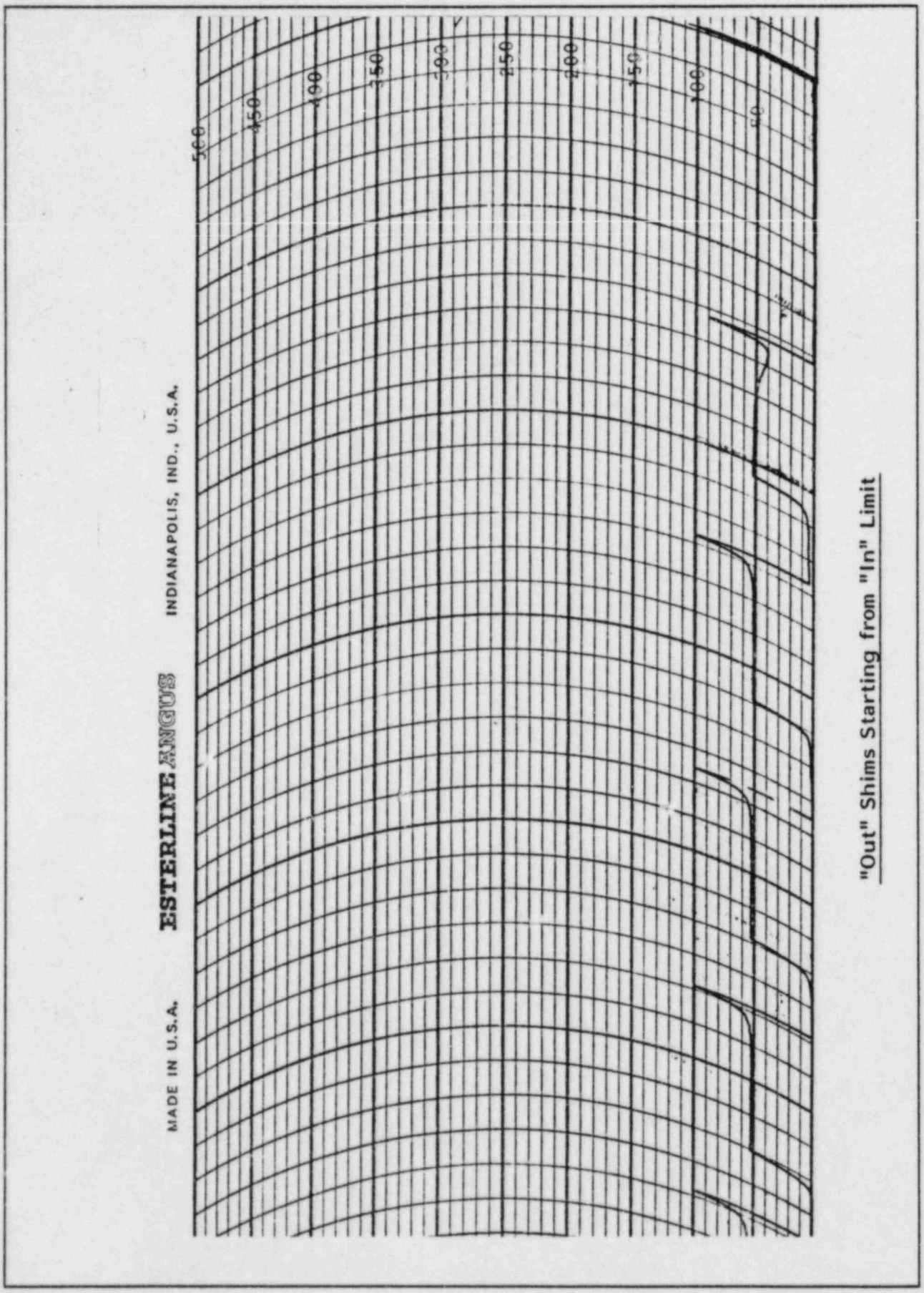

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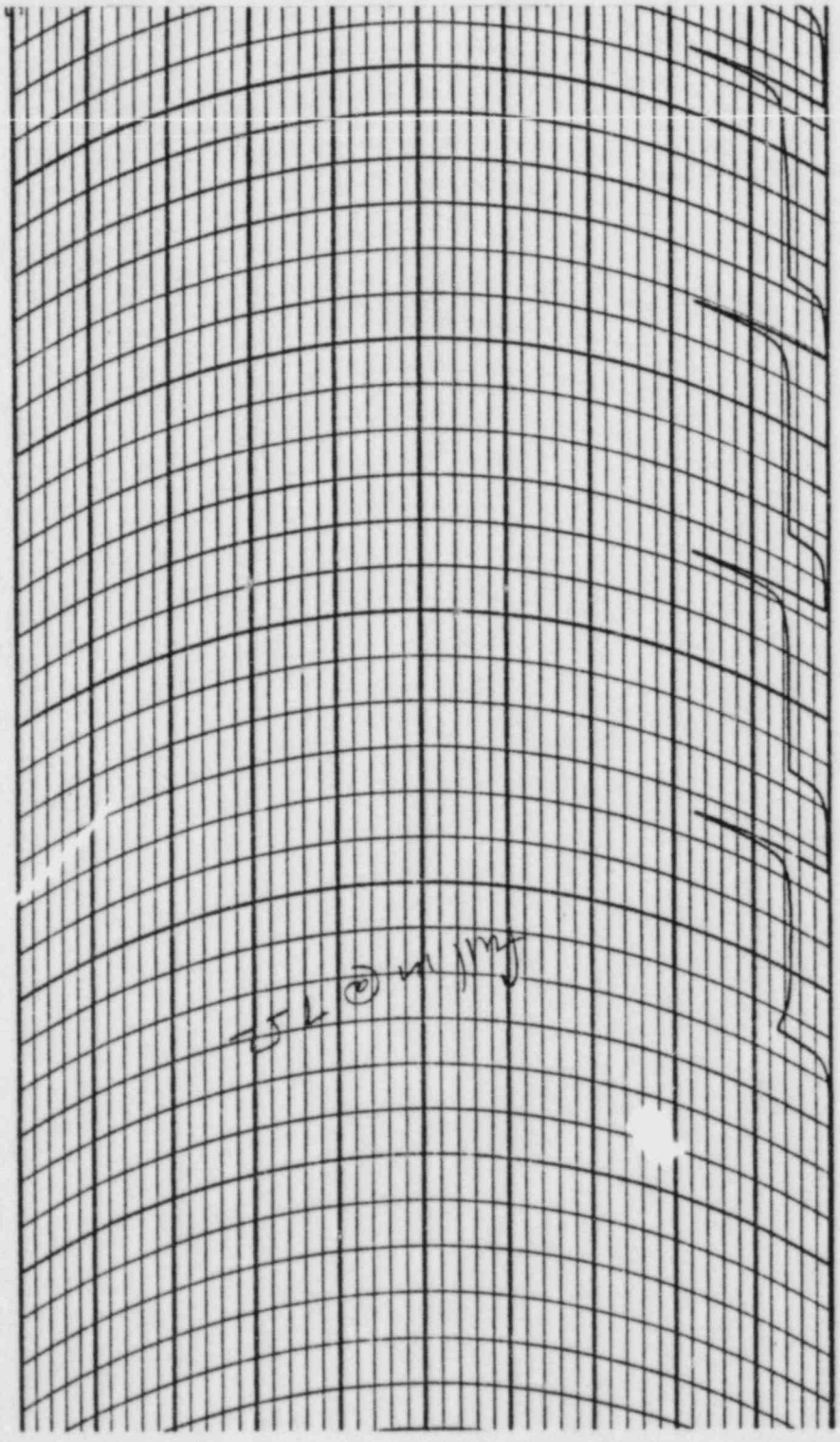

"In" Shims Ending at the "In" Limit

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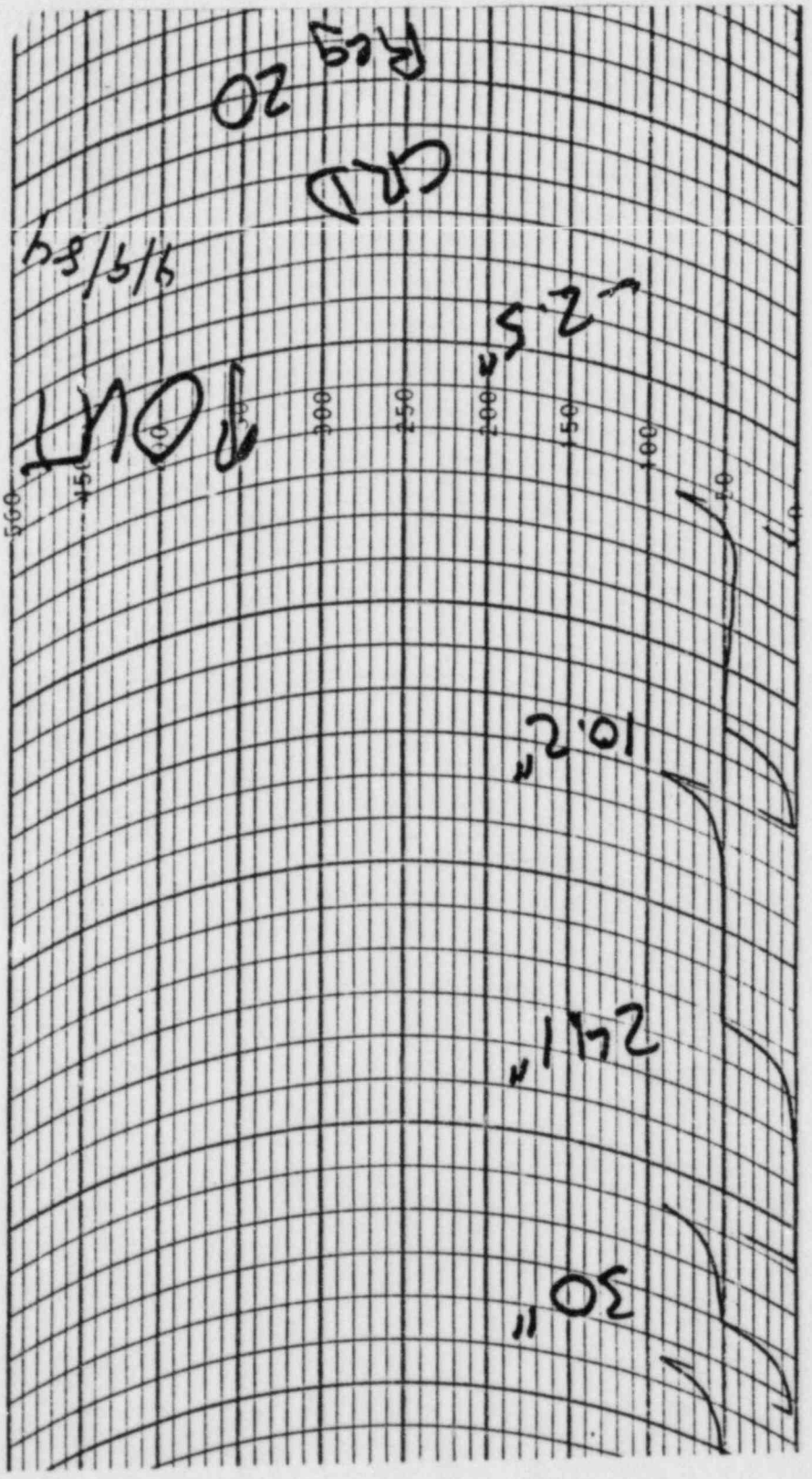

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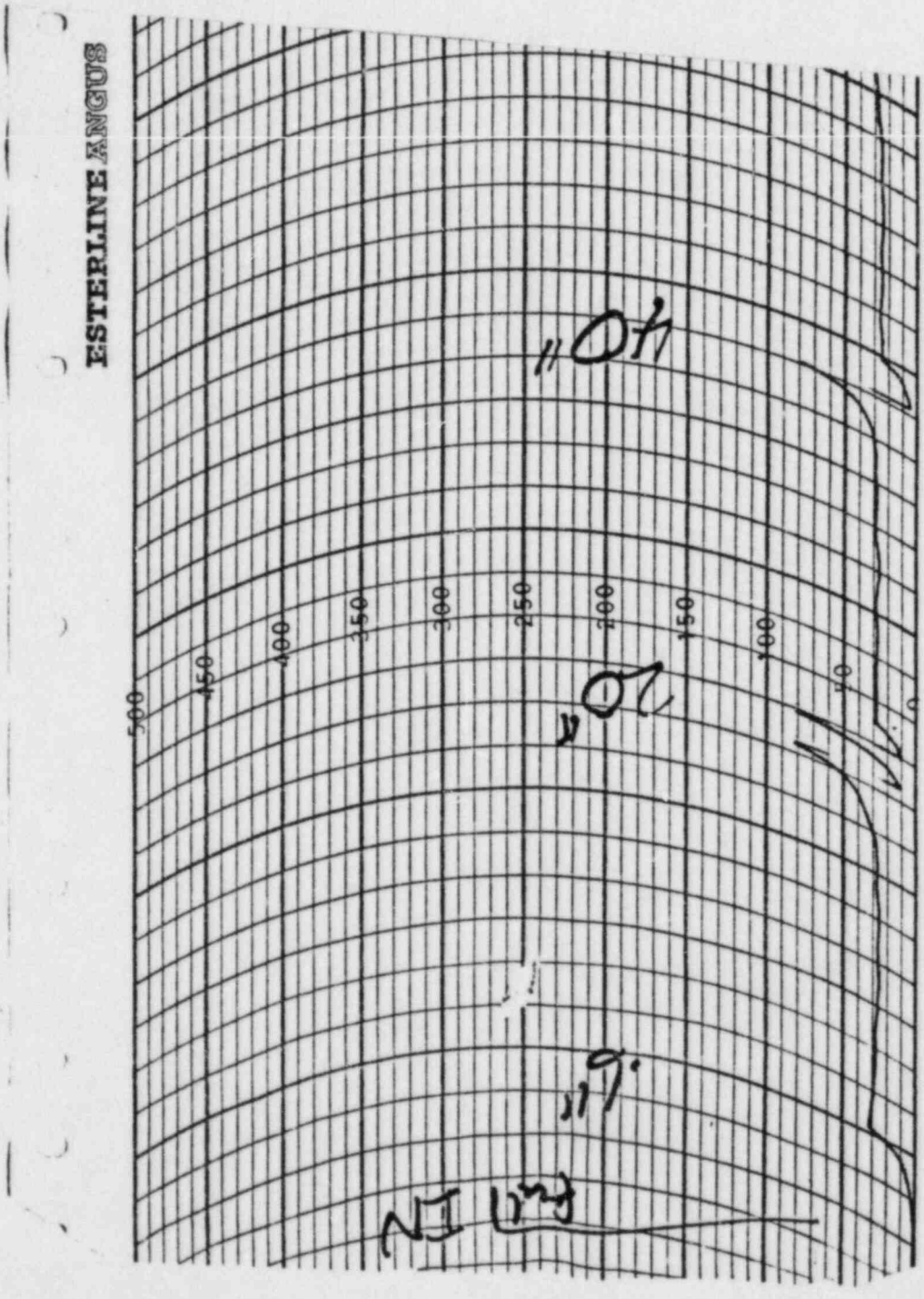

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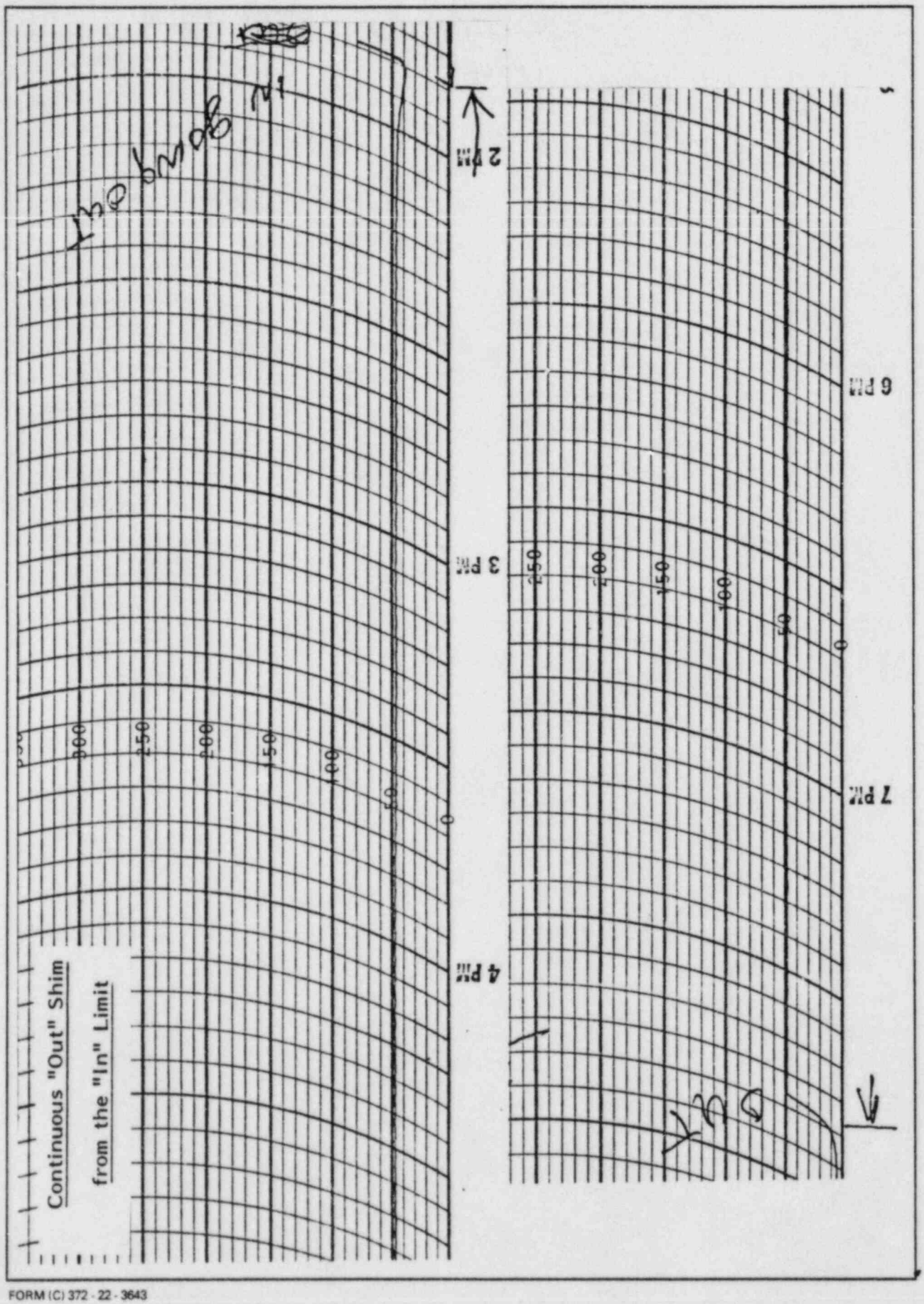

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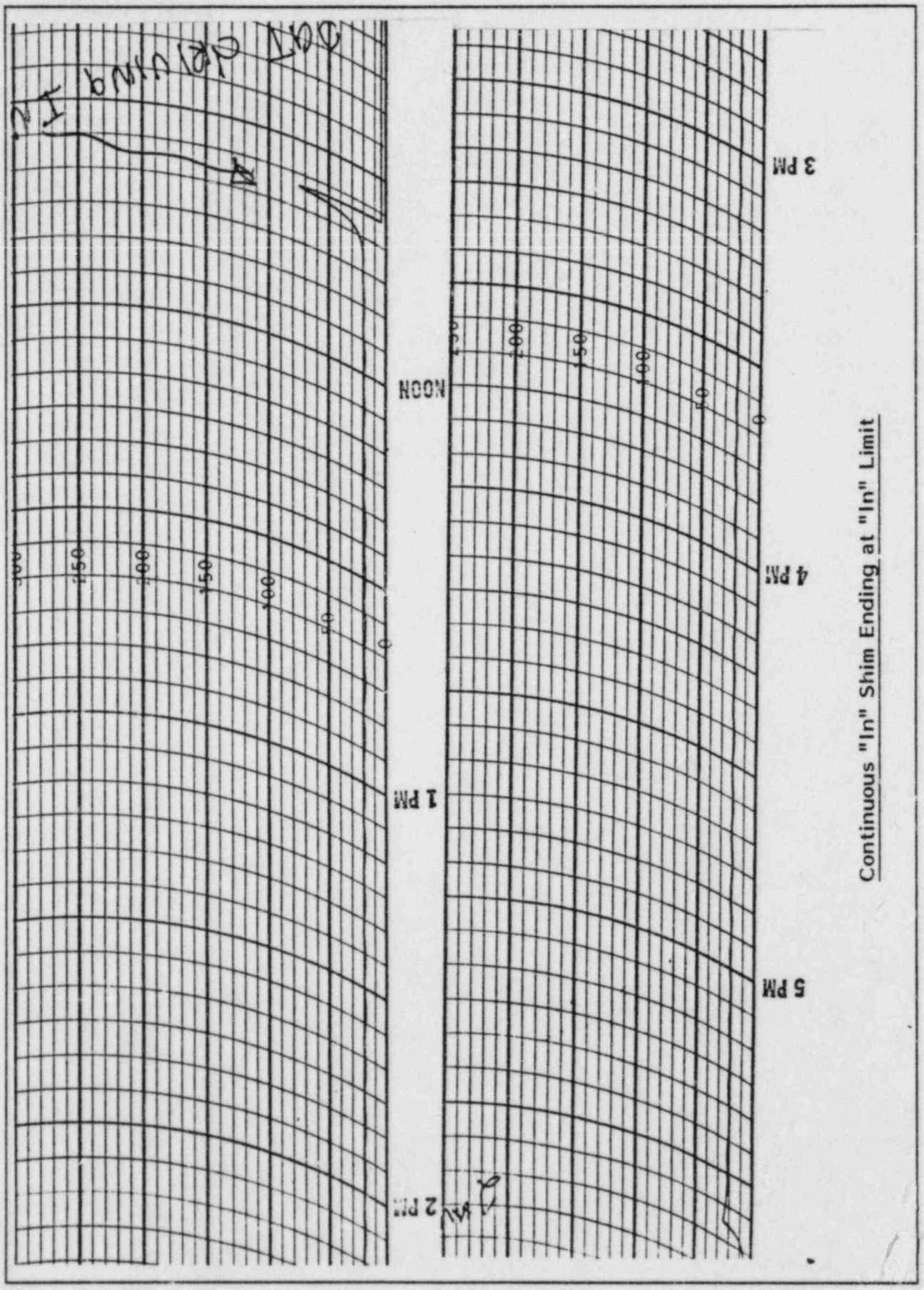

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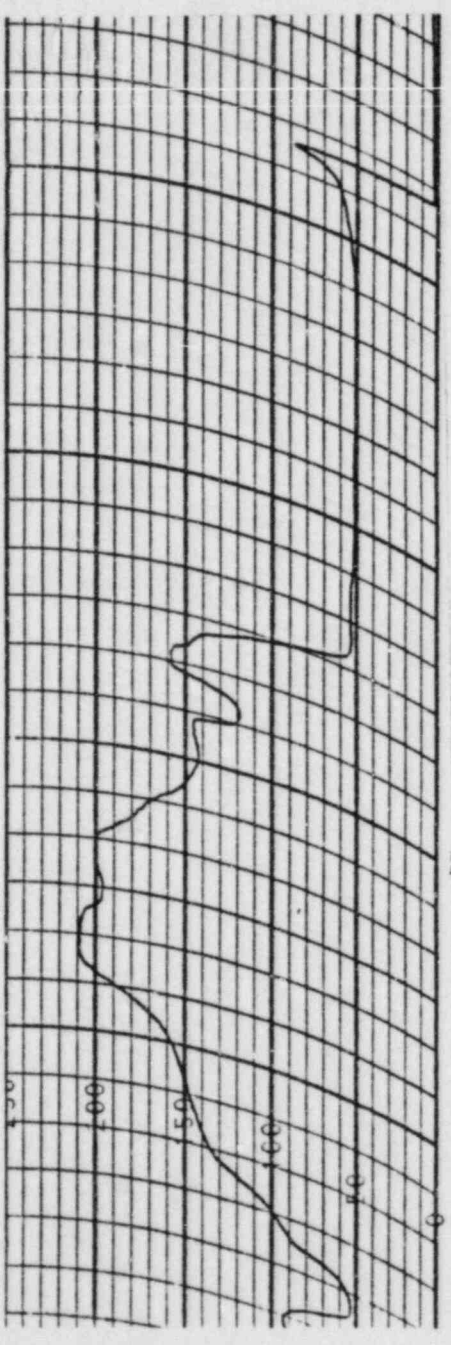

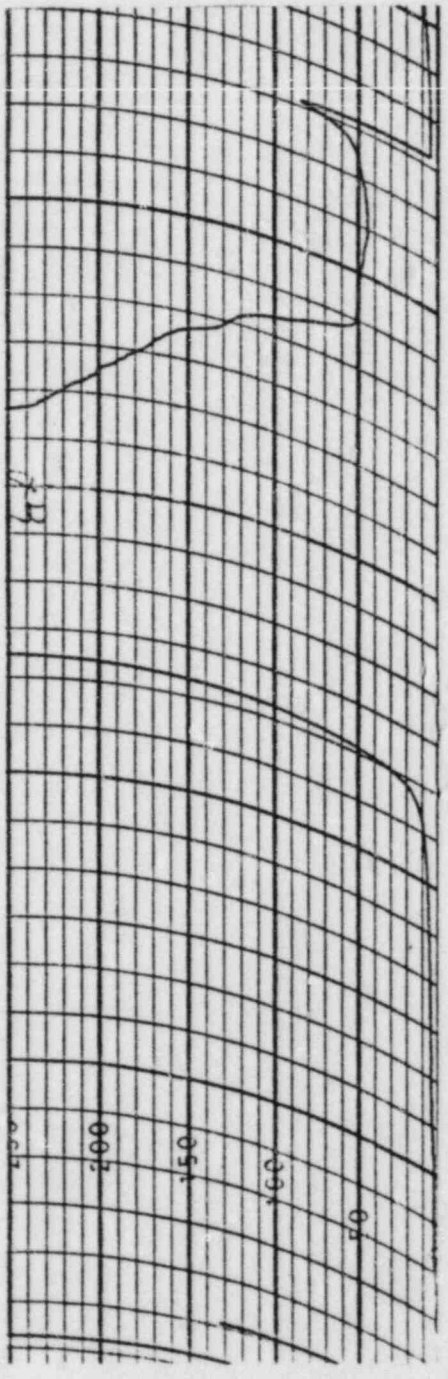

Rotor Seizure and Erratic Motion

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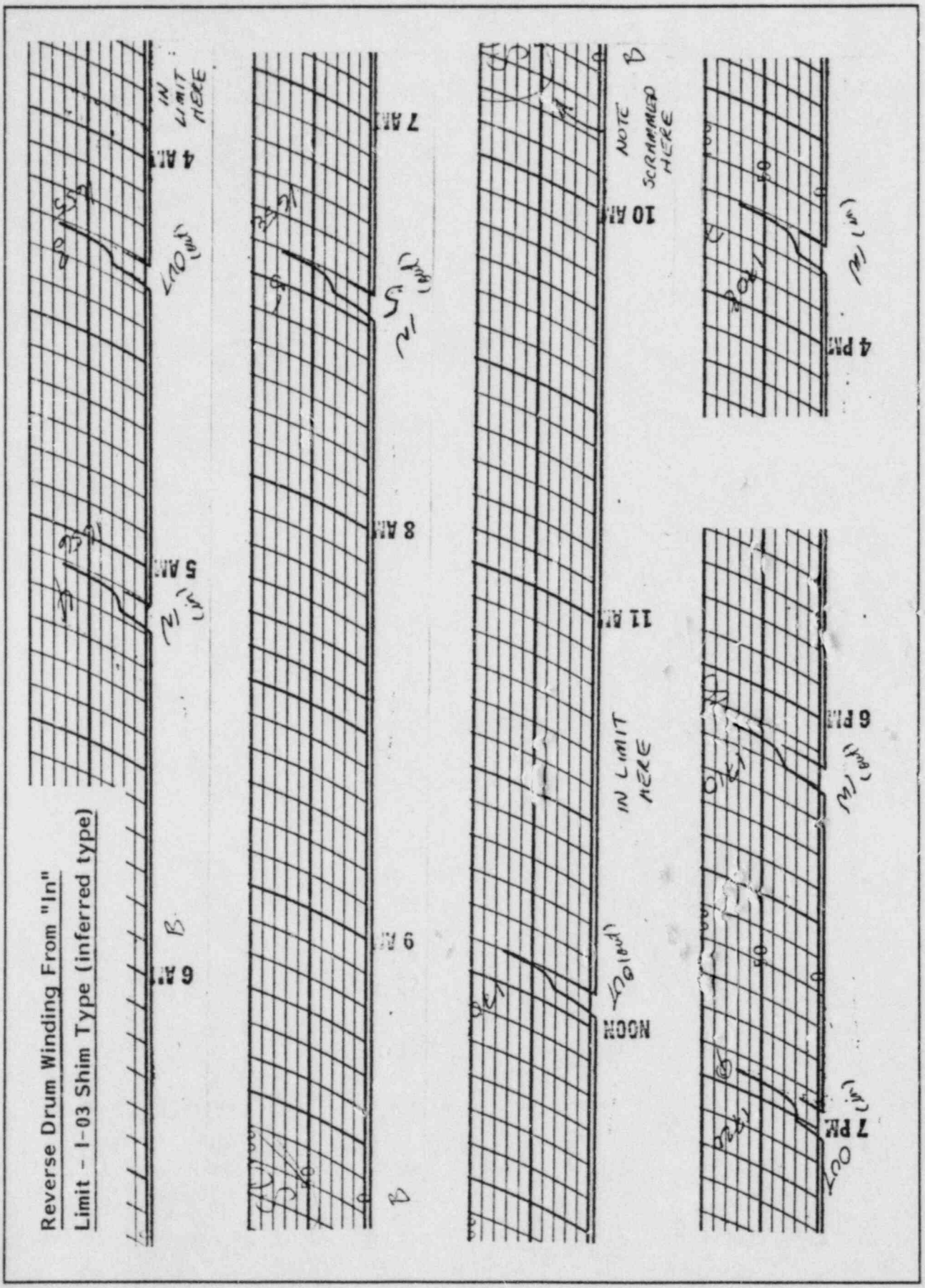

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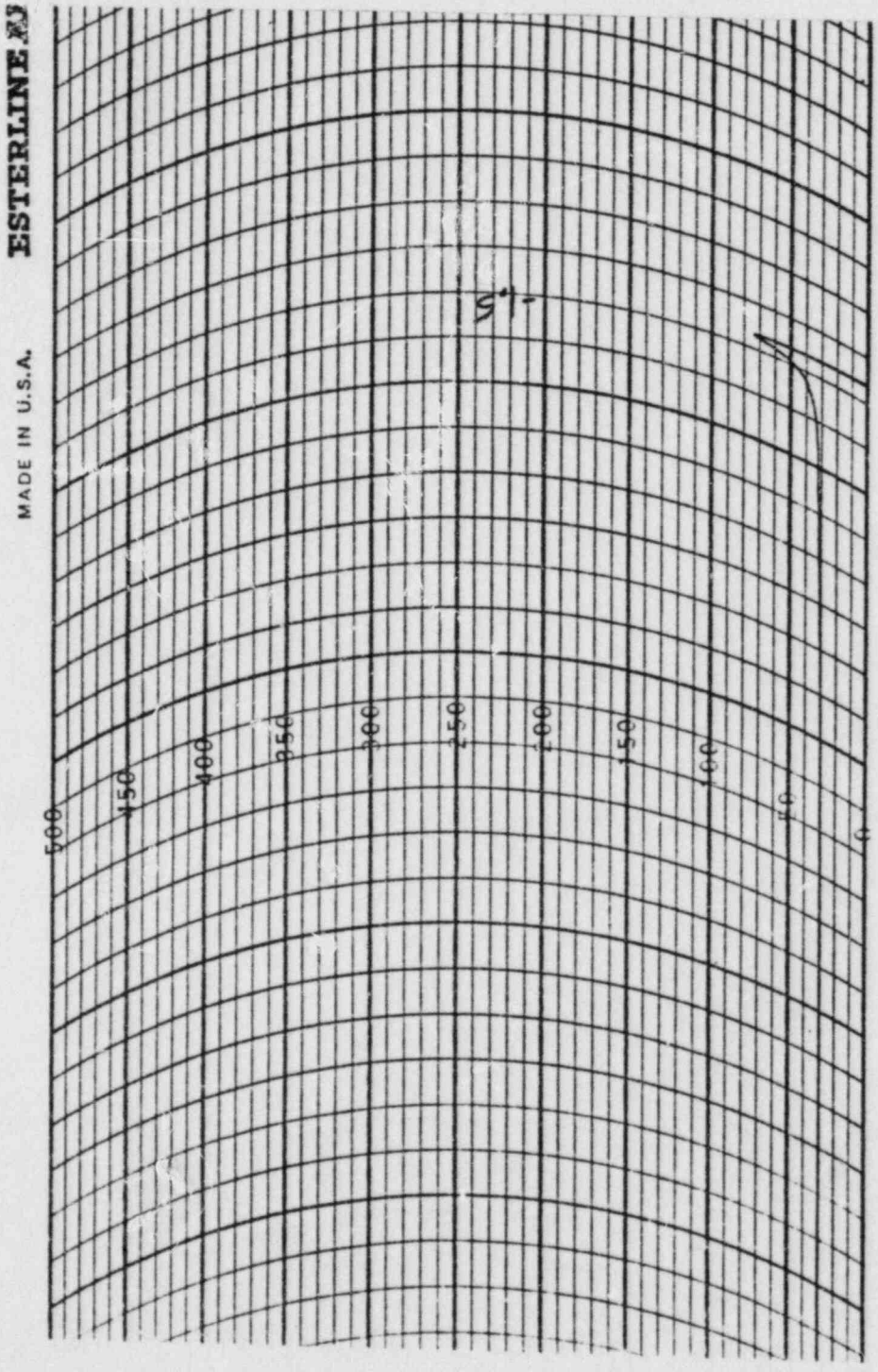

ICRD Continuous Outward Shim (Reference)

O&M REFERENCES TO MOTOR WATTAGE

Page 47: 60 watts - maximum normal out wattage beyond which reliable scram capability not assured.

Page 64: At motor supply voltage of 105V:

22 watts - normal insertion wattage

72 watts - normal withdrawal wattage

Page 75: At motor supply voltage of 105V:

72 watts - normal withdrawal wattage

18 watts - difference between normal and value beyond which scram may not occur due to high friction.

Attachment 15

FSAR REFERENCES TO WATTAGE

The rod withdrawal reading, with the additional 1.0 to 1.3 in-lb torque applied to the motor, was 90w compared to a normal (i.e., "as built") wattage reading of 72w.

Page 3.8-5

5.6.11 Bypass the rod out limit.

5.6.12 Obtain Reactor Operator permission and withdraw rod to full retract limit. ~ 1000 Ω.

*#*Section 5.7 is the result of an NRC commitment. Reference G-84392 and responses. DO NOT DELETE without issuance of comparable controls.*#*

5.7 No "In Limit" Light On Fully Inserted Rod.

5.7.1 Verify there is no slack cable indication.

5.7.2 Reset Scram per Section 3.2

5.7.3 First withdraw affected rod pair to a digital indication of ~6". Do not first insert the rod, since damage to position potentiometers could occur.

5.7.4 Manually insert rod until rod motion stops or a digital indication of 0.0", whichever occurs first.

5.7.5 Verify "In Limit" light is lit. If not, initiate SSR.

ATTACHMENT 8
TO P-85040

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OPERATIONS ORDER

ATTENTION:

|XXXXXX|	|XXXXXX|	|XXXXXX|	|XXXXXX|
	S S	R O	E O	A T
Note: Initial when order is read				

CRD PURGE FLOW LOST

The loss of Control Rod Drive (CRD) purge flow is alarmed in the Control Room. The intended response to a low purge flow alarm is:

1. Review purified helium flow, pressure and temperature indications for abnormal indications.

2. Verify by local indication that flow alarm is valid.

3. Attempt to recover purge flow.

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4. If available, switch to the standby helium purification train.

If the above steps do not restore purge flow, reactor power will be reduced to less than 2% by following established operating procedures.

High Moisture in Primary Coolant

1. Average core outlet temperature ≥ 1200°F and chemical impurities ≥ 10 ppm as determined by Health Physics. Reduce core outlet temperature to < 1200°F. Further reduction of core outlet temperature may be necessary to remain in the limited acceptable range on Figure 4.2.11-1 in the Technical Specifications.

2. Average core outlet temperature ≤ 725°F.

   a. If primary coolant dew point temperature is equal to or greater than 60°F, scram reactor per EP B-1 and notify Superintendent of Operations.

William L Stewart

Superintendent, Operations
(or) Station Manager

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