ATTACHMENT 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

DEC 26 1989

MEMORANDUM FOR: Rolf Westberg, Reactor Inspector, Plant Systems Section, Engineering Branch, Division of Reactor Safety, RIII

FROM: H. J. Miller, Director, Division of Reactor Safety, RIII

SUBJECT: AUGMENTED INSPECTION TEAM (AIT) CHARTER

Enclosed for your implementation is the Charter for the inspection of the events associated with the Prairie Island plant trip of December 26 and accompanying failure of substation power supply breakers to sequence properly maintaining power supply to reactor coolant pumps. This Charter is prepared in accordance with the NRC Inspection Manual Chapter 0325. The objectives of the AIT are to communicate the facts surrounding this event to Regional and Headquarters management, as well as to identify and communicate any generic safety concerns related to findings and conclusions of the onsite inspection.

If you have any questions regarding implementation of the enclosed Charter, please contact either Mr. R. Gardner or Mr. R. Cooper (FTS 388-5578) of my staff or contact me directly.

H. J. Miller, Director
Division of Reactor Safety

Enclosure: AIT Charter

cc w/enclosure:
A. B. Davis, RIII
C. J. Paperiello, RIII
G. M. Holahan, NRR
C. J. Haughney, NRR
J. W. Clifford, EDO
E. L. Jordan, AEOD
C. E. Rossi, NRR
S. A. Varga, NRR
SRI, Prairie Island
D. Butler, RIII

AUGMENTED INSPECTION TEAM (AIT) CHARTER

PRAIRIE ISLAND PLANT TRIP AND
ACCOMPANYING LOSS OF REACTOR COOLANT PUMP
POWER SUPPLIES

You and your team are to perform an inspection to accomplish the following:

1. Develop and validate the sequence of events associated with the plant trip and loss of non-safeguards bus (power supply to the main coolant pumps) that occurred on December 26, 1989 and, to the extent practicable, do the same for the trip occurring on December 21, 1989. Determine what significant differences, if any, exist between these two trips.

2. Determine root cause for the following:

   a. Opening of both MG set output breakers.

   b. Failure of the substation breakers to properly sequence to maintain power supply to main coolant pump buses.

   c. Difficulties in restoring reserve 4160V power to the non-safeguards buses following the event.

3. In evaluating root cause, the following specific items should be addressed:

   a. Design of (i) rod power supplies and (ii) substation load transfer and sequencing functions and equipment.

   b. Adequacy of the licensee's root cause evaluations of the December 21 event and the associated testing and corrective actions (i.e., failed MG set voltage regulator and cold weather induced sluggish behavior of substation breakers). This would include determining if heating of substation breakers was appropriately maintained.

   c. Aging of equipment.

   d. Procurement specifications and pre-installation testing of the substation breakers.

4. Review adequacy of the licensee's program for investigating these events. Oversee troubleshooting, testing and analysis of quarantined equipment.

5. Interview plant operators directly involved in the event and determine if operator actions were adequate.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

ATTACHMENT 2

DEC 1989

Docket No. 50-282
Docket No. 50-306

CAL RIII-89-027

Northern States Power Company
ATTN: Mr. C. E. Larson
Vice President, Nuclear
Generation
414 Nicollet Mall
Minneapolis, MN 55401

Gentlemen:

This confirms the telephone conversation between Edward G. Greenman of this office and you on December 27, 1989, related to the Prairie Island Unit 2 plant trip caused by the opening of both Reactor Protection System motor generator set output breakers. With regard to this event, we understand that you will:

1. Complete an investigation to determine the cause of both Reactor Protection System motor generator set output breakers opening on 12/26/89.

2. Investigate and determine the root cause of the lockout for the 345kv substation Bus 1.

3. In light of the root causes determined for the above, assess your investigation of the trip that occurred on December 21 and determine if there are lessons learned that should be factored into your root cause analysis.

4. Inform the Augmented Inspection Team leader or the Senior Resident Inspector prior to the performance of any testing of any equipment associated with the Reactor Protection System Motor Generator Sets and their output breakers and the Turbine Generator substation output breakers.

5. Submit to NRC Region III a formal report of your findings and conclusions and corrective actions within 30 days of receipt of this letter.

We also understand that you will maintain complete documentary evidence of your investigative effort and furnish this evidence to the NRC's Augmented Inspection Team.

We further understand that reactor startup (power operation) will not occur until you have received concurrence of the Regional Administrator or his designee. Issuance of this Confirmatory Action Letter does not preclude the issuance of an order requiring implementation of the above commitments.

CONFIRMATORY ACTION LETTER

None of these actions specified herein should be construed to take precedence over actions which you feel necessary to ensure plant and personnel safety.

Please advise us immediately if your understanding differs from that set forth above.

Sincerely,

A. Bert Davis
Regional Administrator

cc: DCD/DCB (RIDS)
Licensing Fee Management Branch
Resident Inspector, RIII Prairie Island
John W. Ferman, Ph.D., Nuclear Engineer, MPCA
State Liaison Officer, State of Minnesota
J. M. Taylor, EDO
T. E. Murley, NRR
E. L. Jordan, AEOD
J. Lieberman, OE
G. M. Holahan, NRR
J. A. Zwolinski, NRR
J. O. Thoma, NRR
J. R. Goldberg, OGC
R. J. Strasma, RIII

CONFIRMATORY ACTION LETTER

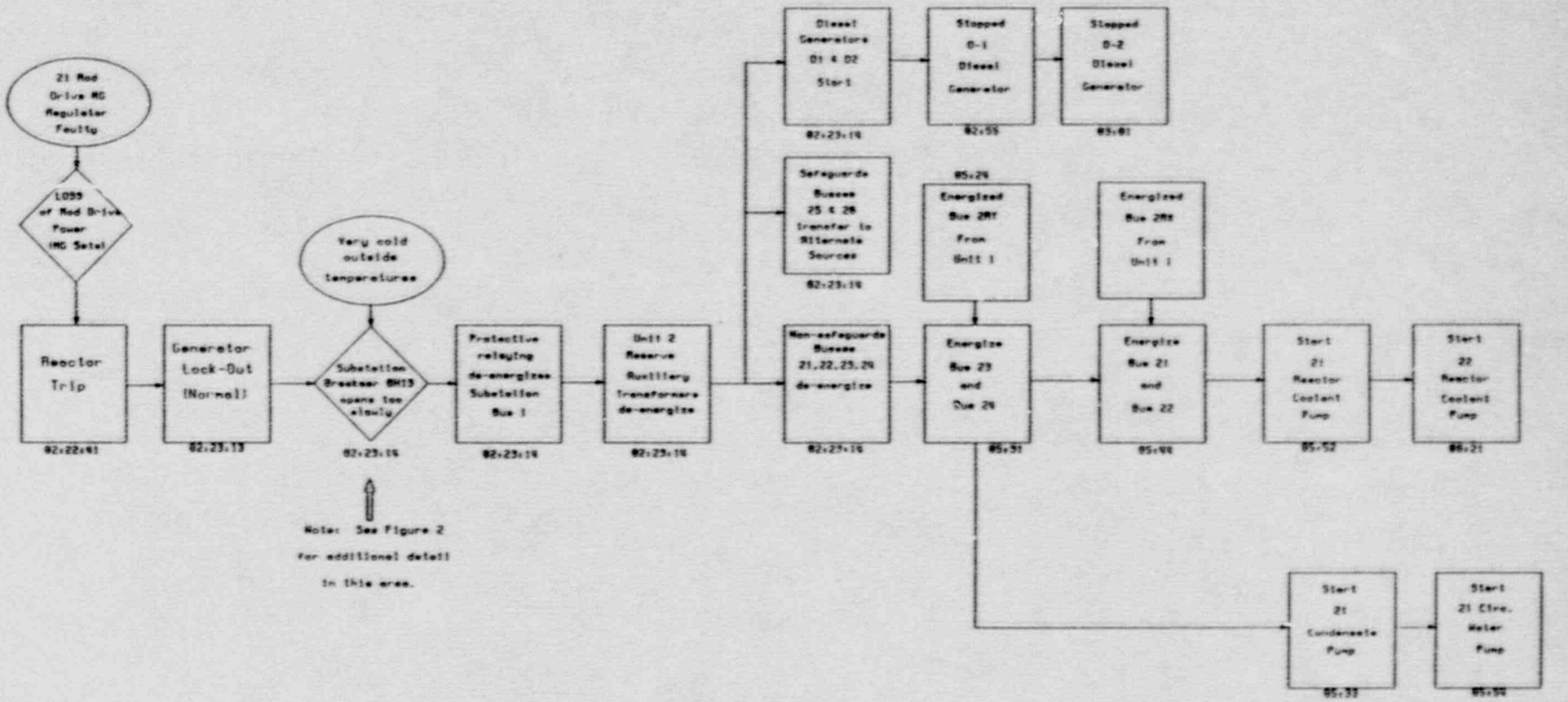


Figure 1
Event Chart
Reactor Trip and Loss of
Non-Safeguards Power 12/21/89
As Determined for Return to Power 12/22/89

RLL 1/5/89

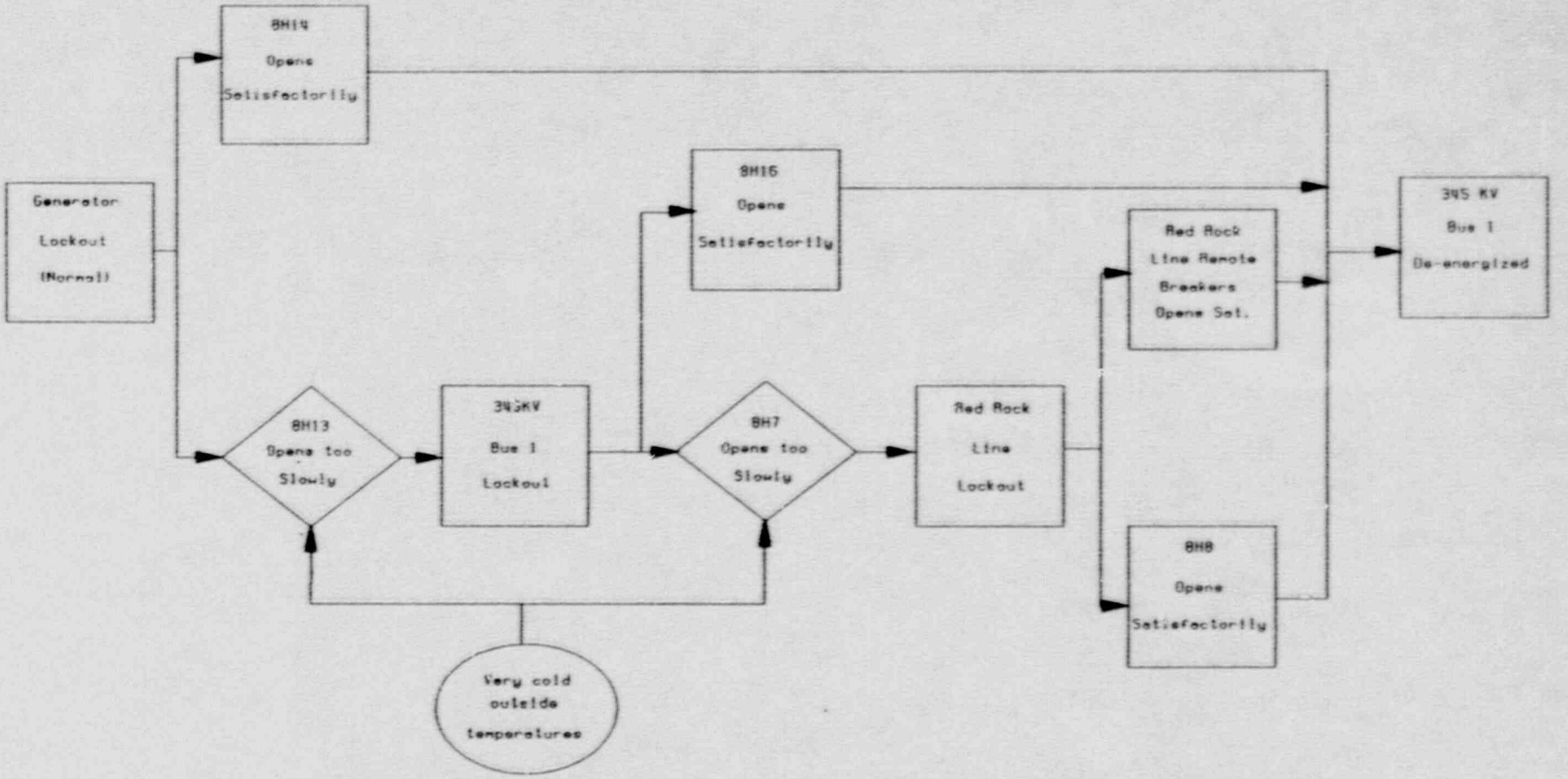
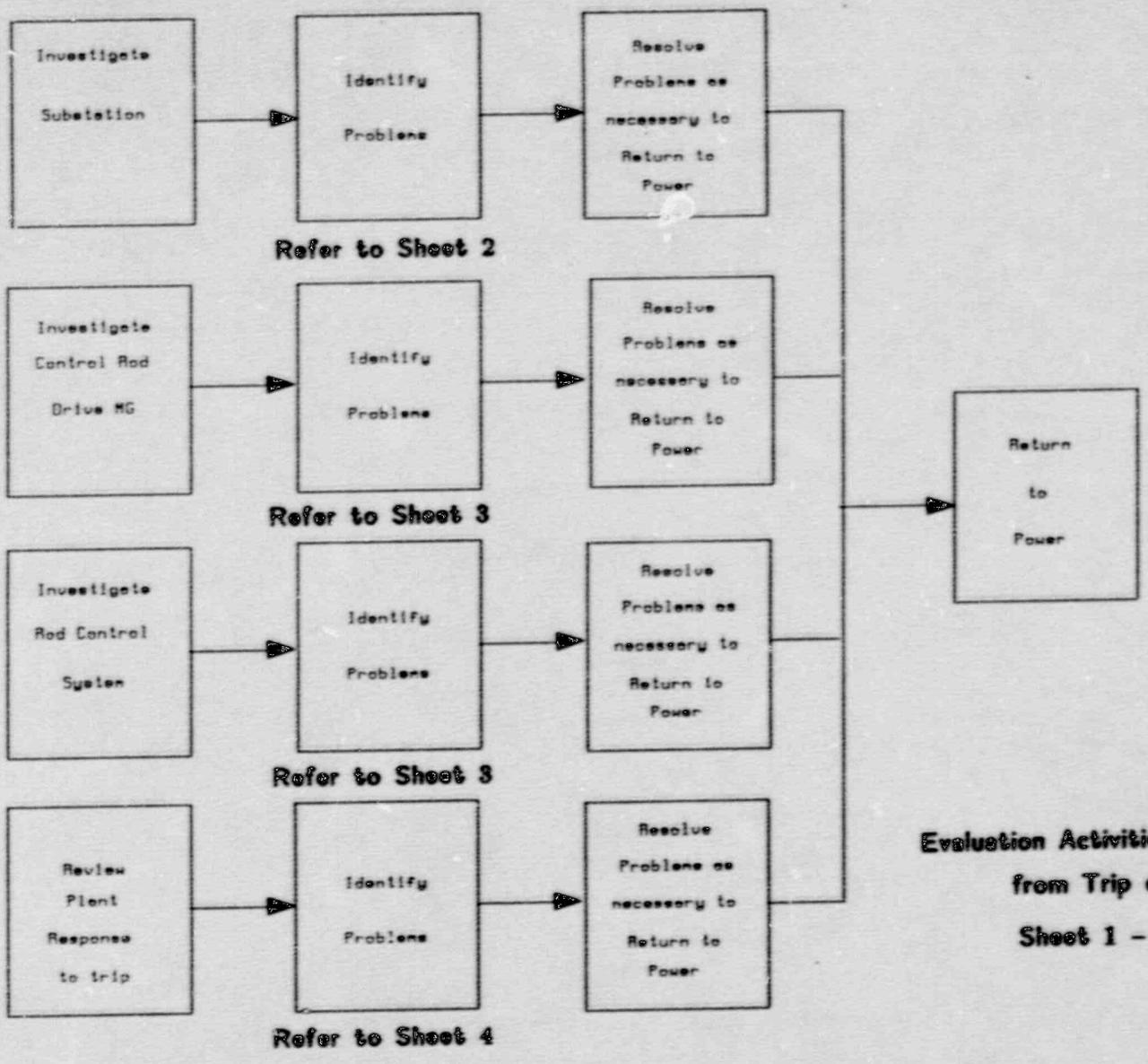


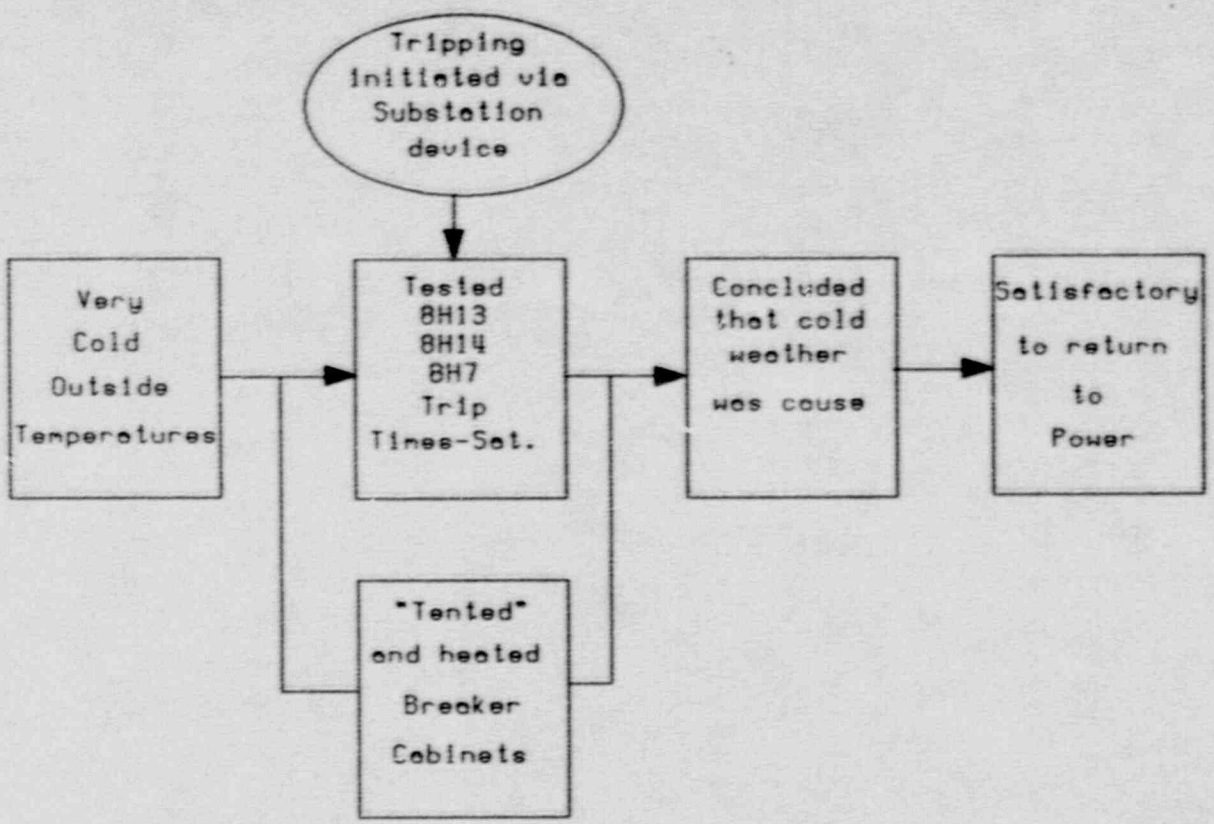
Figure 2
Event and Casual Factor Chart
Detail of Loss of Substation Bus 1
As Determined for Return to Power 12/22/89

RLL 1/4/90



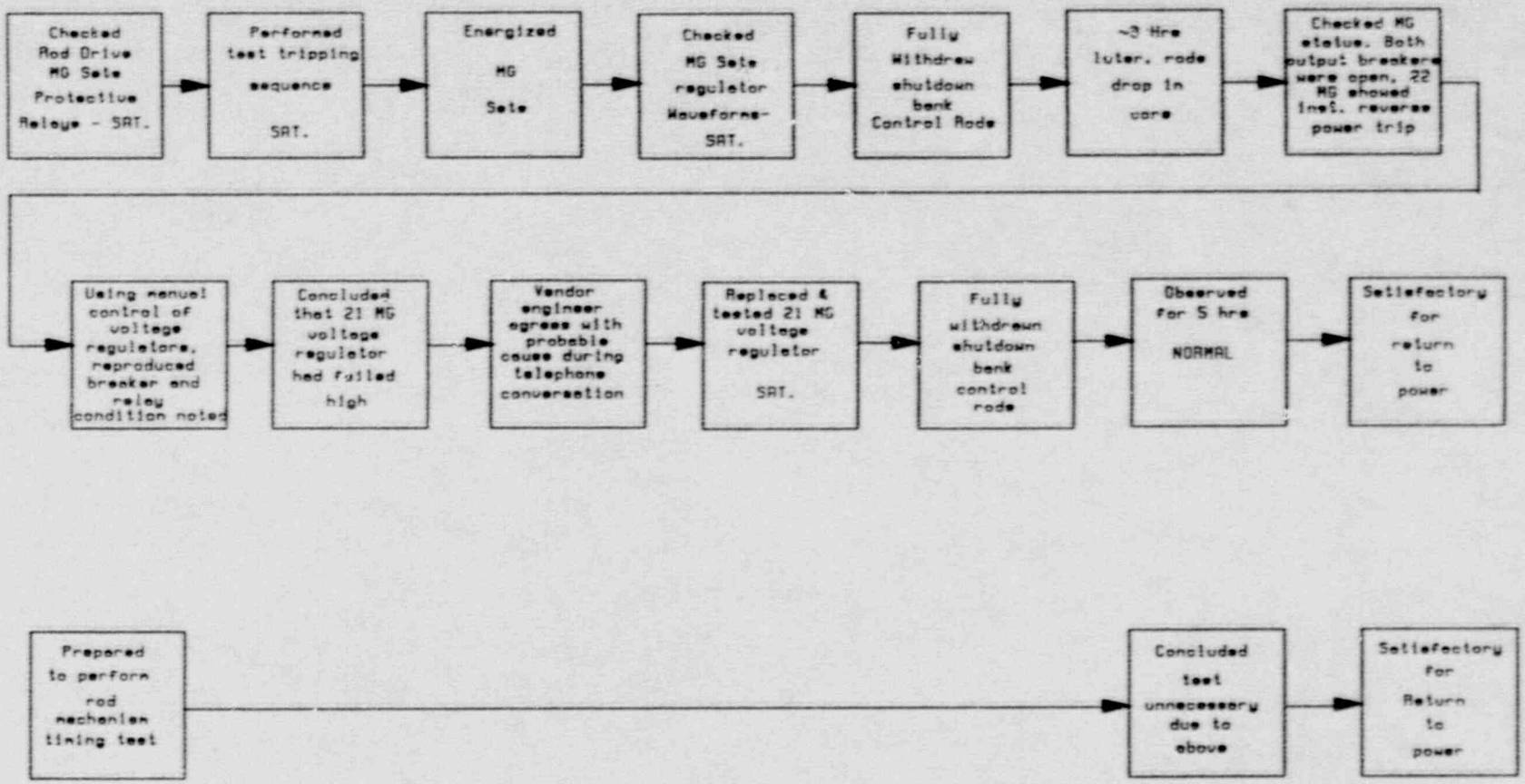
Evaluation Activities Chart for Recovery from Trip of 12/21/89

Sheet 1 – Overview



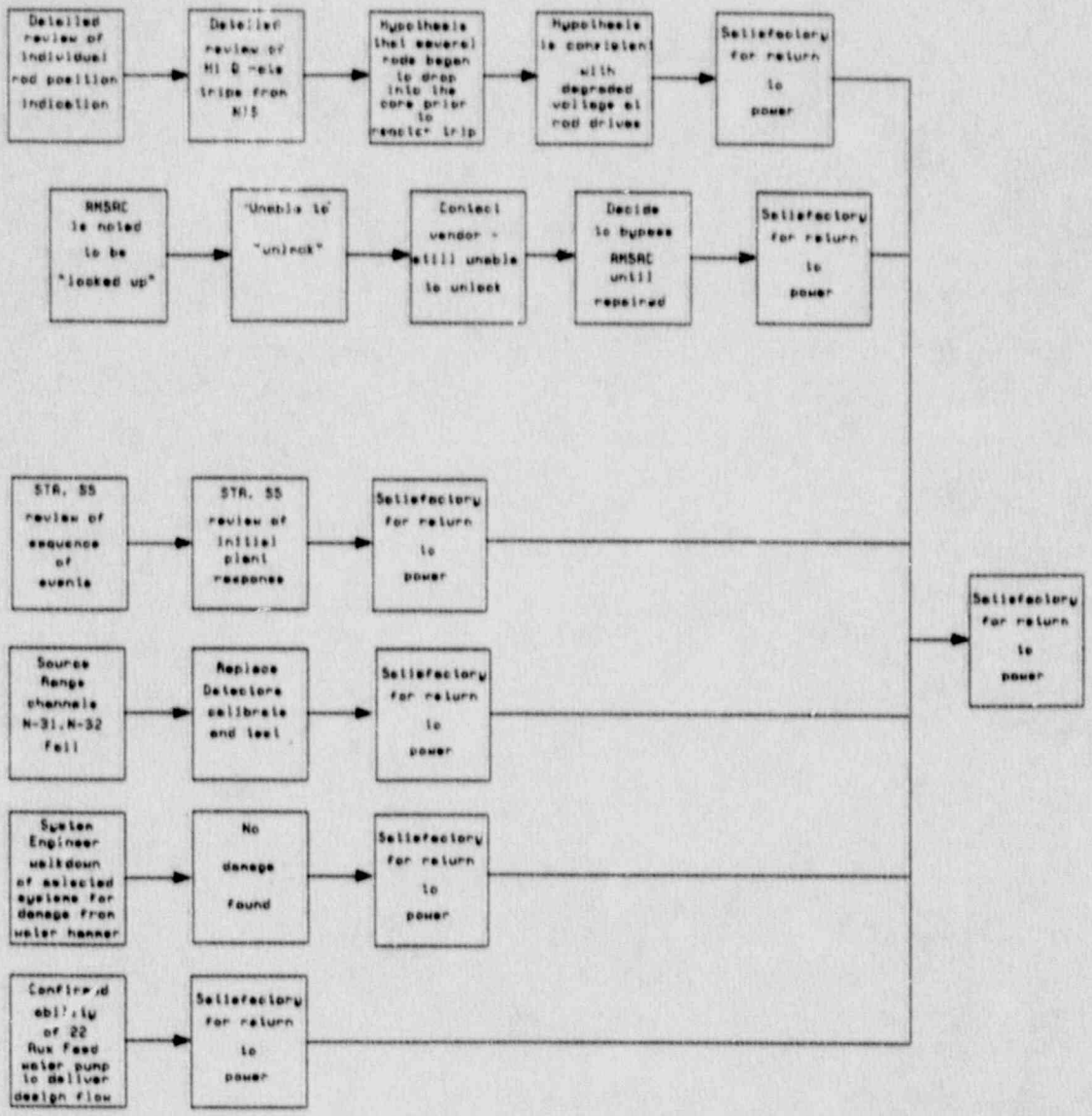
Evaluation Activities Chart for Recovery from Trip of 12/21/89

Sheet 2 – Substation



Evaluation Activities Chart for Recovery from Trip of 12/21/89
Sheet 3 – Rod Drive MG Sets and Rod Control Systems

ALL 1/9/90



Evaluation Activities Chart for Recovery from Trip of 12/21/89
Sheet 4 – Review of Plant Response

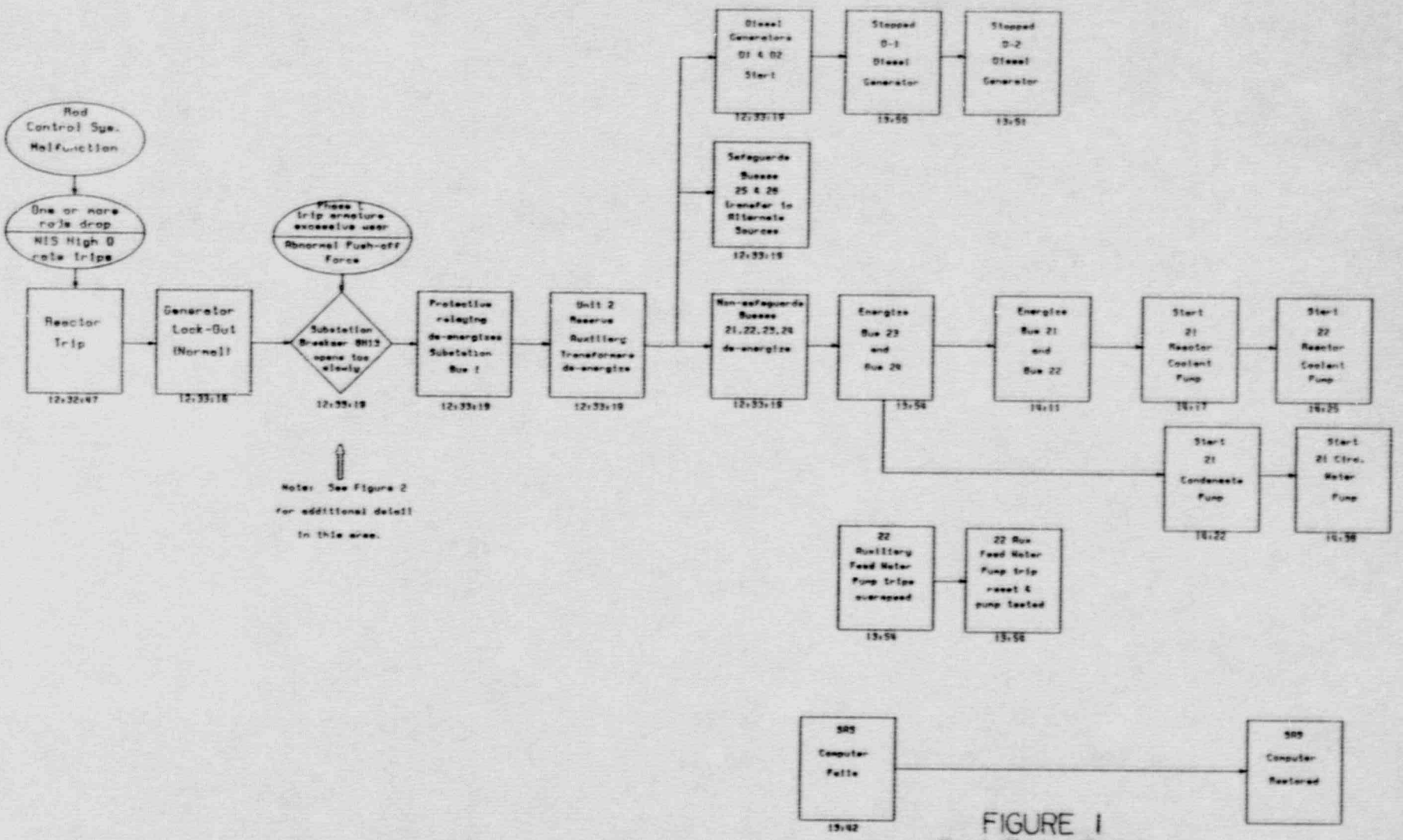


FIGURE 1

Event Chart - Preliminary
Reactor Trip and Loss of
Non-Safeguards Power 12/26/89

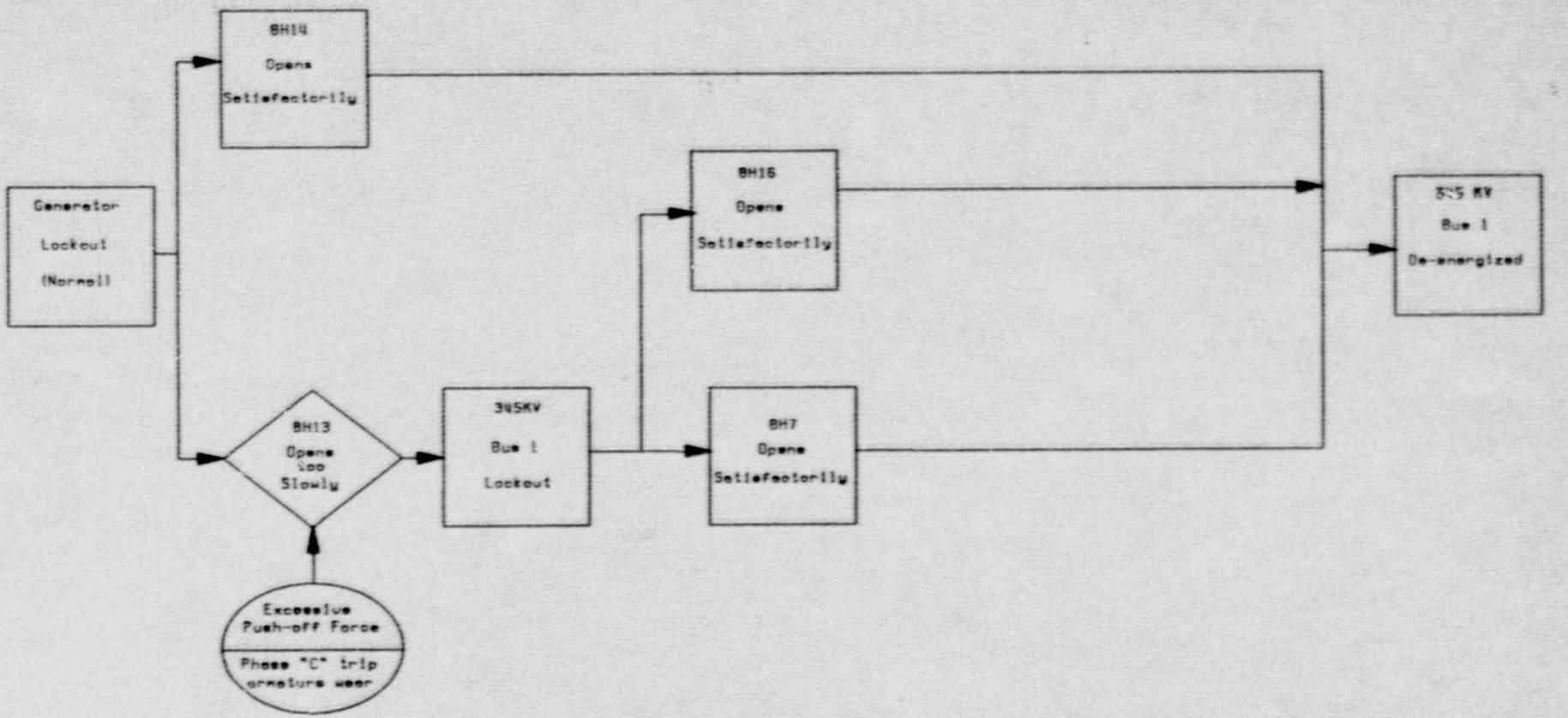
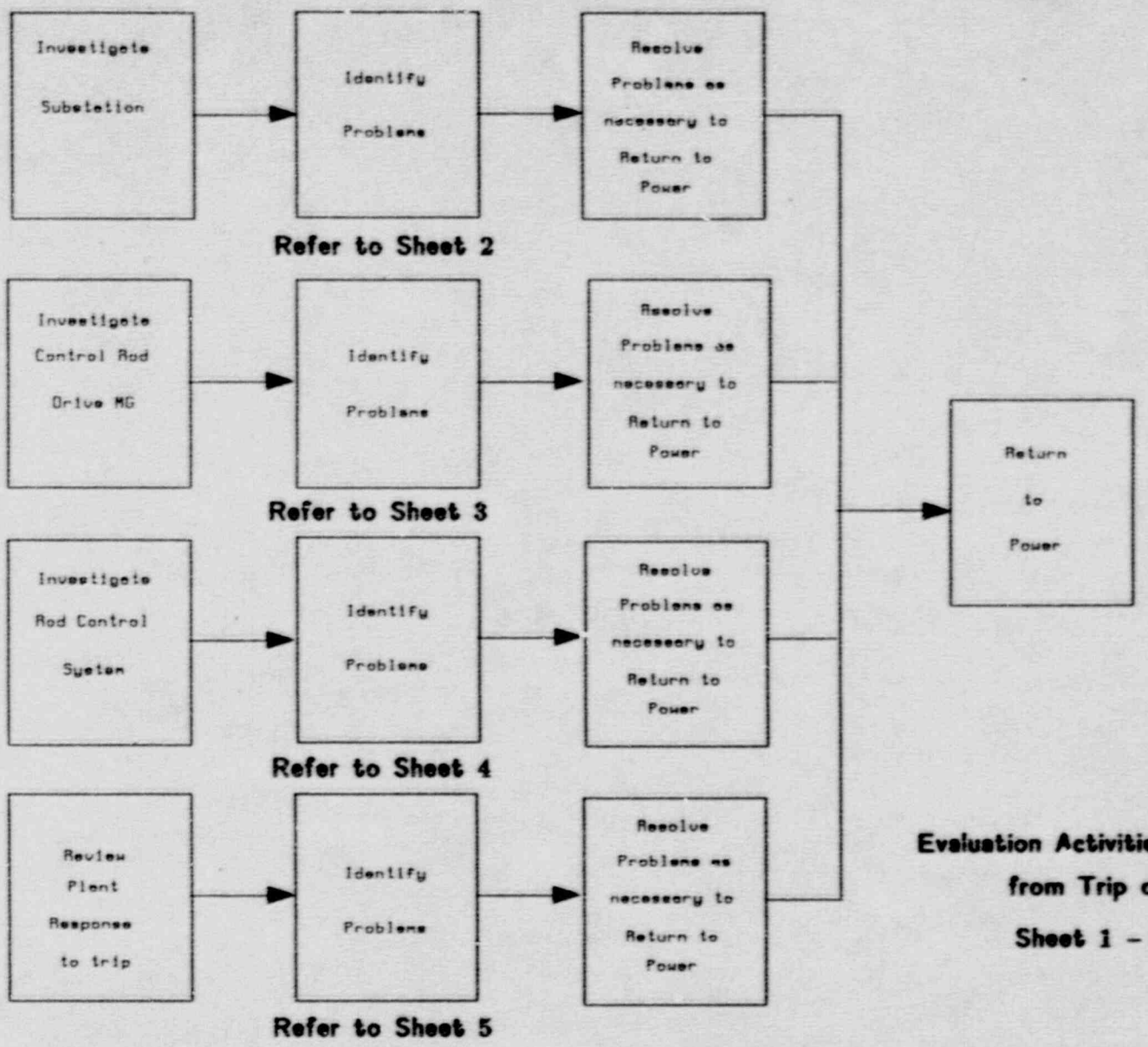


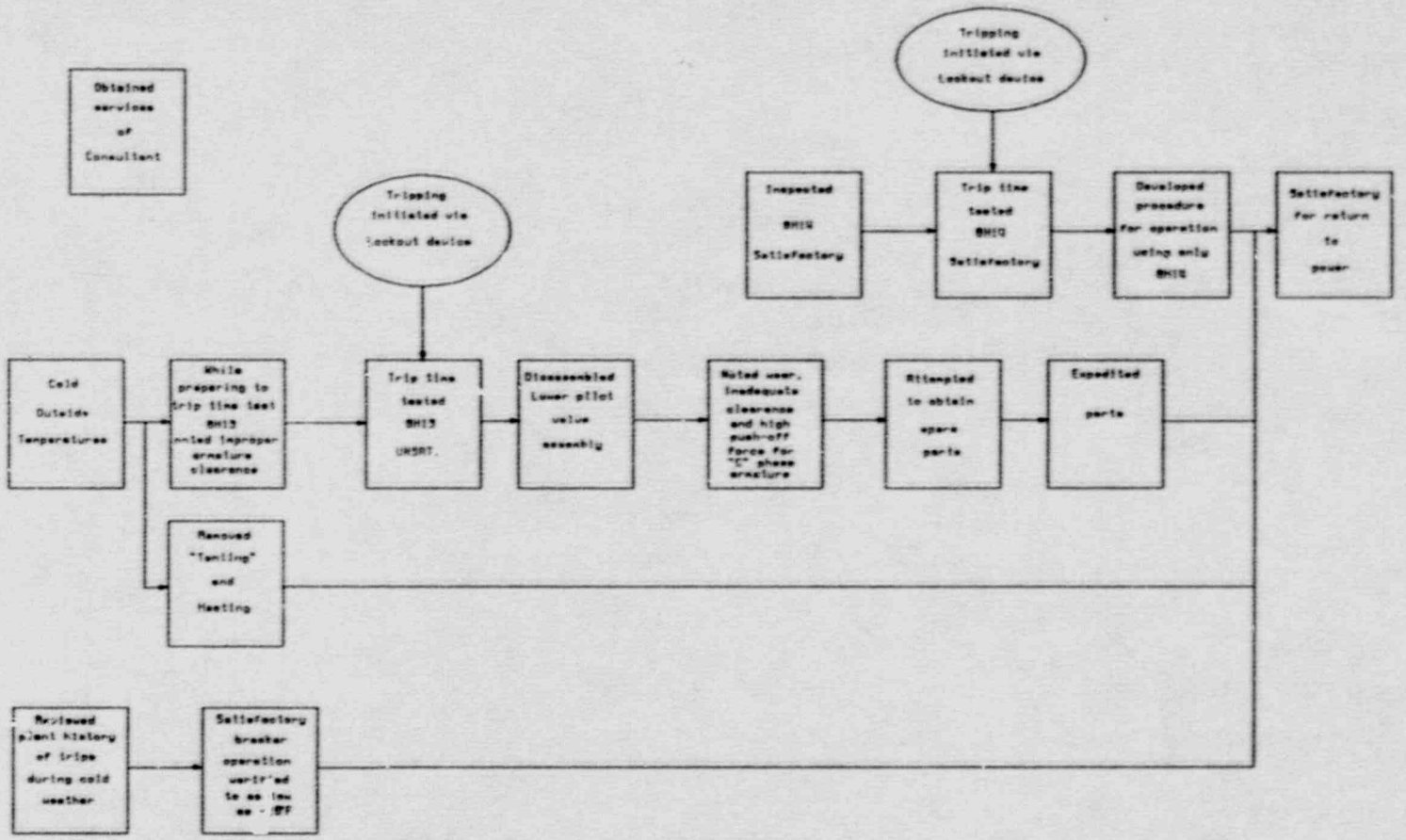
Figure 2
Event and Casual Factor Chart
Detail of Loss of Substation Bus 1
Non-Safeguards Power 12/26/89

RLL 1/9/98



Evaluation Activities Chart for Recovery from Trip of 12/26/89

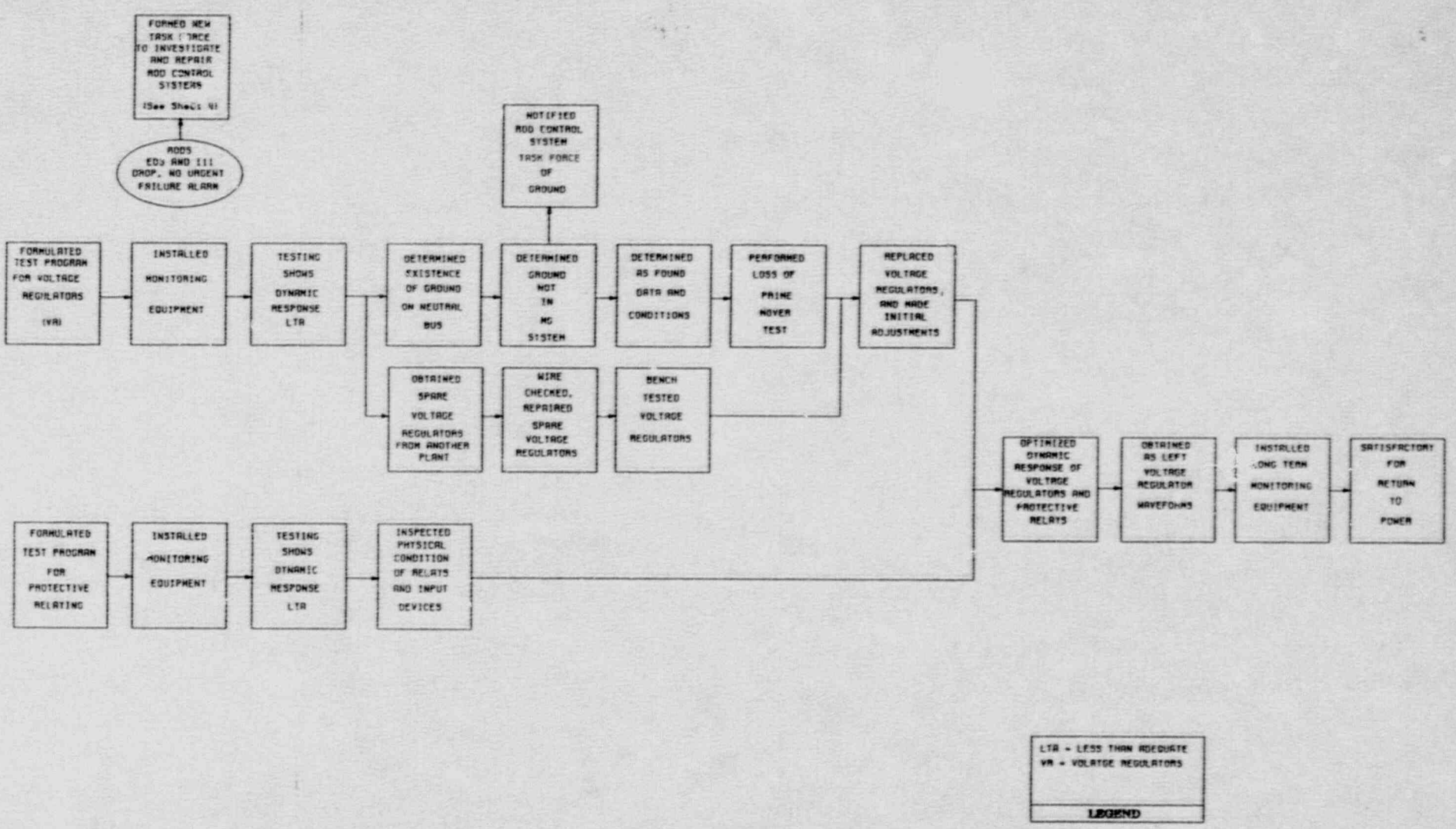
Sheet 1 – Overview



Evaluation Activities Chart for Recovery from Trip of 12/26/89

Sheet 2 – Substation

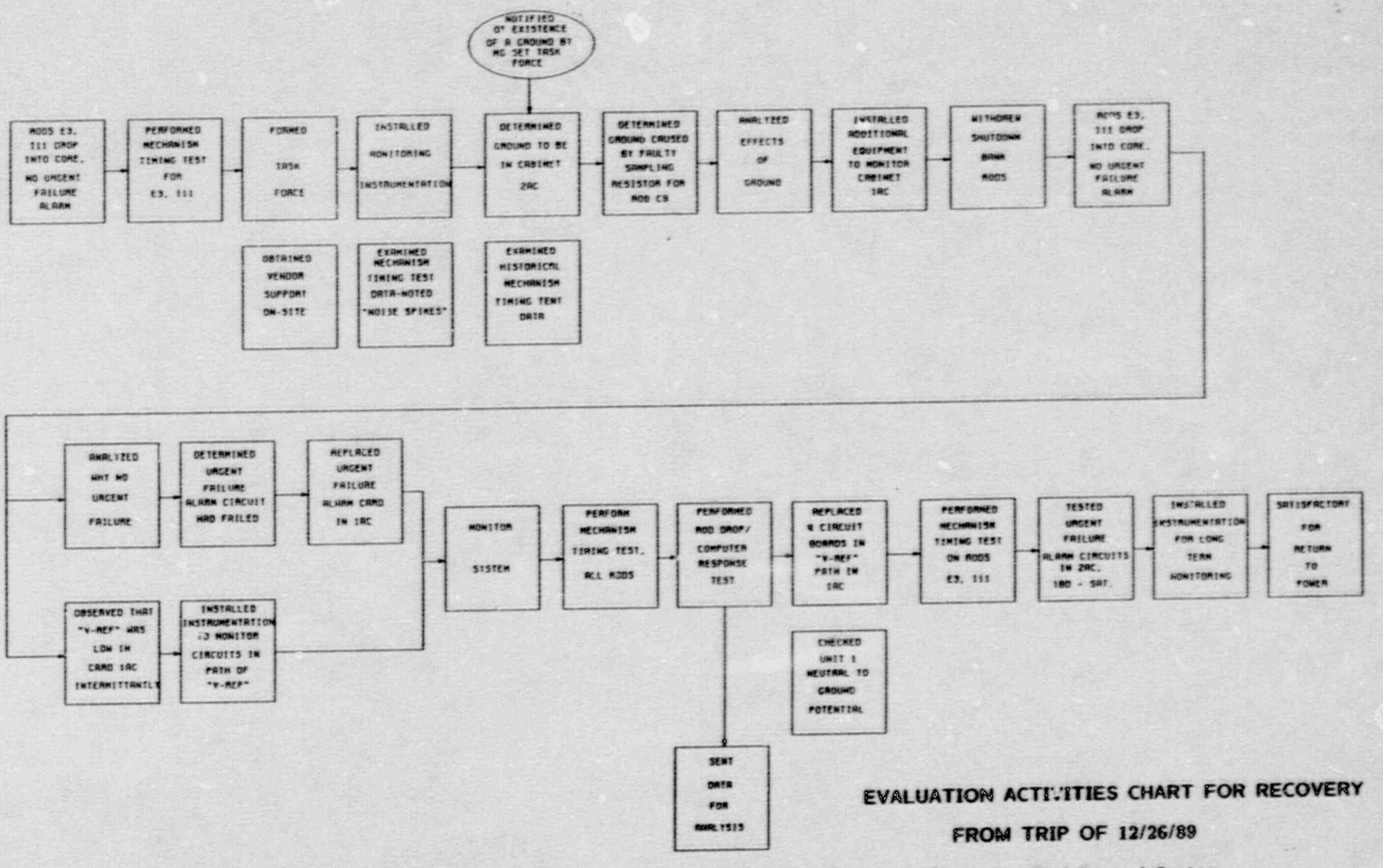
RLL 1/9/98



Evaluation Activities Chart for Recovery from Trip of 12/26/89

Sheet 3 – Control Rod Drive M-G Sets

RLL 1/23/90

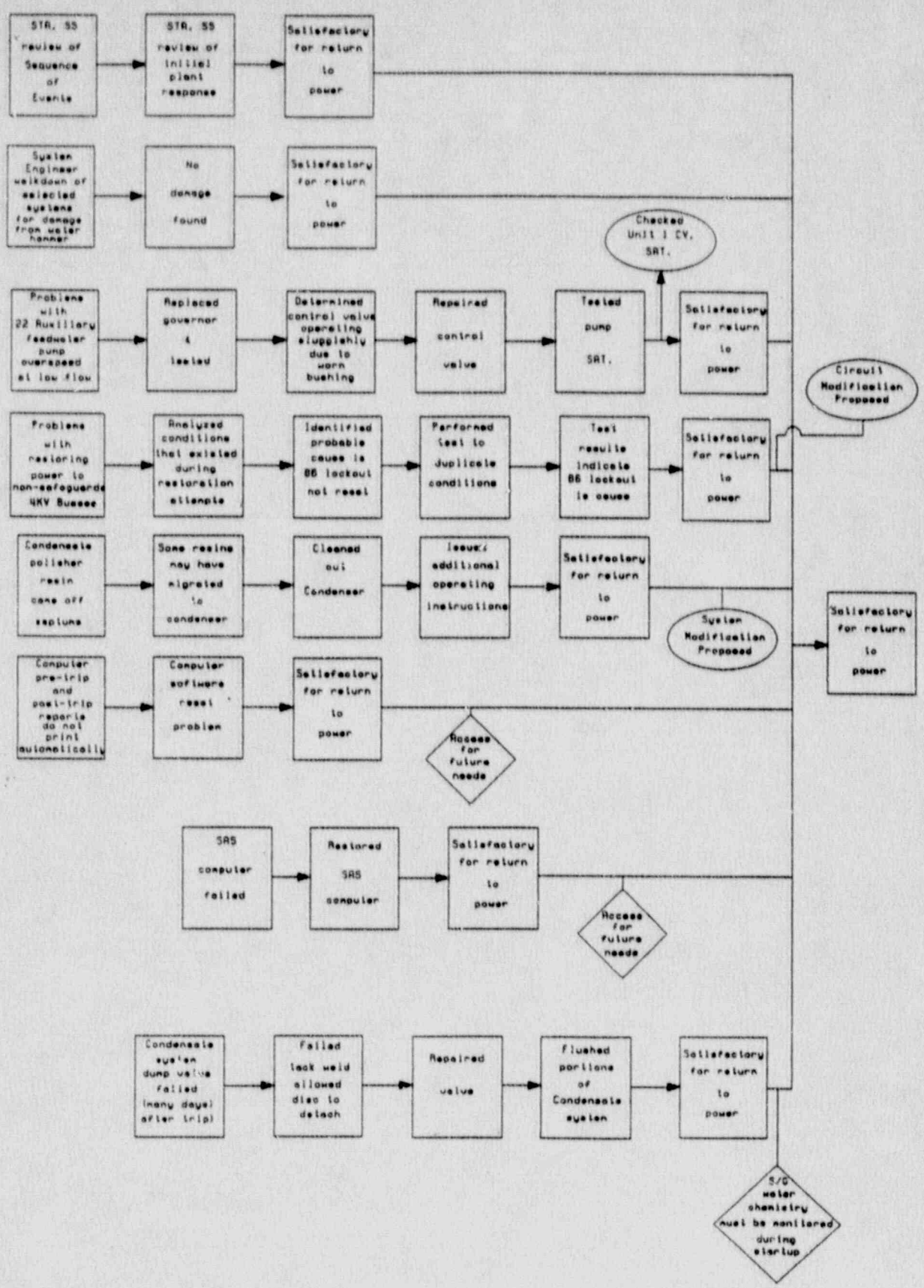


EVALUATION ACTIVITIES CHART FOR RECOVERY

FROM TRIP OF 12/26/89

Sheet 4 – Rod Control System

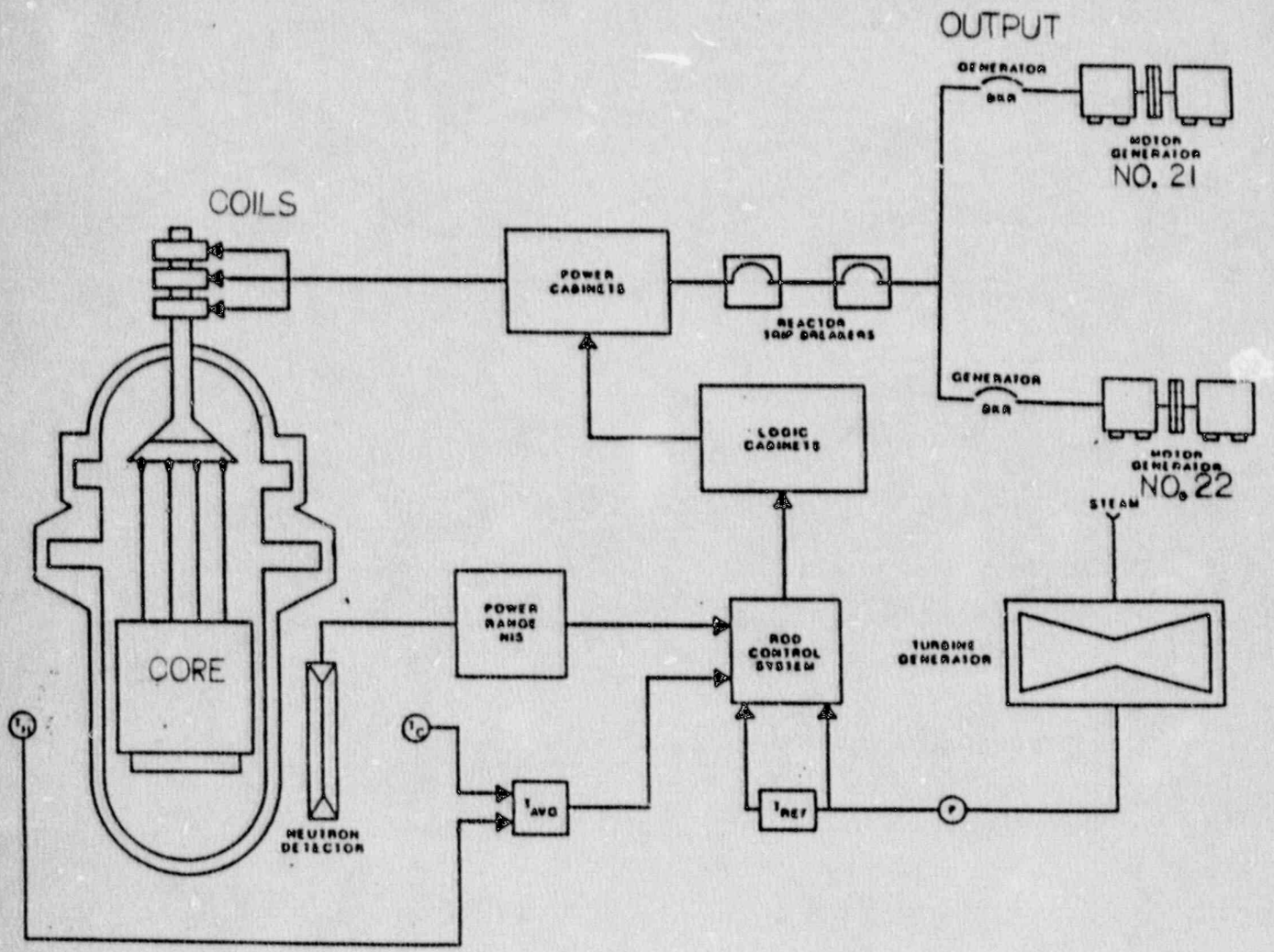
ALL - 1/11/90



Evaluation Activities Chart for Recovery from Trip of 12/26/89
Sheet 5 – Review of Plant Response

ALL 1/11/90

ATTACHMENT NO. 4 : ROD CONTROL SYSTEM



ATTACHMENT 5 - MG SET TESTING SUMMARY

Test No.	Test	Observed Effects	Remarks
(a)	Loss of field on MG set 21	21 MG tripped on time over current in "A" & "C" phases. 22 MG did not trip.	"A" phase current in MG set 21 relay was 1.8 Amps. Relay operated as expected. Bus voltage was 217 volts RMS for 1.5 seconds before the regulator responded.
(b)	Loss of field on MG set 22	21 MG did not trip 22 MG tripped on time over current in "A" & "C" phases.	"A"phase current in MG set 22 was 1.8 Amps. Relay operated as expected. Bus voltage was 218 volts RMS for 1.4 seconds before the regulator responded.
(c)	Loss of feedback on MG set 21	21 MG tripped with no targets after a few seconds delay. 22 MG tripped on time over current in "A" & "C" phases.	MG set 21 tripped on over excitation and bus over voltage after a set time delay of 5 seconds. "A" phase current in MG set 22 was 2.1 amps. Before the current reached the instantaneous trip level, time over current tripped the breaker. Bus voltage was 345 volts RMS for 3.4 seconds before both breakers tripped.
(d)	Loss of feedback on MG set 22.	21 MG tripped on instantaneous over currents in "A" & "C" phases. 22 MG tripped with no targets after a few seconds of delay.	"A" phase current in MG set 21 was 2.4 Amps. Instantaneous units which are set to to pick up at 2.0 Amps operated. MG set 22 tripped on over excitation and bus over voltage after a set time delay of 5

			seconds. Bus voltage was 346 volts RMS for 5 seconds before both breakers tripped.
(e)	Loss of "A" phase feedback on MG set 21.	21 MG tripped with no targets after a few seconds delay. MG set 22 tripped on time over currents in "A" & "C" phases.	This is a less severe test than Test (c). Effects are the same as in Test (c) except that the currents in the relays were less. Bus voltage was 340 volts RMS for 3.4 seconds before both breakers tripped.
(f)	Loss of "A" phase feedback on MG set 22.	21 MG tripped on time over currents in "A" & "C" phases. 22 MG tripped with no targets after a few seconds delay.	This is a less severe test than Test (c). Effects are the same as in Test (d) except that MG set 21 tripped on time over currents as the current level was below the instantaneous level of 2.0 Amps. Bus voltage was 345 volts RMS for 3.8 seconds before both breakers tripped.

Additional testing was performed which included a loss of prime mover (simulating a loss of MG input power by opening the MG input breaker).

(g) Tripped 21 MG set, then 22 MG set.

- When 21 MG set was tripped, no targets appeared,
- 21 MG set appeared to motor (it kept speed).
- Then 22 was tripped; no targets appeared,
- the units coasted down for about 45 seconds,
- then 21 MG output breaker opened.

Final state:

- 22 MG output breaker closed
- 21 MG output breaker open
- no targets.

The 21 MG set attempted to maintain voltage and frequency because of the flywheel affect and became a load on the 22 MG

set. When the 22 MG set was tripped, the two sets coasted down together. The 21 MG voltage regulator appeared to respond faster than the 22 MG regulator. As a result, the potential feedback circuit (21 MG) responded faster to the decreasing 21 MG output voltage and initiated the opening of the 21 MG output breaker on overexcitation (decreasing potential feedback increases the exciter voltage).

(h) Tripped 22 MG set, then 21 MG set.

- When 22 MG set was tripped, no targets appeared,
- 22 MG set appeared to motor (it kept speed).
- Then 21 was tripped; no targets appeared,
- the units coasted down for about 45 seconds,
- then 21 MG output breaker opened (at 260V output).

Final state:

- 22 MG output breaker closed
- 21 MG output breaker open
- no targets.

(i) Tripped 22 MG set and 21 MG set at the same time.

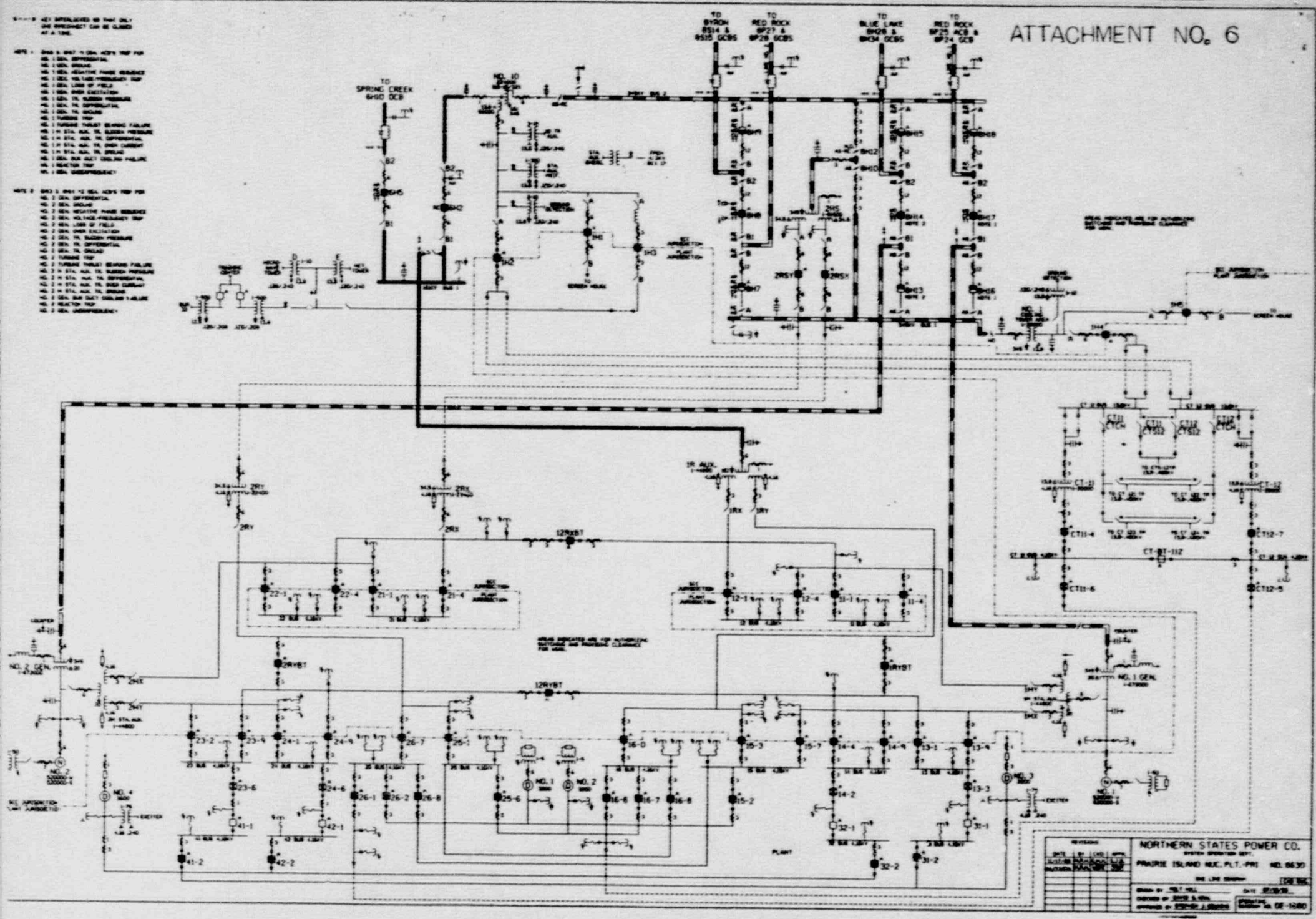
- When both MG sets were tripped; no targets appeared,
- then 21 MG output breaker opened (at 260V output).

Final state:

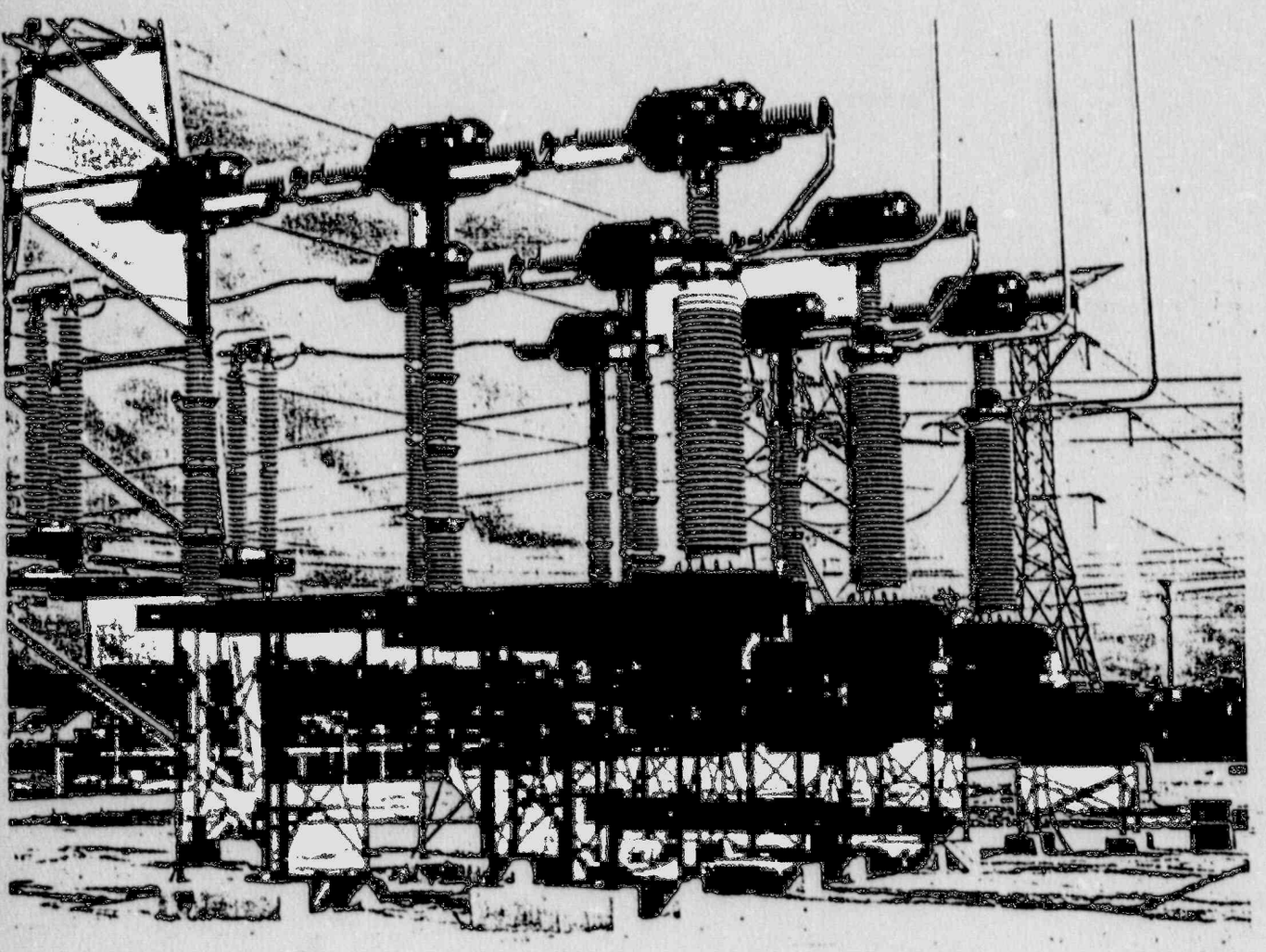
- 22 MG output breaker closed
- 21 MG output breaker open
- no targets.

The analysis for Test (g) also applies to Tests (h) and (i).

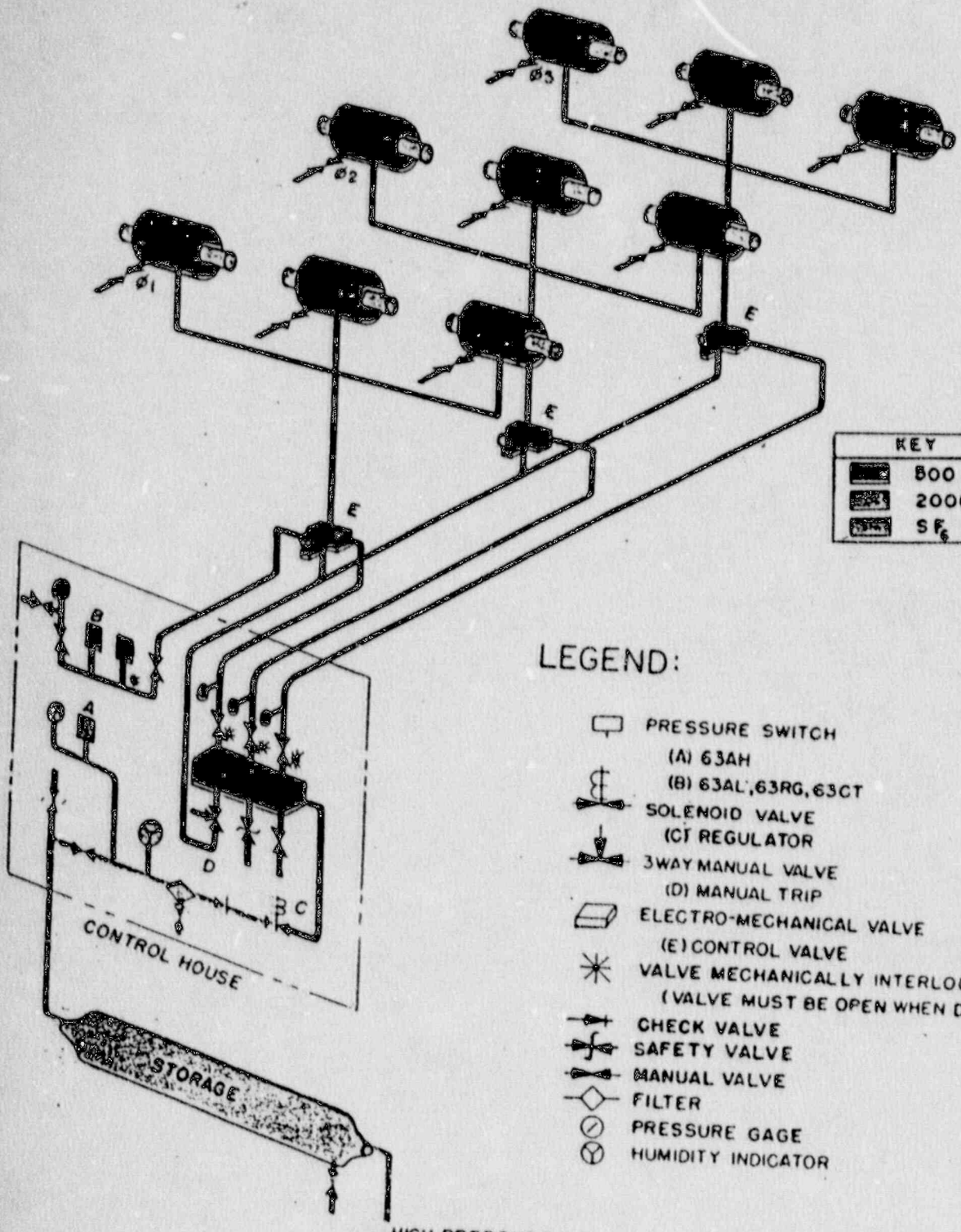
ATTACHMENT NO. 6



Outdoor Air-Blast Circuit Breaker, Type ATB-362-7



Typical Breaker Installation



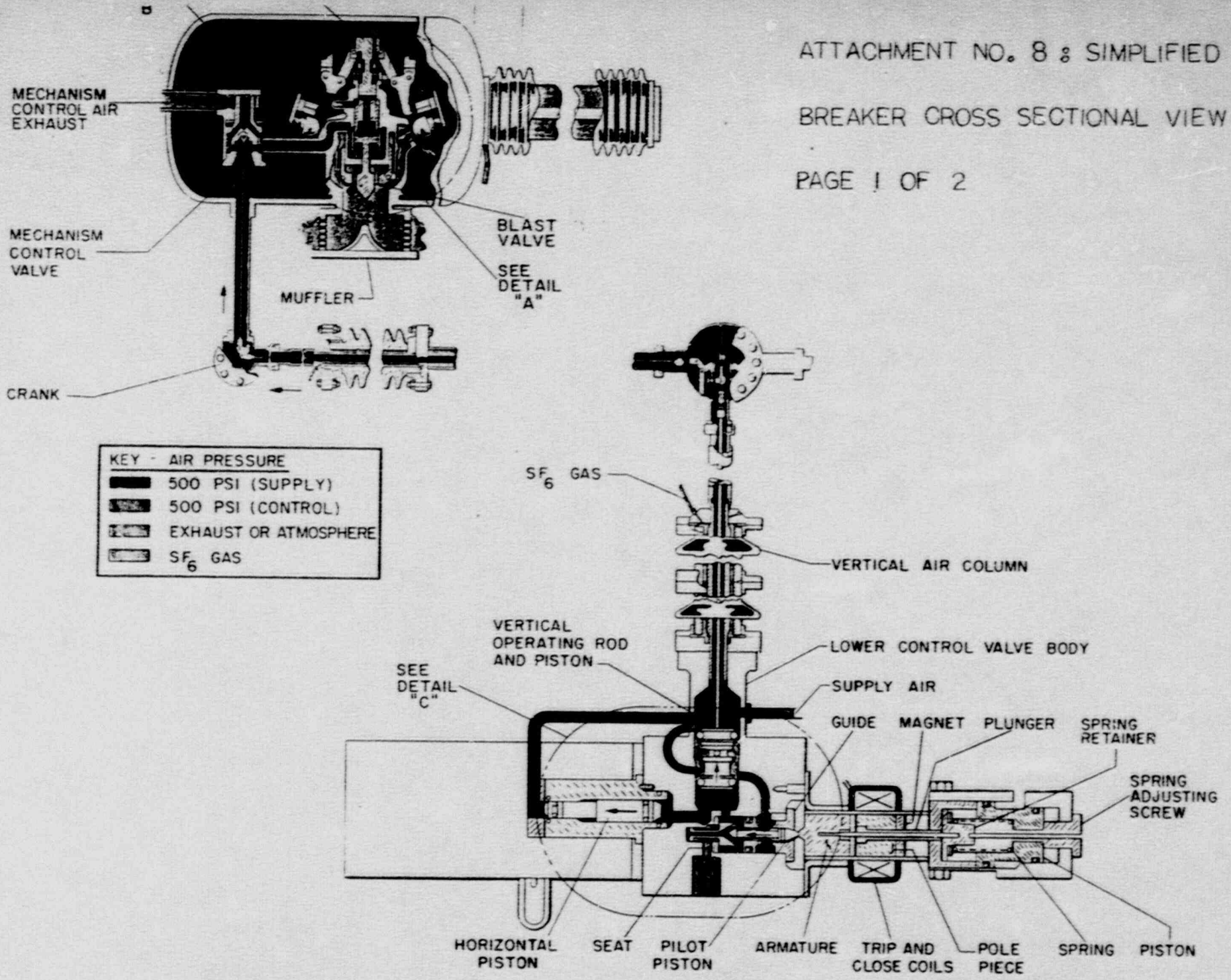
KEY (AIR PRESSURE)
800 PSI (SUPPLY LINE)
2000 PSI
SF_6 GAS

LEGEND:

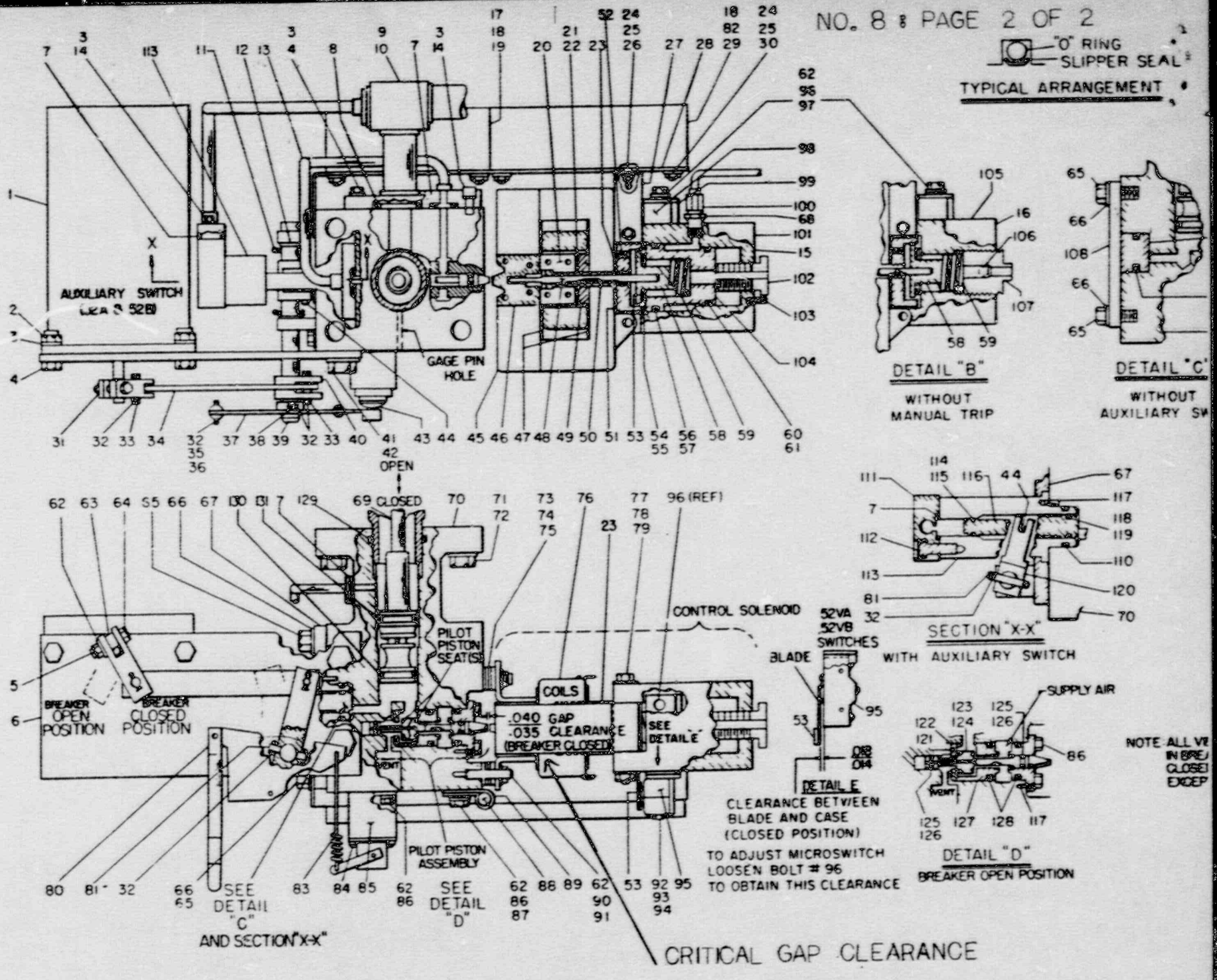
- PRESSURE SWITCH
  - (A) 63AH
  - (B) 63AL, 63RG, 63CT
- SOLENOID VALVE
  - (C) REGULATOR
- 3WAY MANUAL VALVE
  - (D) MANUAL TRIP
- ELECTRO-MECHANICAL VALVE
  - (E) CONTROL VALVE
- VALVE MECHANICALLY INTERLOCKED WITH CONTROL HOUSE (VALVE MUST BE OPEN WHEN DOOR IS CLOSED)
- CHECK VALVE
- SAFETY VALVE
- MANUAL VALVE
- FILTER
- PRESSURE GAGE
- HUMIDITY INDICATOR

ATTACHMENT NO. 8 : SIMPLIFIED

BREAKER CROSS SECTIONAL VIEW



Opening Operation – Overall Breaker


"O" RING
SLIPPER SEAL
TYPICAL ARRANGEMENT
AUXILIARY SWITCH
GAGE PIN HOLE
DETAIL "B"
WITHOUT MANUAL TRIP
DETAIL "C"
WITHOUT AUXILIARY SW
SECTION "X-X"
WITH AUXILIARY SWITCH
CONTROL SOLENOID
52VA 52VB SWITCHES
BLADE
DETAIL E
CLEARANCE BETWEEN BLADE AND CASE (CLOSED POSITION)
TO ADJUST MICROSWITCH LOOSEN BOLT # 96 TO OBTAIN THIS CLEARANCE
SUPPLY AIR
DETAIL "D"
BREAKER OPEN POSITION
BREAKER CLOSED POSITION
PILOT PISTON SEAT(S)
COILS
.040 GAP
.035 CLEARANCE
(BREAKER CLOSED)
SEE DETAIL E
PILOT PISTON ASSEMBLY
SEE DETAIL "C" AND SECTION "X-X"
SEE DETAIL "D"
OPEN
CLOSED
96 (REF)
NOTE ALL VE IN BRE CLOSE EXCEP
CRITICAL GAP CLEARANCE