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 AUTH. NAME AUTHOR AFFILIATION
 DIETCH, R. Southern California Edison Co.
 RECIP. NAME RECIPIENT AFFILIATION
 DENTON, H. R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards "Reactor Trip Breakers," providing technical & programmatic aspects of 830301 & 08 surveillance test failures, superseding 830413 rept. Handouts from 830412 meeting encl.

see RPI
Handout
1-Meeting Reactor Trip Breakers
63
37+73

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NRR/DE/HGEB 30	1	1	NRR/DE/MEB 18	1	1
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NRR/DE/SGEB 25	2	2	NRR/DHFS/HFEB40	1	1
NRR/DHFS/LQB 32	1	1	NRR/DL/SSPB	1	0
NRR/DSI/AEB 26	1	1	NRR/DSI/ASB	1	1
NRR/DSI/CPB 10	1	1	NRR/DSI/CSB 09	1	1
NRR/DSI/ICSB 16	1	1	NRR/DSI/METB 12	1	1
NRR/DSI/PSB 19	1	1	NRR/DSI/RAB 22	1	1
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10 Cys Advance H. Rood

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Southern California Edison Company



P. O. BOX 800

2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

ROBERT DIETCH
VICE PRESIDENT

TELEPHONE
213-572-4144

April 15, 1983

Mr. H. R. Denton
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

SCE met with the NRC staff on April 12, 1983 in Bethesda, Maryland to review the technical aspects of the March 1 and 8, 1983 surveillance test failures of the San Onofre Units 2 and 3 reactor trip breaker (RTB) undervoltage trip devices. By letter dated April 13, 1983, SCE transmitted a report relative to the technical aspects of the RTB discussed during the April 12, 1983 meeting and committed to provide additional information regarding the programmatic aspects of this issue.

Consistent with this commitment, enclosed please find sixty three (63) copies of the Reactor Trip Breaker report for San Onofre Units 2 and 3. This report provides information on both the technical and programmatic aspects relative to the RTB's. The comparable technical sections of this report are essentially unchanged from the information submitted on April 13, 1983; however, to the extent that these two reports differ, the report transmitted by this letter supersedes the report previously transmitted on April 13, 1983.

Also enclosed is a copy of the handouts which were used during the April 12, 1983 meeting.

Please contact me if you have any questions or comments.

Very truly yours,

Robert Dietch

cc: Mr. John Martin, Regional Administrator NRC Region V

13001
1/63 - Reactor Trip Breakers
1 - Meeting Handout

10cys Advance H. Road

B304180392 B30415
PDR ADDCK 05000361
PDR
P

ENCLOSURE TO
SCE TO NRC LETTER DATED APRIL 15, 1983
FROM R. DIETCH TO H. R. DENTON

The following paragraphs of the enclosed April 15, 1983 Reactor Trip Breaker Report contain changes other than editorial changes from the technical portion of the RTB report provided by SCE's letter dated April 13, 1983:

III.B.2.d

The fourth sentence was corrected to reflect the fact that when the breaker is installed in the "test" position (not "racked out" as indicated previously), the diode is in the UV coil circuit.

IV.D.3.b.6)

Change provides clarification of the intent of the maintenance procedure.

IV.D.4

Paragraph was reworded to clarify intent.

V.A.3

The third paragraph was revised to be consistent with discussion provided in Section IV.D.3.b.6).

VI.A.4

Paragraph was reworded to clarify description of shunt coil performance.

ENCLOSURE

REACTOR TRIP BREAKERS

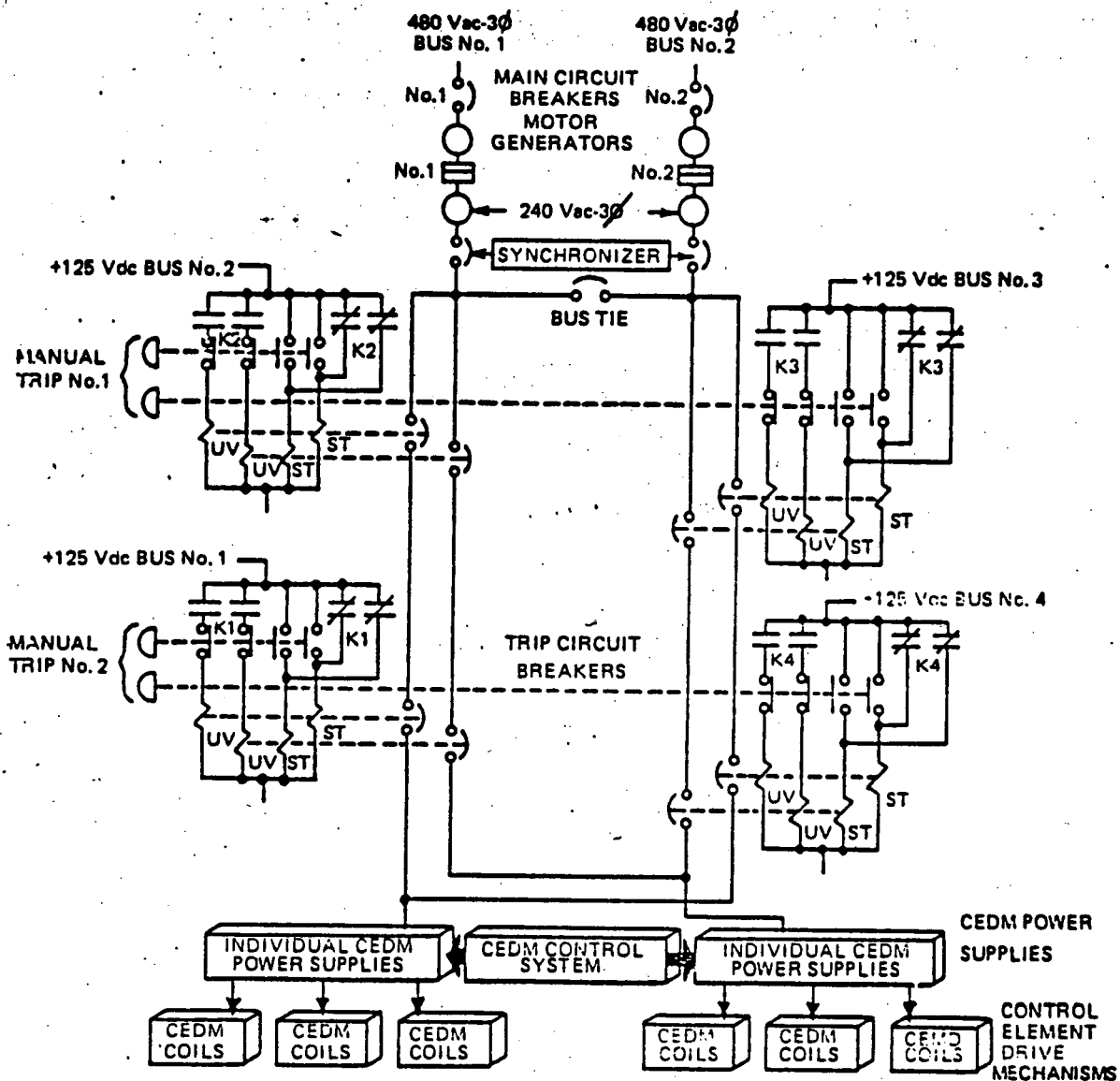
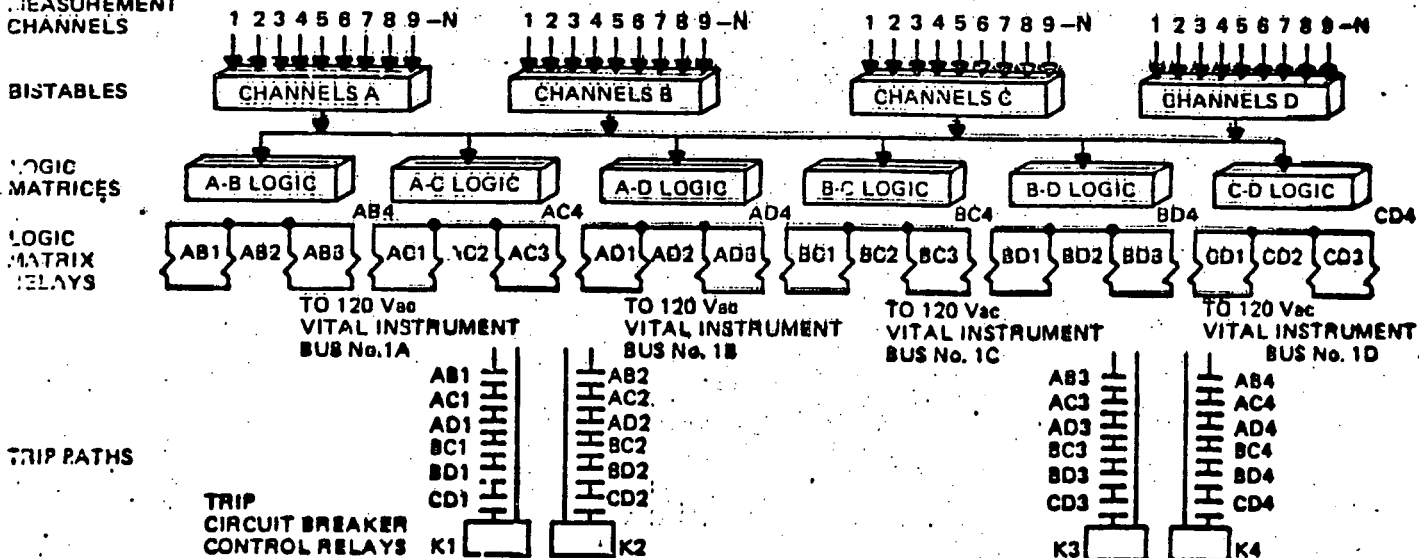
San Onofre Units 2 and 3

April 12, 1983 Meeting Handouts

MEETING WITH NRC
SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3
REACTOR TRIP CIRCUIT BREAKERS
April 12, 1983

- I. Introduction K.P. Baskin
- II. Background R.L. Phelps
 - A. Reactor Protection System Design
 - B. Reactor Trip Breaker Design
- III. Reactor Trip Breaker Investigative Tests W.N. Rothenbuhler
 - A. Description of Testing
 - B. Conclusions from Testing
 - C. Corrective Actions
- IV. Pre-Return-To-Power Actions
 - A. Breaker Maintenance S.W. Stilwagen
 - B. Breaker Surveillance Testing M.O. Medford
- V. Conclusions K.P. Baskin

POINTS FROM NSSS
MEASUREMENT
CHANNELS



SIMPLIFIED FUNCTIONAL DIAGRAM OF THE REACTOR PROTECTION SYSTEM

REACTOR TRIP SWITCHGEAR

A. PURPOSE

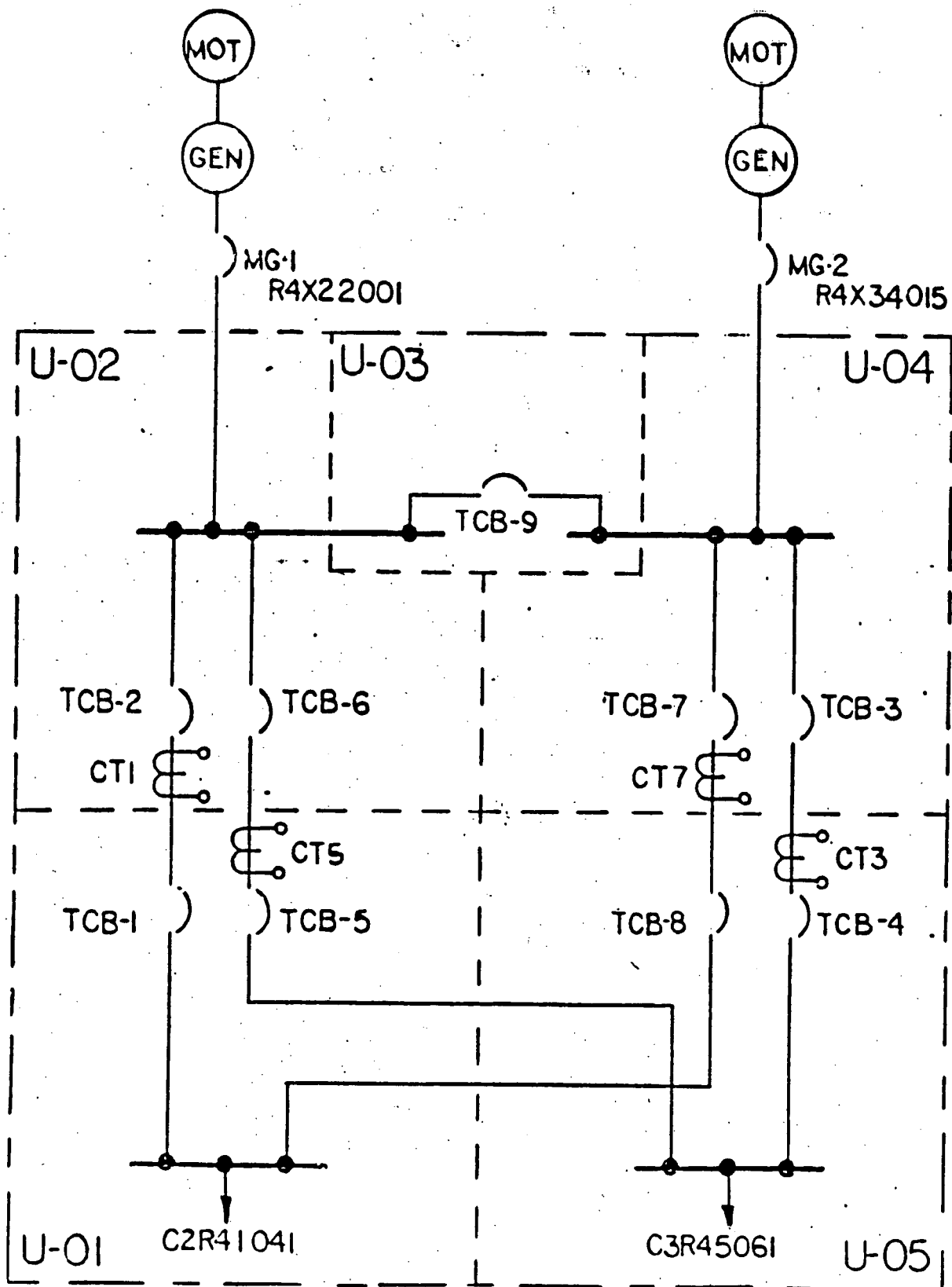
INTERRUPT POWER TO THE CONTROL ELEMENT DRIVE MECHANISMS WHEN REQUIRED BY AN AUTOMATIC TRIP SIGNAL FROM THE PPS OR WHEN A MANUAL TRIP IS INITIATED.

B. BREAKER CONFIGURATION

THE BREAKERS ARE CONFIGURED TO ENSURE THAT WHEN A TRIP IS REQUIRED A SINGLE BREAKER FAILURE WILL NOT PREVENT A TRIP. ADDITIONALLY, A SINGLE BREAKER FAILURE WILL NOT CAUSE A REACTOR TRIP.

C. BREAKER CONTROL CIRCUIT

1. BREAKER PAIRS RECEIVE POWER FROM FOUR INDEPENDENT CONTROL POWER SOURCES.
2. THE BREAKER TRIP CIRCUIT FUNCTION IS SAFETY GRADE. THE BREAKER CLOSING CIRCUITS IS QUALIFIED FOR STRUCTURAL INTEGRITY BUT DOES NOT HAVE A SAFETY GRADE FUNCTION.
3. THE BREAKER TRIP FUNCTION IS ACTUATED AUTOMATICALLY AND MANUALLY VIA A SHUNT TRIP DEVICE AND AN UNDERVOLTAGE DEVICE. THE SHUNT TRIP IS ENERGIZED TO ACTUATE. THE UNDERVOLTAGE DEVICE IS DEENERGIZED TO ACTUATE.



SUMMARY

- RPS AND RTB POWERED BY 4 CHANNELIZED INDEPENDENT, BATTERY BACKED VITAL BUSES
- RPS AUTOMATIC AND MANUAL ACTUATION OPERATES BOTH UV AND SHUNT TRIP DEVICES ON RTB
- REACTOR TRIP SWITCHGEAR UTILIZES 8 RTBs
- RPS/RTB MEETS SINGLE FAILURE CRITERION
- UV TRIP DEVICE NOT REQUIRED TO FUNCTION FOR THE RPS TO ACCOMPLISH ITS PROTECTION FUNCTION.

INVESTIGATIVE PROGRAMS

IN PLANT INVESTIGATION

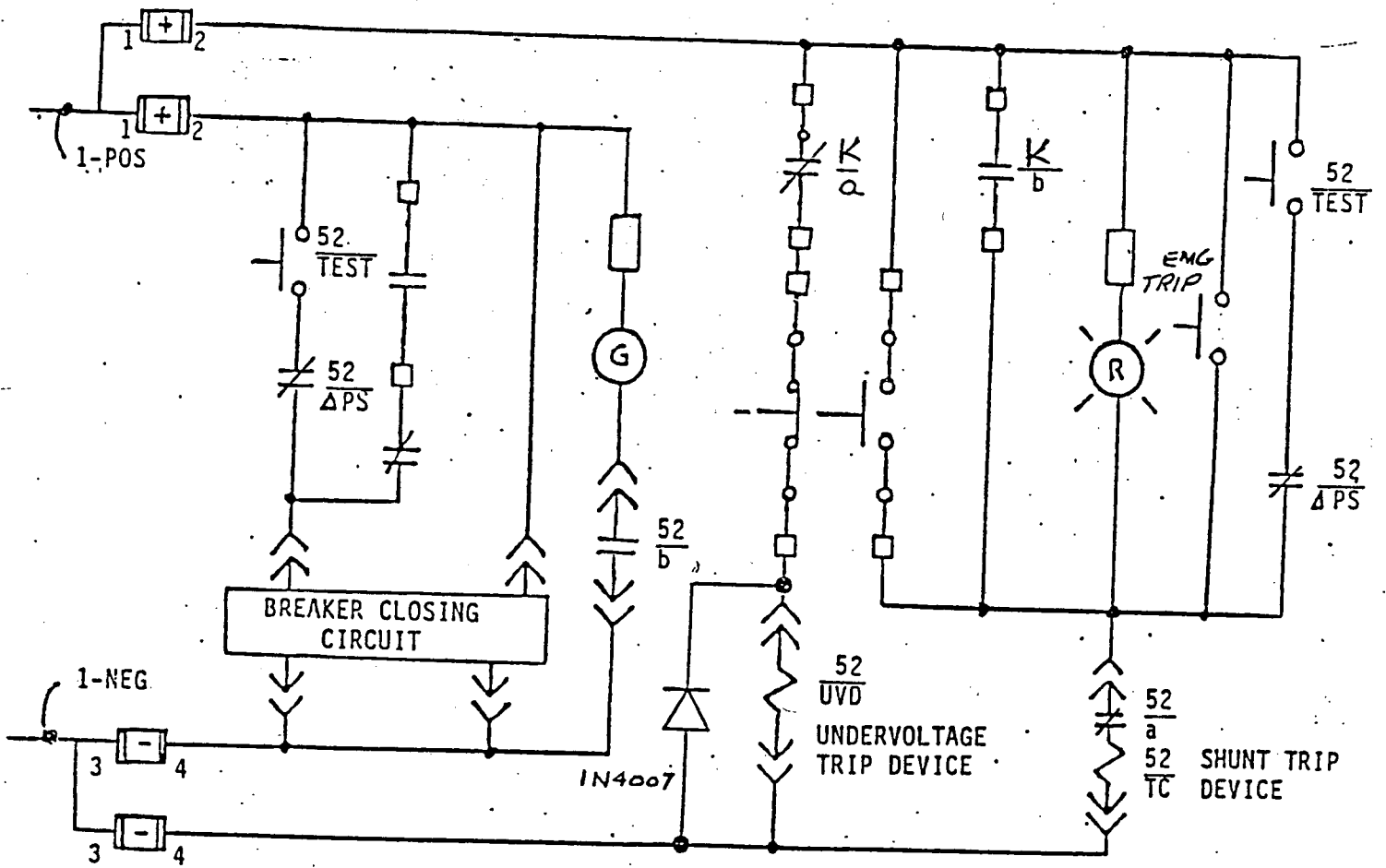
- o INVESTIGATED 3 TCB'S
- o VENDOR & NRC INVOLVED
- o PRELIMINARY RESULTS

SCE INVESTIGATION AT SHOP AND TEST

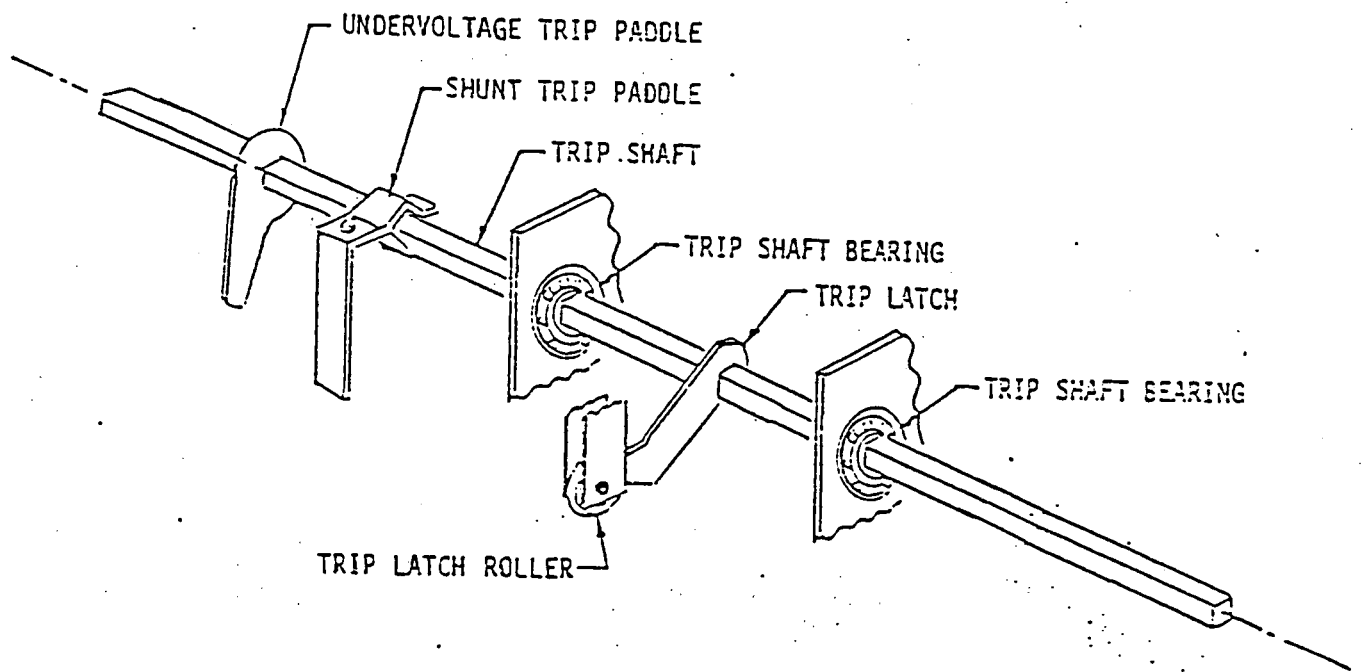
- o SCE TECHNICAL CAPABILITIES
- o GUIDELINES
- o TEST RESULTS
- o OBSERVATIONS

CONCLUSIONS

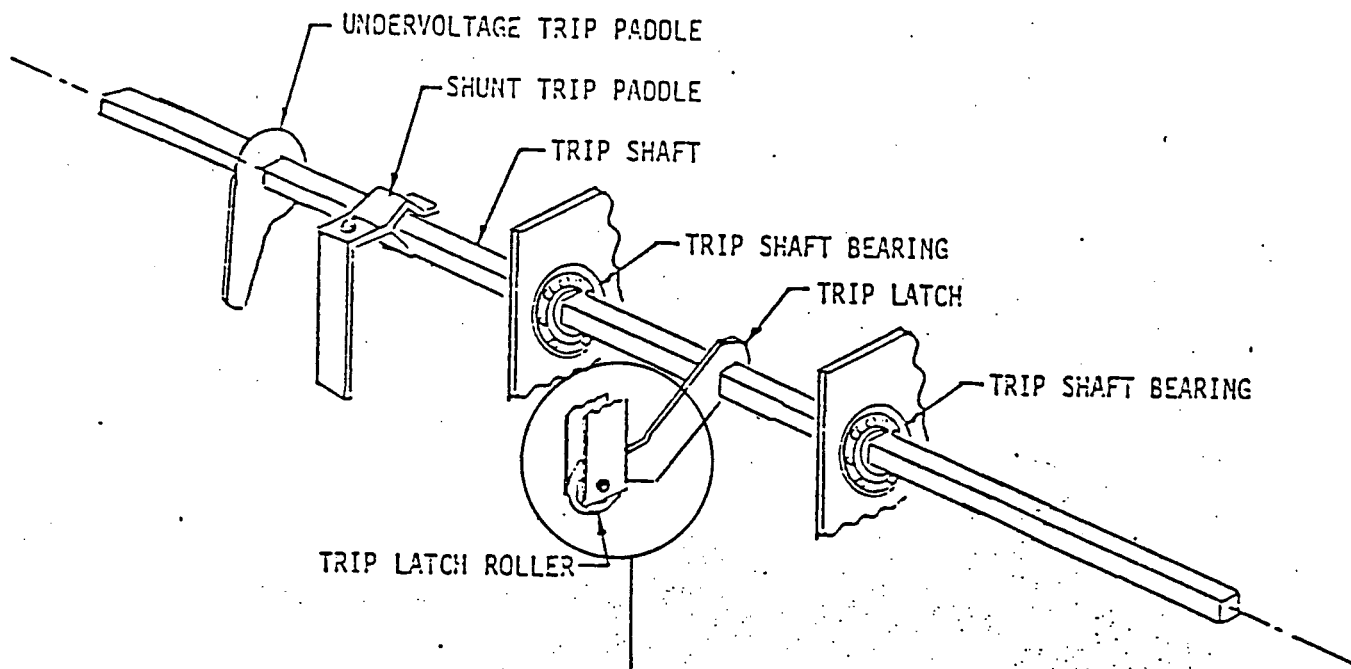
RECOMMENDATIONS



ELEMENTARY DIAGRAM FOR BREAKER CONTROL

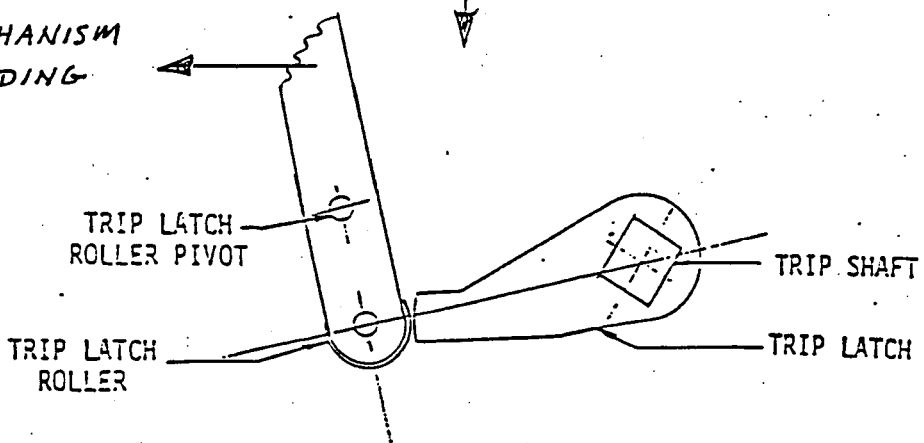


TRIP SHAFT
(OVER-CURRENT AND MANUAL TRIP PADDLES NOT SHOWN)

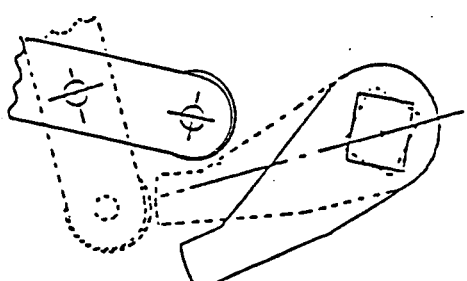


TRIP LATCH ROLLER

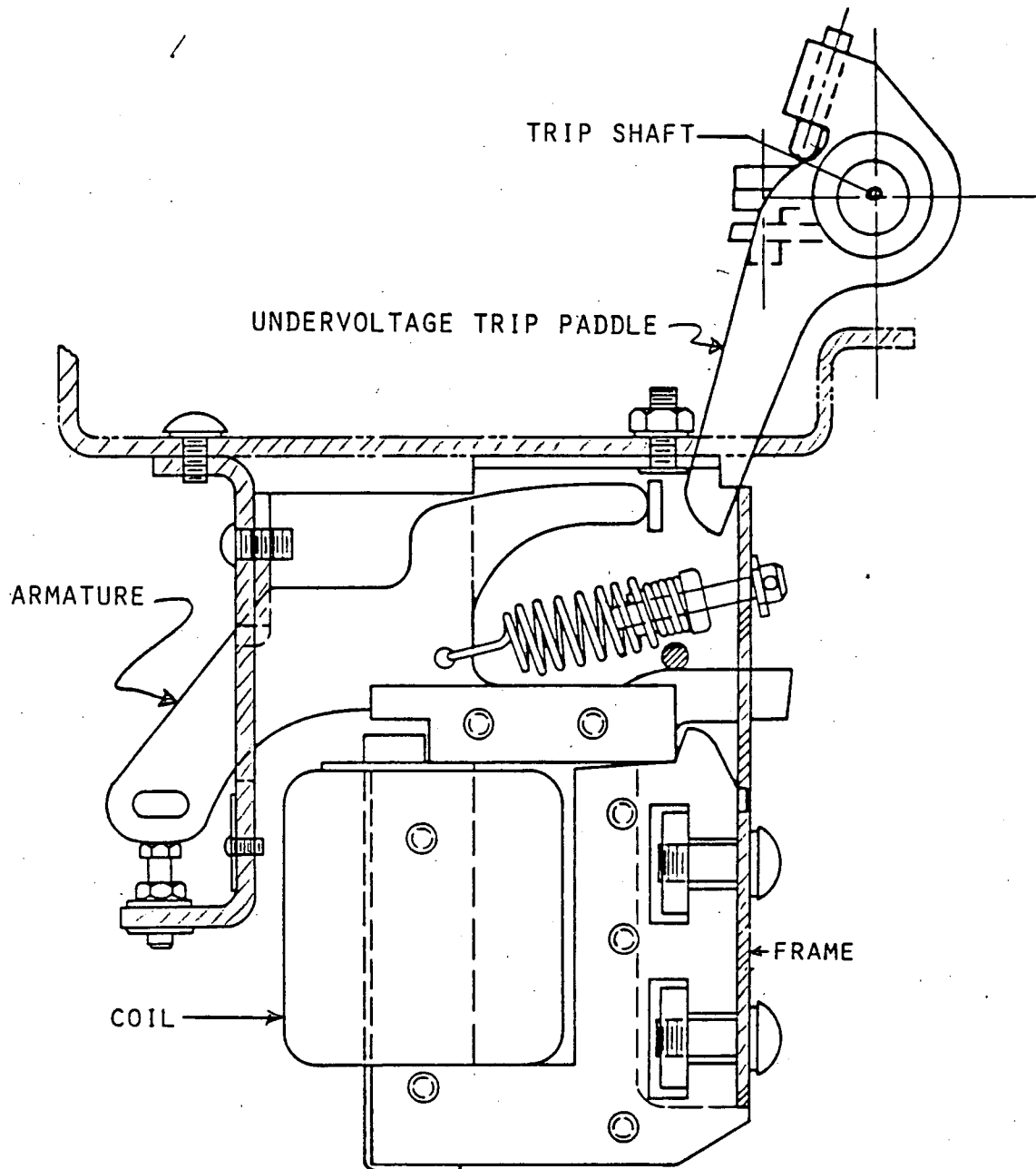
*MECHANISM
LOADING*



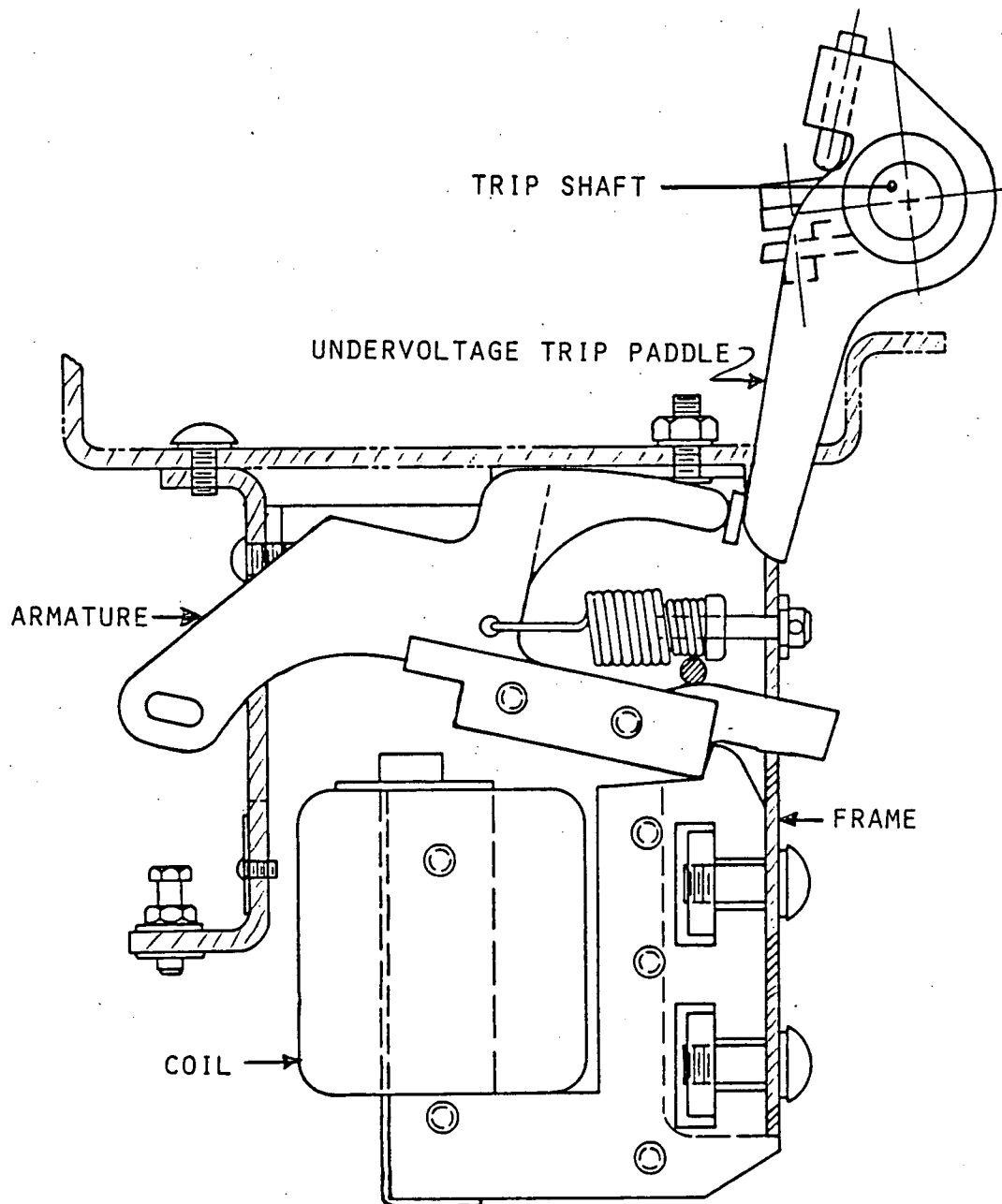
TRIP LATCH-READY TO TRIP



TRIP LATCH-AFTER TRIPPED



UNDervOLTAGE TRIP DEVICE
COIL ENERGIZED POSITION



UNDERVOLTAGE TRIP DEVICE
COIL DE-ENERGIZED

IN-PLANT INVESTIGATION

THREE TCB'S INSPECTED

- o ONE THAT PASSED SURVEILLANCE TESTING
- o TWO THAT FAILED SURVEILLANCE TESTING
- o MARCH 13-16, 1983

PERSONNEL INVOLVED

- o SCE-STATION AND ENGINEERING
- o GENERAL ELECTRIC
- o FRANKLIN RESEARCH CENTER
- o NRC

INSPECTIONS AND TESTS

- o VISUAL INSPECTION
- o OPERATIONAL TESTS
- o TRIP SHAFT TORQUE MEASUREMENT
- o UV DEVICE PICKUP AND DROPOUT

MAINTENANCE

- o CLEAN & LUBRICATE
- o CHECK & ADJUST AS REQUIRED
- o ADJUST UV PICKUP

AS LEFT CONDITIONS

- o MEASUREMENTS
- o OPERATION

IN-PLANT INVESTIGATION

TCB-2 PASSED SURVEILLANCE TESTING

AS FOUND CONDITIONS

- o OPERATION - SATISFACTORY
- o TRIP SHAFT TORQUE - 1.5 TO 2.0 IN-LBS
- o UV DEVICE PICKUP - 106.0 TO 108.1

SPECIAL INVESTIGATION

- o REDUCED UV DEVICE PICKUP TO 100 VOLTS DC
- o SLUGGISH OPERATION - DELAY TRIP

WORK PERFORMED

- o CRC 5-56 APPLIED TO BEARINGS & LATCHES

RESULTS

- o TRIP SHAFT TORQUES - 1.19 IN-LBS
- o OPERATION - SUCCESSFUL WITH UV DEVICE ADJUSTED TO 92 VOLTS DC

IN-PLANT INVESTIGATION

TCB-1 FAILED SURVEILLANCE TEST

AS FOUND CONDITIONS

- o OPERATION - INCONSISTENT/SLUGGISH
- o TRIP SHAFT TORQUE - 1.5 TO 2.0 IN-LBS
- o UV DEVICE PICKUP - 97.5 TO 103.7 VOLTS DC

WORK PERFORMED

- o ADJUSTED PICKUP VOLTAGE TO 106
- o CRC 5-56 APPLIED TO BEARINGS & LATCHES

AS LEFT

- o TRIP SHAFT TORQUE - 1.0 TO 1.3 IN-LBS
- o UV DEVICE - 95.5 TO 99.0 VOLTS DC
- o OPERATION - POSITIVE UV TRIPS

IN-PLANT INVESTIGATION .

TCB-6 FAILED SURVEILLANCE TESTS

AS FOUND CONDITIONS

- o OPERATION - SLOW AND FAILED TO TRIP
- o TRIP SHAFT TORQUE - GREATER THAN 2 IN-LBS
- o UV DEVICE PICKUP - 97.6 VOLTS DC

SPECIAL INVESTIGATION

- o INCREASED UV PICKUP TO 106.3 VOLTS DC
- o BREAKER TRIPPED BUT SLOW (2 SECONDS)

WORK PERFORMED

- o CRC 5-56 APPLIED TO BEARINGS & LATCHES

AS LEFT

- o TRIP SHAFT TORQUE - 1.31 TO 1.56 IN-LBS
- o UV DEVICE PICKUP - 98.6 TO 103.0 VOLTS DC
- o OPERATION - POSITIVE UV TRIPS

SCE INVESTIGATION

TEST PROCEDURE

- o STATION WORK PACKAGE

PERSONNEL

- o APPARATUS ENGINEERS
- o STATION MAINTENANCE
- o STATION ENGINEERING
- o STATION QC
- o GE SERVICE ENGINEER

TEST PROGRAM

- o GUIDELINES DEVELOPED
- o TEST RESULTS
- o OBSERVATIONS

SCE INVESTIGATION

TECHNICAL CAPABILITIES

- o APPARATUS ENGINEERING SECTION
 - o APPARATUS SPECIFICATIONS
 - o QUALIFICATION
 - o VENDORS
 - o EQUIPMENT
 - o TESTS
 - o FACTORY
 - o ACCEPTANCE
 - o CIRCUIT BREAKERS
 - o PRODUCT SPECIALISTS
 - o FIELD TROUBLES
 - o PRODUCTS INVOLVED
 - o ELECTRICAL
 - o MECHANICAL
 - o SUBSTATION
 - o GENERATION
 - o DISTRIBUTION
- o SHOP & TEST FACILITIES
 - o REPAIR FACILITIES
 - o TRANSFORMERS
 - o MOTORS
 - o CIRCUIT BREAKERS
 - o STANDARDS LABORATORY

SCE INVESTIGATION

TCB-4 FAILED SURVEILLANCE TESTS

AS FOUND CONDITIONS

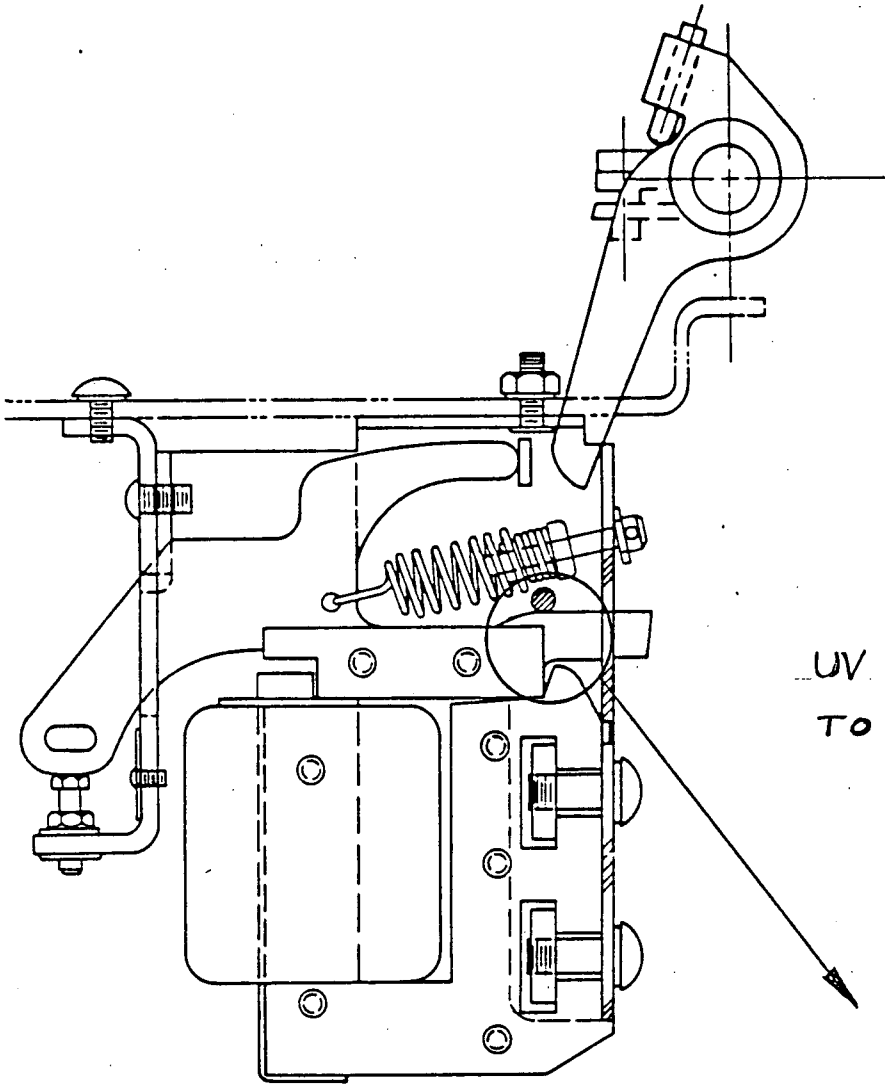
- o OPERATION
 - o INCONSISTENT - SOME FAILURES TO TRIP
- o TRIP SHAFT TORQUE - 1.56 TO 2.0 IN-LBS
- o UV DEVICE PICKUP - 93.7 TO 97.0 VOLTS DC
- o SUCCESSFUL SHUNT TRIP AT 30.2 VOLTS

WORK PERFORMED

- o TRIP SHAFT & OPERATING MECHANISM
 - o REMOVED AND INSPECTED
 - o BAD LATCH ROLLER BEARING
 - o CLEANED AND LUBRICATED
- o UV DEVICE
 - o REMOVED AND INSPECTED
 - o EXCESSIVE ARMATURE TO RIVET CLEARANCE
 - o CLEANED AND ADJUSTED
- o CHECKED ADJUSTMENTS

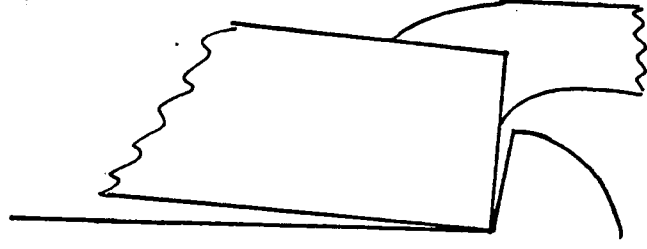
AS LEFT

- o TRIP SHAFT TORQUE - 1.00 TO 1.44 IN-LBS
- o UV DEVICE PICKUP - 104.5 TO 106.5 VOLTS DC
- o OPERATION
 - o POSITIVE UV TRIP
 - o UV TRIP TIME - 60.1 TO 62.8 MSEC W/DIODE
 - o UV TRIP TIME - 28.6 TO 30.2 MSEC W/O DIODE
- o NCR PREPARED FOR BAD LATCH ROLLER



UV DEVICE - ARMATURE
TO RIVET CLEARANCE

RIVET



UV DEVICE
EFFECT OF COIL TEMPERATURE
ON PICKUP VOLTAGE

<u>TEST NO.</u>	<u>COIL TEMPERATURE °C</u>	<u>UV PICKUP VOLTS DC</u>
1	26.1	106.5
2	26.1	104.5
3	26.1	105.2
4	26.1	105.9
5	52.8*	125.7
6	52.8	124.9
7	52.8	123.8

* THE 52.8C COIL SURFACE TEMPERATURE WAS OBTAINED
AFTER THE COIL WAS ENERGIZED AT 130 VOLTS DC FOR
ABOUT ONE HOUR.

SCE INVESTIGATION

TIMING TEST RESULTS

AS FOUND

- o 61.1 MSEC TO FAILURE TO TRIP

AFTER ADJUSTING UV PICKUP FROM 93.7 TO 104.9 VOLTS DC

- o 61.6 TO 75.7 MSEC

AFTER CLEANING TRIP SHAFT BEARINGS/LATCHES

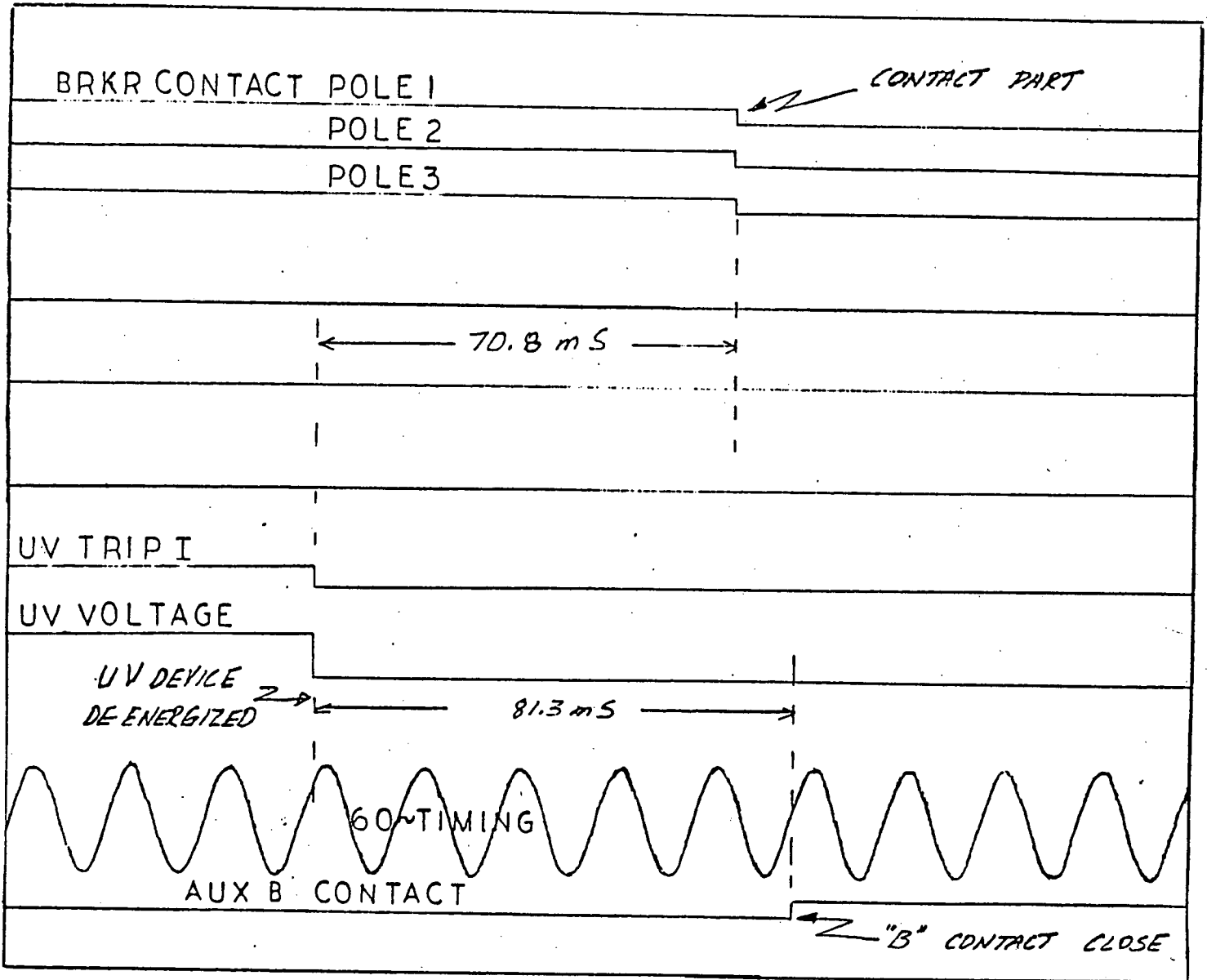
- o 65.4 TO 70.3 MSEC

AFTER CLEANING AND ADJUSTING UV DEVICE

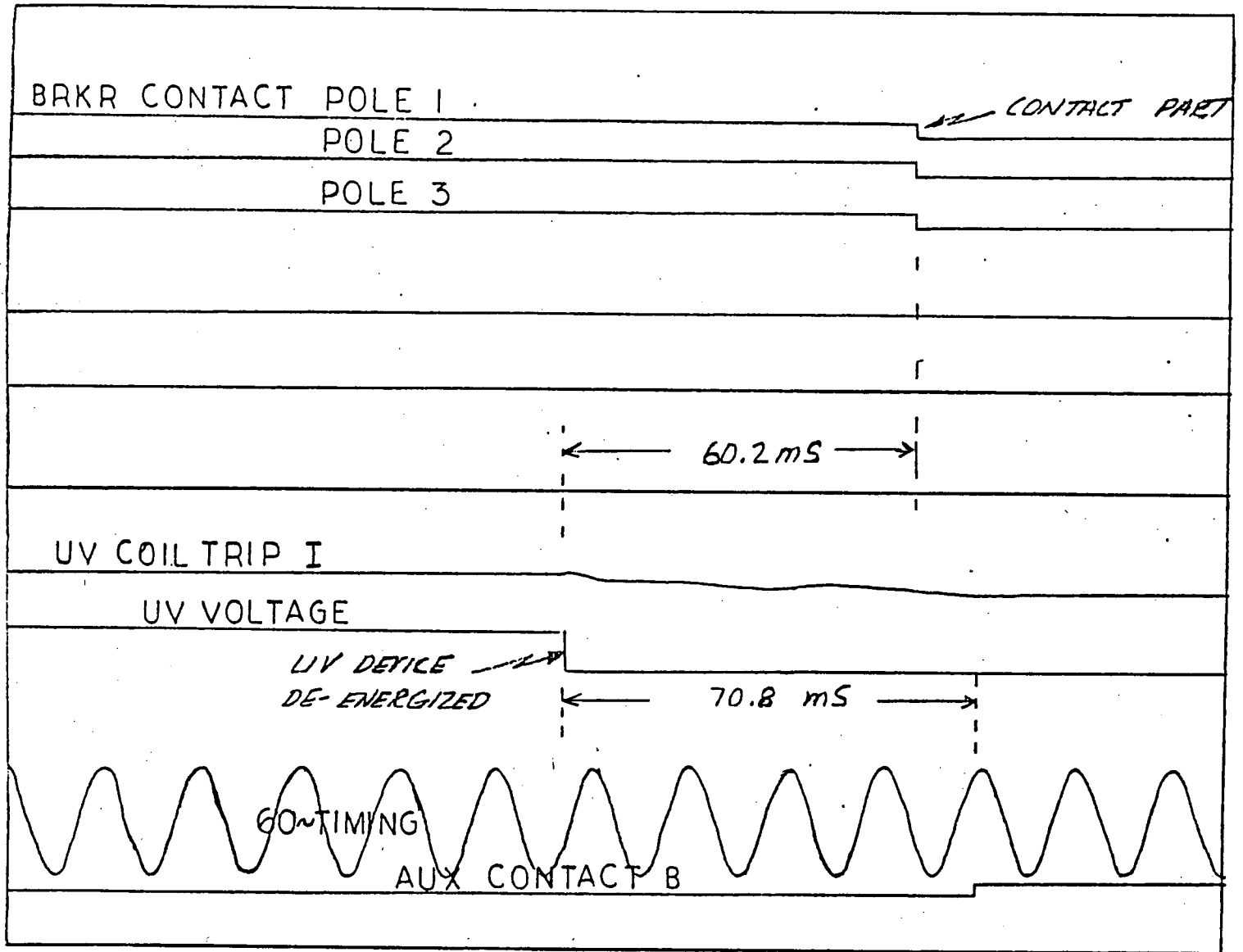
- o 60.1 TO 62.8 MSEC

OBSERVATION

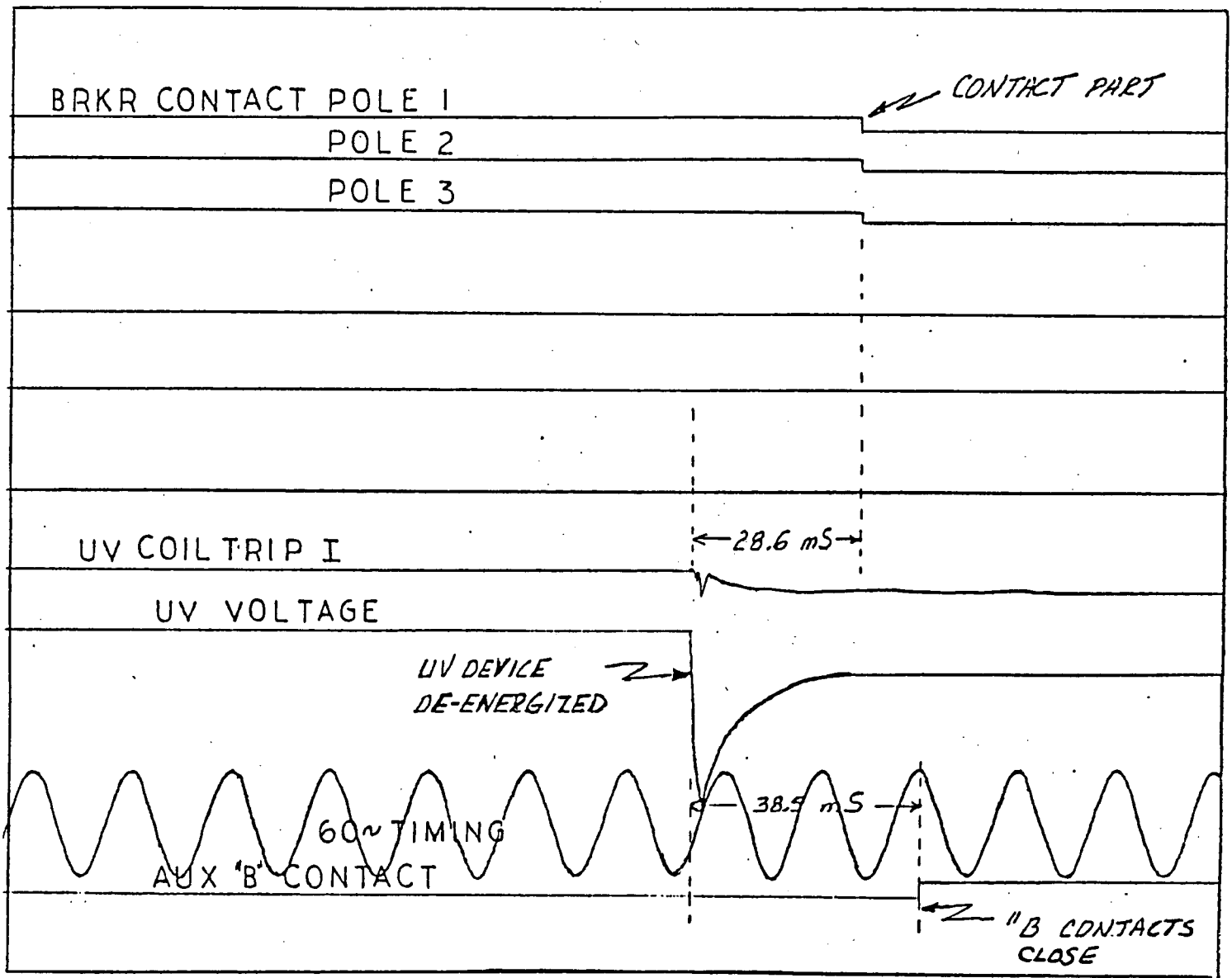
- o TIMING TESTS
 - o GOOD QUANTITATIVE MEASUREMENT
 - o NEED TO ESTABLISH LIMITS



TCB-4 AS FOUND CONDITIONS
 SUCCESSFUL UV TRIP



TCB-4 AFTER MAINTENANCE
(WITH DIODE)



TCB-4 AFTER MAINTENANCE
(WITHOUT DIODE)

SUMMARY OF INVESTIGATION

- SHUNT TRIP DEVICE HAS SIGNIFICANT MARGIN AND CONSISTANTLY OPERATED SATISFACTORILY
- THE UV DEVICE PERFORMANCE CAN BE AFFECTED BY SEVERAL FACTORS

<u>ITEM</u>	<u>AFFECT</u>
● LUBRICATION OF TRIP SHAFT BEARINGS AND LINKAGE AND LATCH POINTS	MAJOR
● SETTING OF UV DEVICE PICKUP VOLTAGE AT KNOWN TEMPERATURE	MAJOR
● UV DEVICE ARMATURE TO RIVET CLEARANCE	MAJOR
● INSTALLATION OF DIODE	MINOR
● TRIP LATCH BEARING PROBLEM FOUND ON TCB-4	MINOR
● MEASURABLE PARAMETERS PROVIDE A GOOD INDICATION OF BREAKER OPERATION	
● UV TRIP TIME	
● TRIP SHAFT TORQUE	

RECOMMENDATION

BASE-LINE MAINTENANCE

- AS FOUND
 - TRIP SHAFT TORQUE
 - UV PICKUP VOLTAGE
 - UV TRIP TIME
- REMOVE TRIP SHAFT AND MECHANISM
 - CLEAN, INSPECT, LUBRICATE

PREVENTATIVE MAINTENANCE

- ADJUSTMENTS
- UV DEVICE ARMATURE TO RIVET CLEARANCE
- UV DEVICE PICKUP
- UV DEVICE DROPOUT
- TRIP SHAFT TORQUE

SURVEILLANCE TESTS

- UV TRIP TIME
- RECORD AND TRACK FOR EACH BREAKER

CONCLUSIONS

- o FOR THE FOUR TCB'S INVESTIGATED, SUCCESSFUL OPERATION WAS OBTAINED IN ALL CASES BY ADJUSTING AND LUBRICATING
- o OPTIMIZATION OF ADJUSTMENTS WILL PROVIDE MARGIN IN OPERATIONS
- o QUANTITATIVE MEASUREMENTS CAN BE MADE TO MEASURE PERFORMANCE
 - o TRIP SHAFT TORQUE
 - o UV TRIP TIME
- o THE UNDERVOLTAGE TRIP FUNCTION OF THE TCB CIRCUIT BREAKERS CAN PROVIDE RELIABLE OPERATION WITHOUT ANY DESIGN CHANGES IF APPROPRIATE MAINTENANCE AND SURVEILLANCE TECHNIQUES ARE USED

PREVENTATIVE MAINTENANCE PROGRAM
FOR GENERAL ELECTRIC AK2-25-2 CIRCUIT BREAKERS

- o GENERATION OF STATION PROCEDURE S023-I-4.66
 - o S023-I-4.66 APPROVED 4/5/83

- o CONDUCT TRAINING OF STATION CRAFT WITH VENDOR CERTIFICATION
 - o COMPLETED CLASS ROOM TRAINING 3/31/83
 - o COMPLETED IN PLANT PHASE 4/6/83

- o IMPLEMENT PREVENTATIVE MAINTENANCE PROCEDURE S023-I-4.66
 - o COMMENCED PROCEDURE 4/6/83
 - o ESTIMATED COMPLETION OF PROCEDURE 4/10/83

- o EVALUATION OF DATA TO ACCESS ADEQUACY OF PREVENTATIVE MAINTENANCE FREQUENCY

PREVENTATIVE MAINTENANCE PROCEDURE

S023-1-4.66

OBJECTIVE

- PROVIDES DETAILS FOR INSPECTION, CLEANING
ADJUSTMENTS AND TESTING OF AK-2-25-2
CIRCUIT BREAKERS
- SECTIONS 6.1; 6.2; 6.4; 6.6 THROUGH 6.9
AND 6.11 WILL BE PERFORMED EVERY FOUR (4)
MONTHS
- PROCEDURE SHALL BE PERFORMED IN ITS ENTIRETY
AT LEAST ANNUALLY

PROCEDURES

- 6.1 REMOVE BREAKER FROM CUBICLE
- 6.2 "AS FOUND" INSPECTION (4 MONTH INTERVAL)
 - OBTAIN PICK UP VOLTAGE OF THE UV DEVICE WHEN AT AMBIENT AND AT TEMPERATURE
 - MEASURE OPENING TIME OF CIRCUIT BREAKER - CONDUCT THREE TIMES
- 6.3 BREAKER INSPECTION AND CLEANING (ANNUAL)
- 6.4 TRIP TORQUE VERIFICATION AND CLEANING (4 MONTH INTERVAL)
 - "AS FOUND" TRIP TORQUE MEASUREMENT
 - CLEAN TRIP-LATCH SURFACES
 - FINAL TRIP TORQUE MEASUREMENTS
- 6.5 BREAKER MECHANICAL OPERATION CHECKS AND ADJUSTMENTS (ANNUAL)
 - INSPECT/ADJUST CONTACT WIPE CLEARANCE
 - MEASURE CONTACT SPRING COMPRESSION ON EACH POLE
- 6.6 CHECK UNDER-VOLTAGE DEVICE FOR ARMATURE CLEARANCE (4 MONTH INTERVAL)
 - VERIFY CLEARANCE BETWEEN ARMATURE ARM AND RIVET - VERIFY FREEDOM & MOVEMENT
 - ADJUST ARMATURE CLEARANCE TO $\leq 0.006"$

- 6.7 CHECK INSTANTANEOUS UNDER-VOLTAGE PICKUP
AND TRIP SETTINGS (4 MONTH INTERVAL)
- 6.8 POSITIVE TRIP CHECK AND ADJUSTMENTS (4 MONTH INTERVAL)
- 6.9 TRIP LATCH ADJUSTMENT (4 MONTH INTERVAL)
- 6.10 POST-MAINTENANCE TESTING (ANNUAL)
 - PERFORM INSULATION-RESISTANCE CHECKS
 - MEASURE THE CONTACT RESISTANCE FOR EACH PHASE
 - PERFORM OVERCURRENT TRIP TEST
- 6.11 REINSTALL BREAKER
- 6.12 RESTORATION AND POST-MAINTENANCE CHECKS
(4 MONTH INTERVAL)

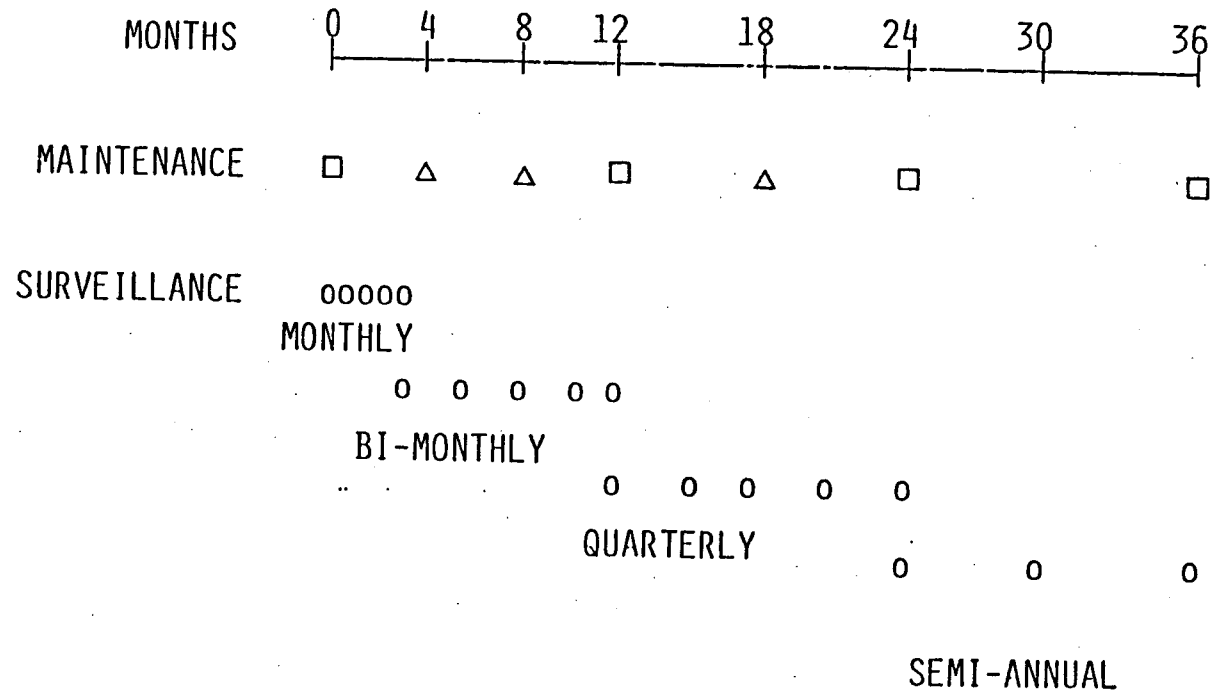
REACTOR TRIP BREAKER SURVEILLANCE
PRE - MARCH 1983

- o PLANT PROTECTION SYSTEM TEST
 - o MONTHLY TEST REQUIREMENT
 - o TESTS SHUNT AND UV TOGETHER
 - o GO-NO-GO TEST
- o SUPPLEMENTAL TEST
 - o TESTS SHUNT AND UV SEPARATELY
 - o REQUIRED BY TECHNICAL SPECIFICATION ON EIGHTEEN MONTH CYCLE
 - o PERFORMED MORE FREQUENTLY DURING INITIAL STAGES OF STARTUP
 - o GO-NO-GO TEST

REACTOR TRIP BREAKERS
SUPPLEMENTAL TEST

- o EXISTING TEST
 - o GO-NO-GO TEST OF UV DEVICE
 - o GO-NO-GO TEST OF SHUNT DEVICE
- o REVISED TEST
 - o RESPONSE TIME TEST OF UV DEVICE
 - o DETECTION OF ONSET OF DEGRADED PERFORMANCE
 - o INITIAL AND FINAL ACCEPTANCE CRITERIA
 - o GO-NO-GO TEST OF SHUNT DEVICE

REACTOR TRIP BREAKERS SURVEILLANCE TEST PROGRAM



- o = SURVEILLANCE TEST
- = FULL PREVENTIVE MAINTENANCE
- △ = PREVENTIVE LUBRICATION OF TRIP BAR BEARINGS

60