

Table 9 Generators Constants in 1990

GEN	XE(%)	XD(%)	XQ(%)	XQ(%)	XD(%)	POM(%)	POD(%)	FNU(P.U)	GMUIP.U	100(S)	TF(S)	TG(S)	LF(%)	LG(%)
Arayat	0.0	10.00	24.40	42.30	827.00	413.00	50.00	3.80	8.50	1.00	10.00	10.00	200.00	110.00
Arayat(Aux)	0.0	114.50	264.50	484.80	313.00	156.00	50.00	1.80	7.50	1.00	1.00	10.00	200.00	110.00
Malaya 1	0.0	2.40	12.50	12.20	4595.00	2458.00	100.00	3.20	5.20	1.00	1.00	10.00	150.00	110.00
Malaya 2	0.0	7.10	35.10	41.60	5267.00	4432.00	100.00	3.70	5.20	1.00	1.00	10.00	150.00	110.00
Kalayaan	0.0	3.50	13.60	21.20	937.00	468.00	50.00	3.80	8.70	1.00	1.00	10.00	200.00	110.00
Caliraya	0.0	75.00	152.50	267.50	112.00	56.00	50.00	3.50	7.50	1.00	1.00	10.00	200.00	110.00
Rotocan	0.0	86.70	216.70	346.70	84.00	42.00	50.00	2.70	7.50	1.00	1.00	10.00	200.00	110.00
Mak-Ban	0.0	5.80	23.30	34.20	2046.00	1623.00	100.00	3.50	6.10	1.00	1.00	1.00	150.00	110.00
PNPP	0.0	5.60	19.70	26.20	5914.00	2557.00	100.00	4.50	5.90	1.00	1.00	1.00	150.00	110.00
Calaca	0.0	4.80	25.10	25.60	7004.00	3502.00	100.00	3.20	7.20	1.00	1.00	1.00	150.00	110.00
Masluay	0.0	277.20	405.00	605.00	10.00	5.00	50.00	1.20	4.20	1.00	1.00	10.00	200.00	110.00
Panta-Ban	0.0	24.30	86.40	86.40	413.00	207.00	50.00	1.10	8.50	1.00	1.00	10.00	200.00	110.00
Binga 1	0.0	55.80	101.50	181.70	171.00	86.00	50.00	0.50	7.20	1.00	1.00	10.00	200.00	110.00
Binga 2	0.0	55.80	107.50	181.70	171.00	86.00	50.00	0.50	7.20	1.00	1.00	10.00	200.00	110.00
Ambuklao	0.0	37.20	70.70	107.90	299.00	149.00	50.00	0.80	7.20	1.00	1.00	10.00	200.00	110.00
Magat	0.0	5.20	13.60	21.40	5049.00	2525.00	50.00	3.80	4.80	1.00	1.00	10.00	200.00	110.00
Tiwi 1	0.0	13.10	46.70	75.10	1031.00	515.00	100.00	1.70	6.10	1.00	1.00	1.00	150.00	110.00
Tiwi 2	0.0	15.50	70.00	117.20	687.00	344.00	100.00	1.20	6.10	1.00	1.00	1.00	150.00	110.00
Bataan	0.0	13.10	105.00	118.00	1869.00	934.00	100.00	1.60	5.90	1.00	1.00	1.00	150.00	110.00
Sucot	0.0	9.00	46.30	48.80	4995.00	2498.00	100.00	1.60	5.90	1.00	1.00	1.00	150.00	110.00
Manila	0.0	17.60	92.80	124.20	542.00	271.00	100.00	3.20	5.20	1.00	1.00	1.00	150.00	110.00
ManitD	0.0	15.60	70.00	111.20	687.00	344.00	100.00	1.20	6.10	1.00	1.00	1.00	150.00	110.00

GENERATOR = 22 FREQUENCY = 60.0 DELT = 0.020 CK = 1.00 DKD = 0.20 ICASE = 2

Fig. 1 DISTRIBUTION OF ACTUAL AND CALCULATED VOLTAGE (1984) Unit : kV (230) : CALCULATION VALUE

230 : ACTUAL VALUE

LEGEND:

TRANSMISSION LINE:

Existing UnderConst.

230 kV

115 kV

POWER PLANT:

HYDRO PLANT (H)

OIL FIRED THERMAL PLANT (T)

COAL FIRED THERMAL PLANT (C)

GEOTHERMAL PLANT (G)

NUCLEAR PLANT (N)

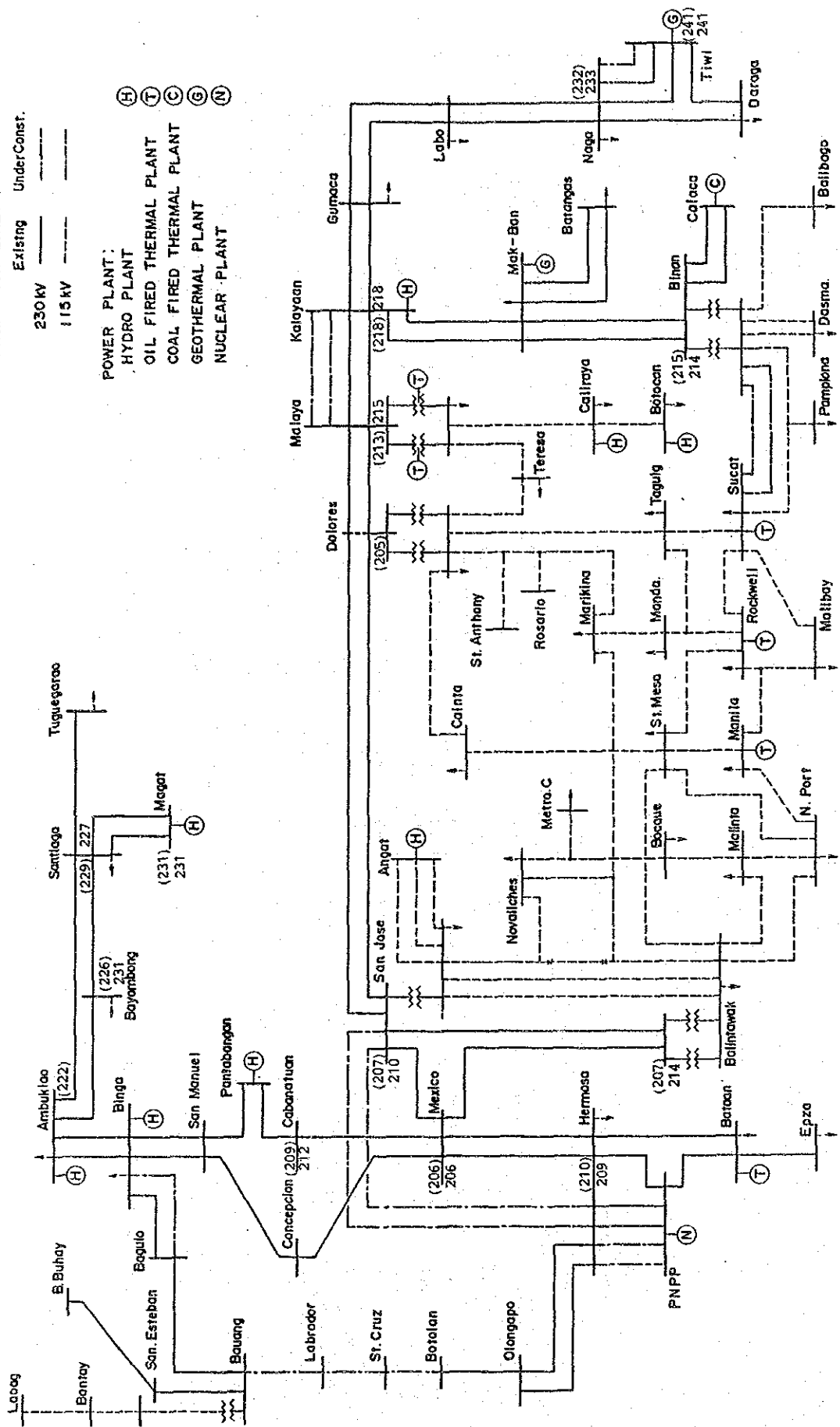
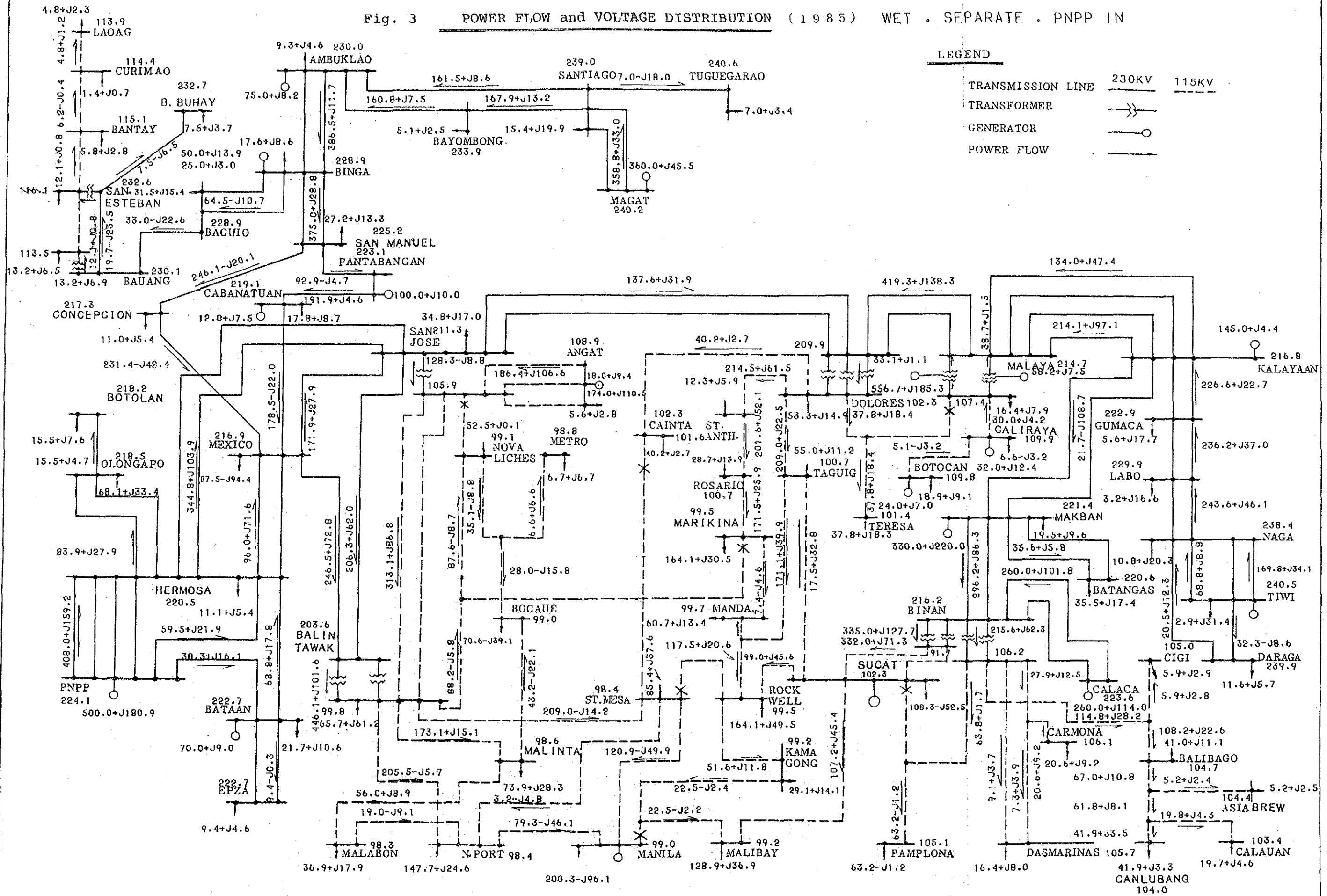


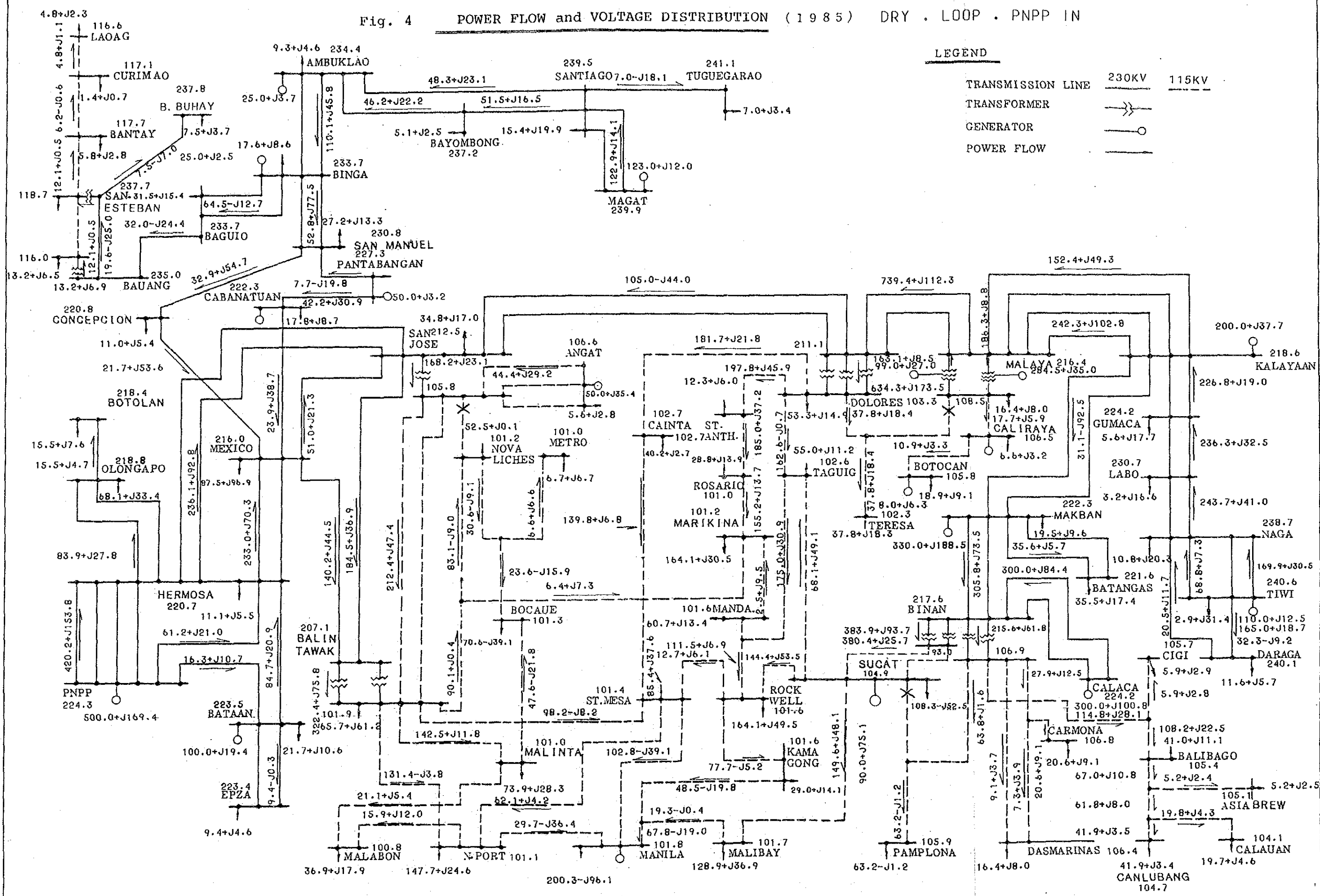
Fig. 3 POWER FLOW and VOLTAGE DISTRIBUTION (1985) WET . SEPARATE . PNPP IN



LEGEND

TRANSMISSION LINE	230KV	115KV
TRANSFORMER	[Symbol]	
GENERATOR	[Symbol]	
POWER FLOW	[Symbol]	

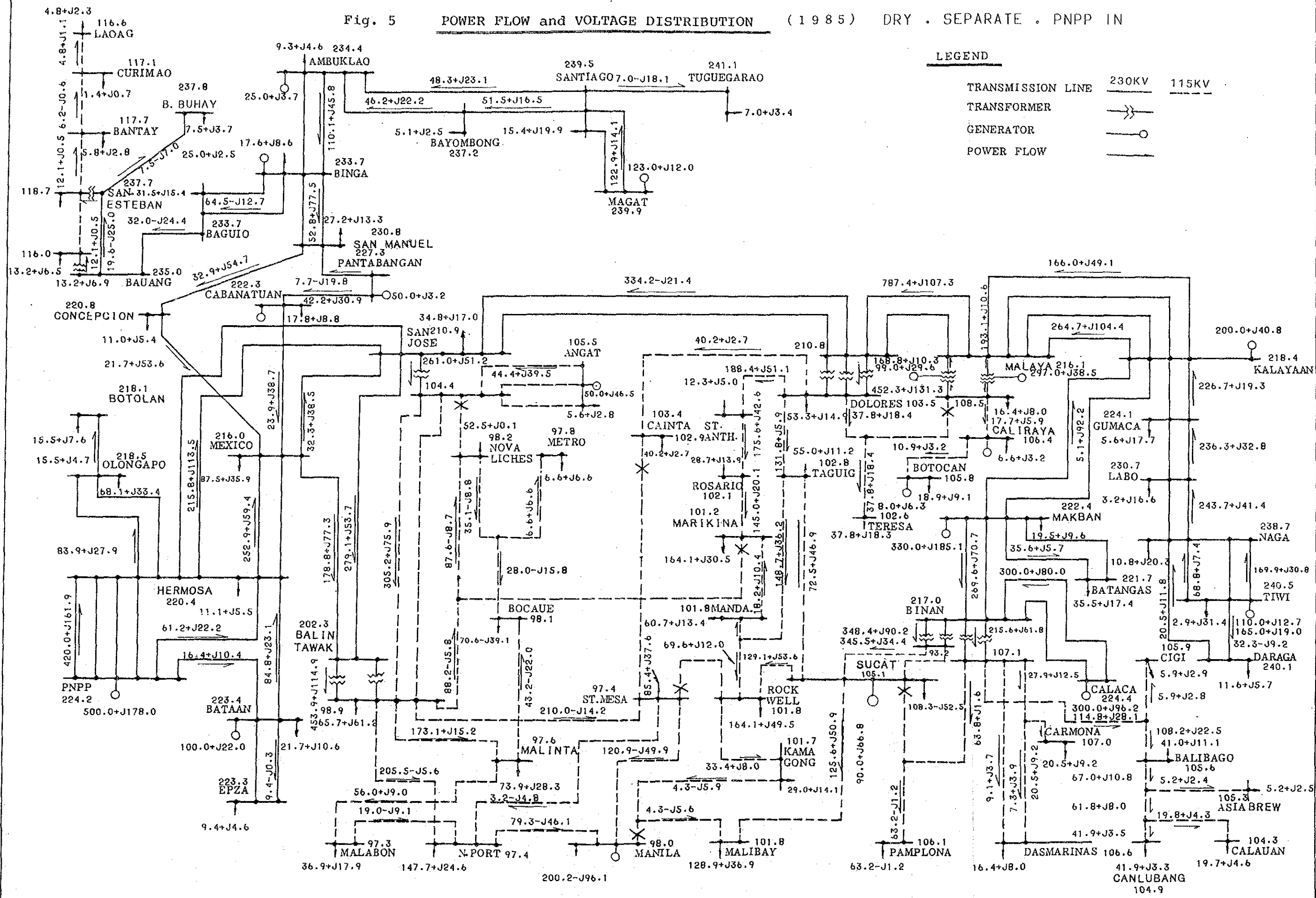
Fig. 4 POWER FLOW and VOLTAGE DISTRIBUTION (1985) DRY . LOOP . PNPP IN



LEGEND

TRANSMISSION LINE	230KV	115KV
TRANSFORMER	[Symbol]	
GENERATOR	[Symbol]	
POWER FLOW	[Symbol]	

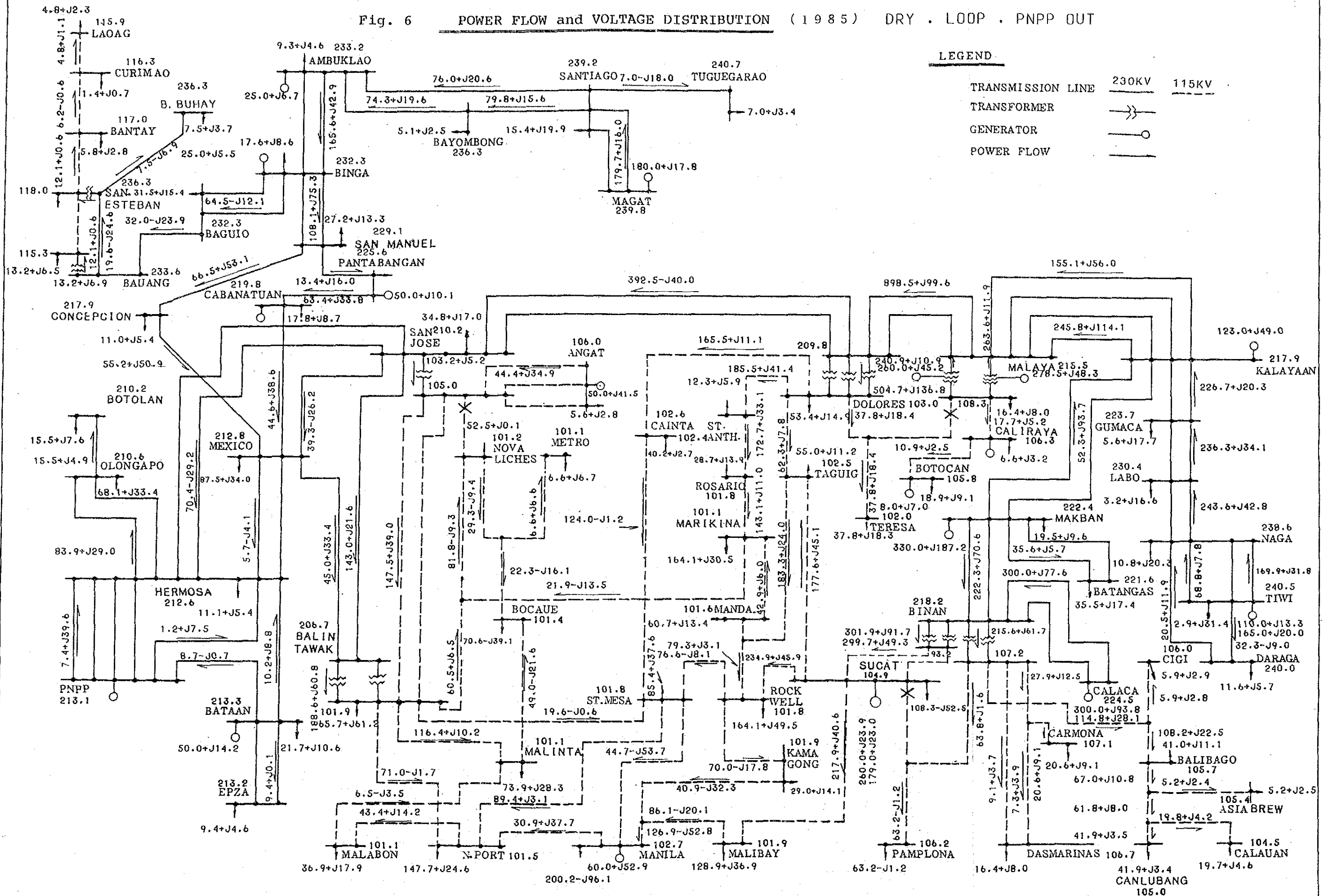
Fig. 5 POWER FLOW and VOLTAGE DISTRIBUTION (1985) DRY . SEPARATE . PNPP IN



LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER
- GENERATOR
- POWER FLOW

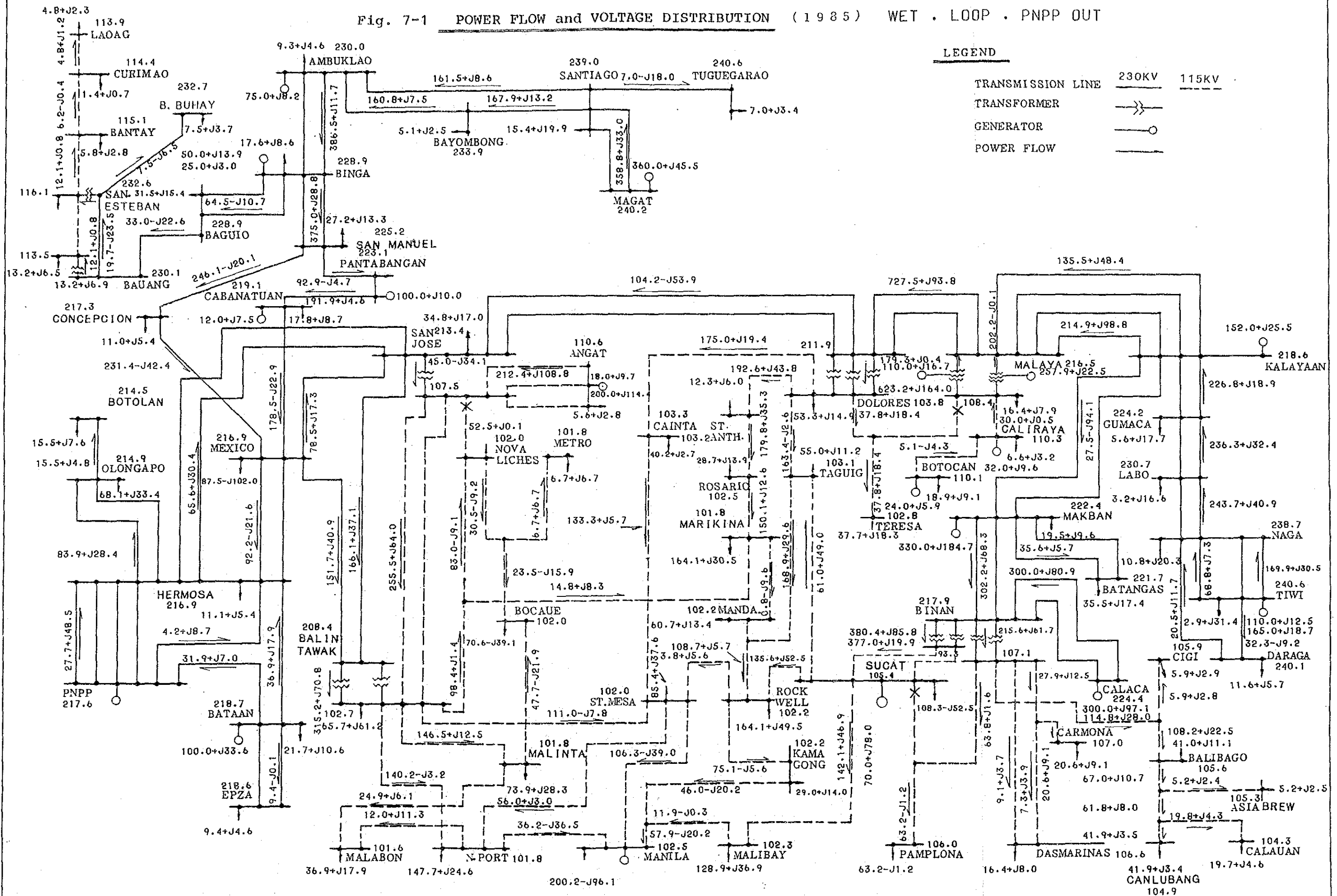
Fig. 6 POWER FLOW and VOLTAGE DISTRIBUTION (1985) DRY . LOOP . PNPP OUT



LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER ⏏
- GENERATOR ⊙
- POWER FLOW →

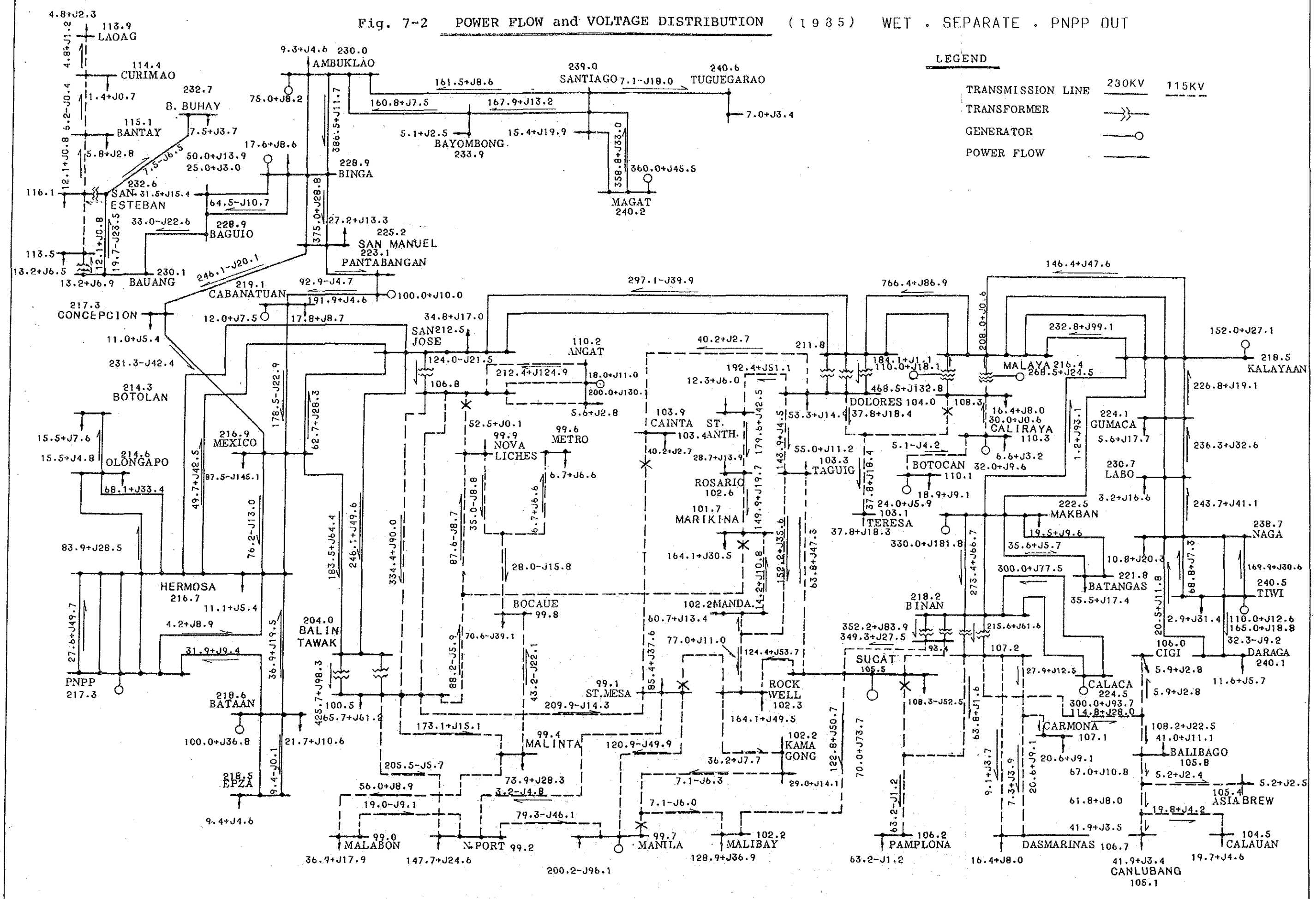
Fig. 7-1 POWER FLOW and VOLTAGE DISTRIBUTION (1985) WET . LOOP . PNPP OUT



LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER
- GENERATOR
- POWER FLOW

Fig. 7-2 POWER FLOW and VOLTAGE DISTRIBUTION (1985) WET . SEPARATE . PNPP OUT



LEGEND

TRANSMISSION LINE	230KV	115KV
TRANSFORMER		
GENERATOR		
POWER FLOW		

Fig. 8 POWER FLOW and VOLTAGE DISTRIBUTION (1987) WET . LOOP . PNPP IN

LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER
- GENERATOR
- POWER FLOW

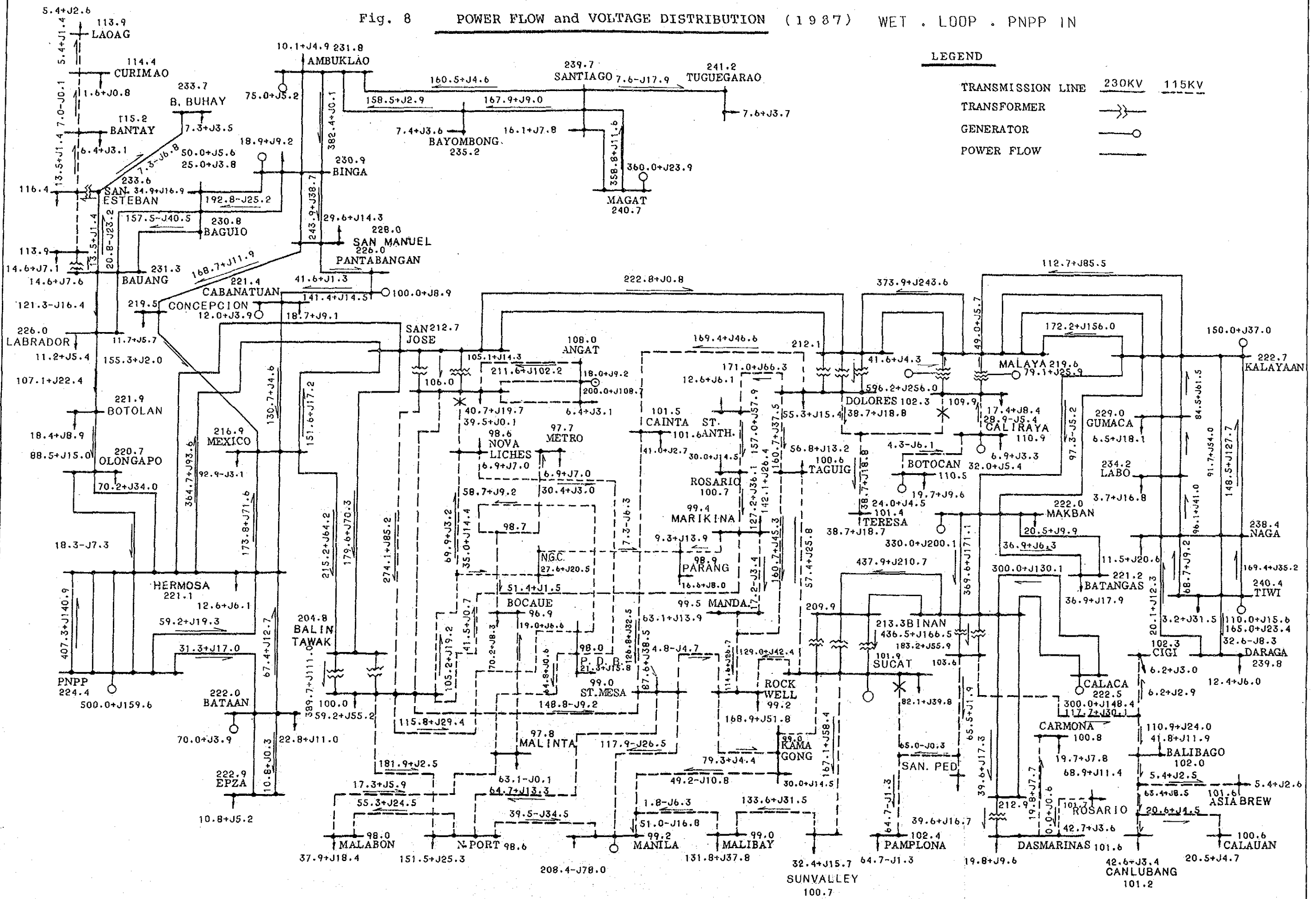


Fig. 10-2 POWER FLOW and VOLTAGE DISTRIBUTION (1987) DRY . LOOP . PNPP IN

LEGEND

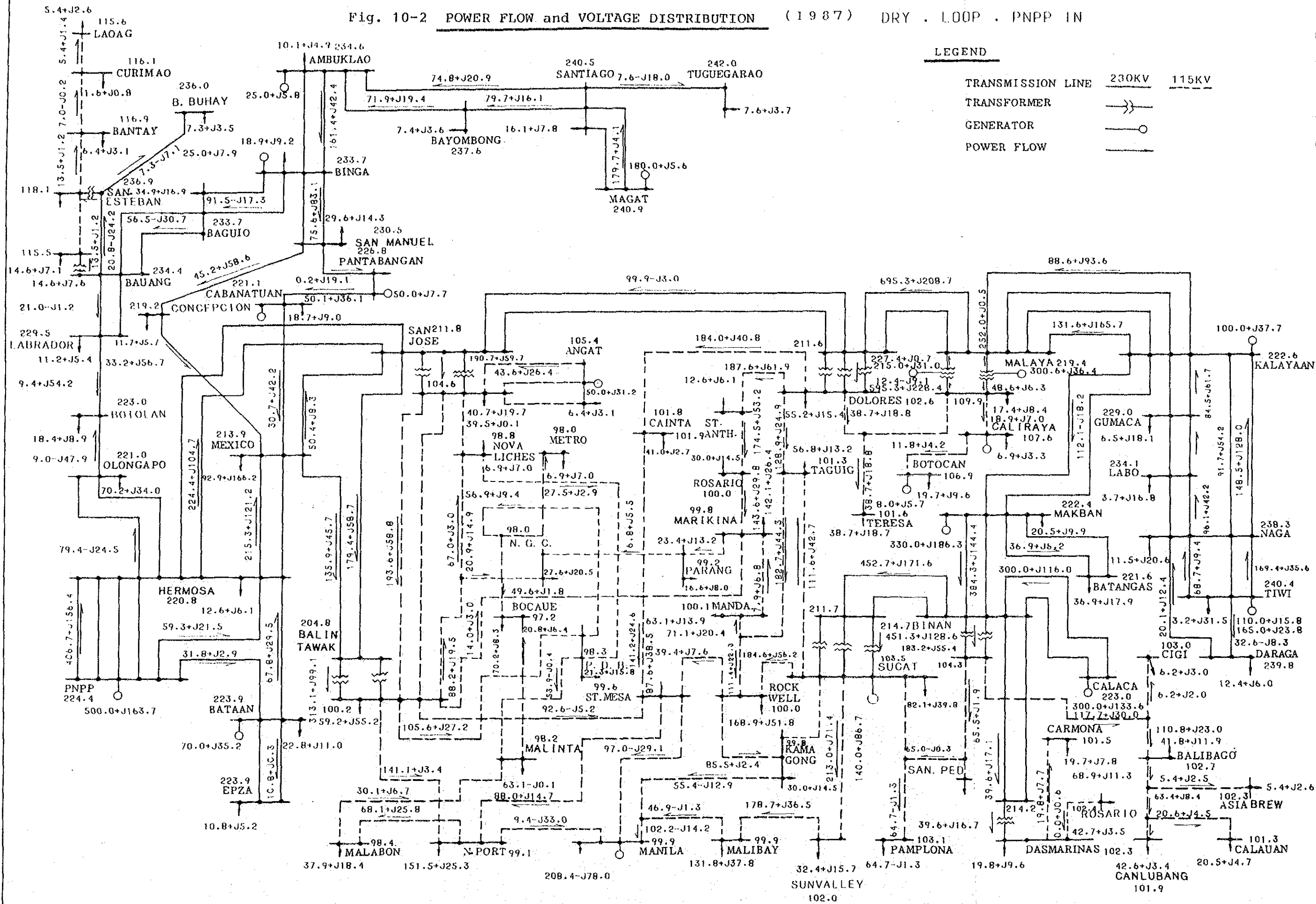
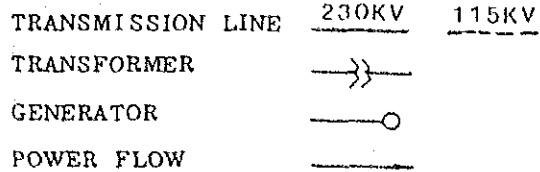
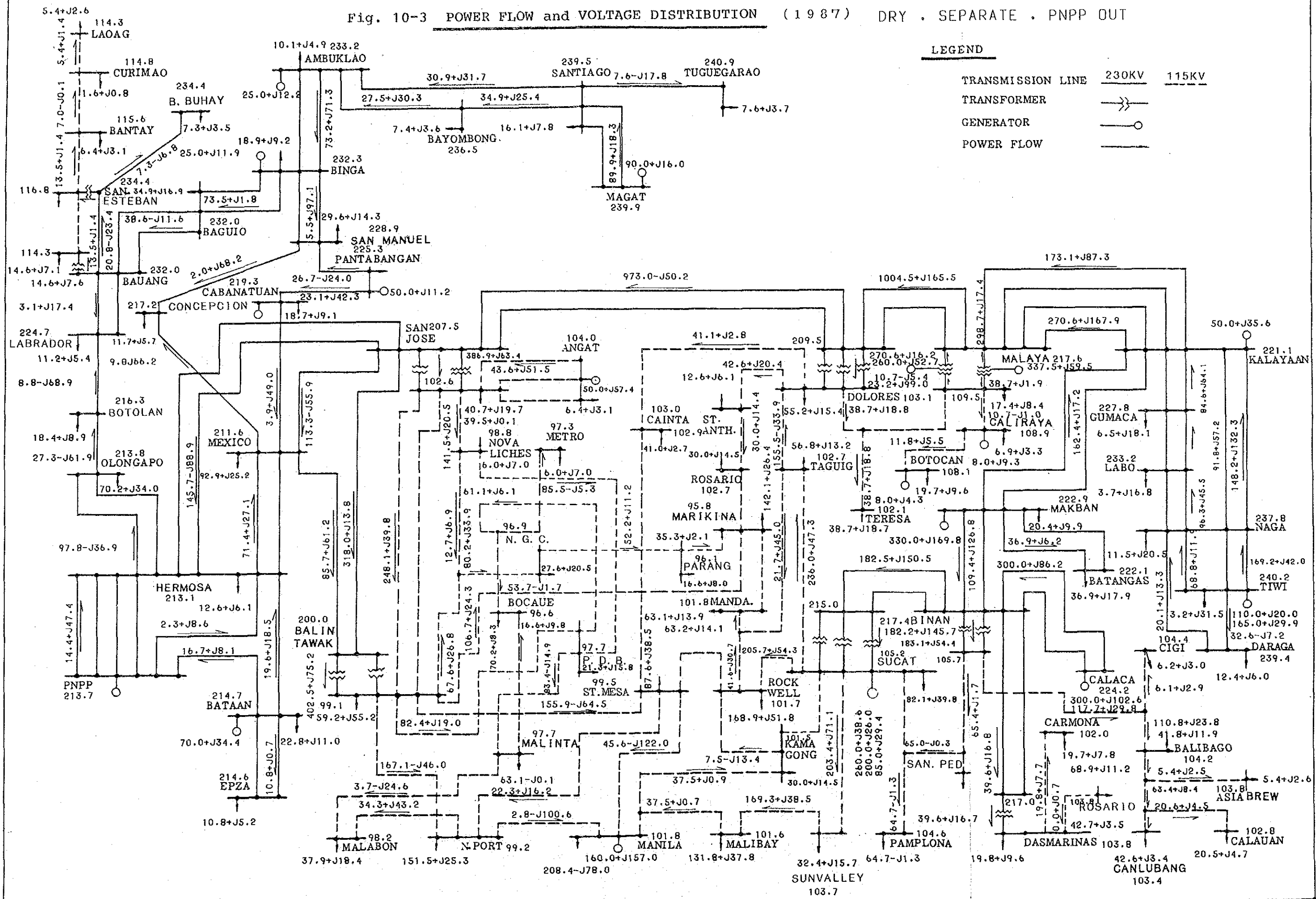


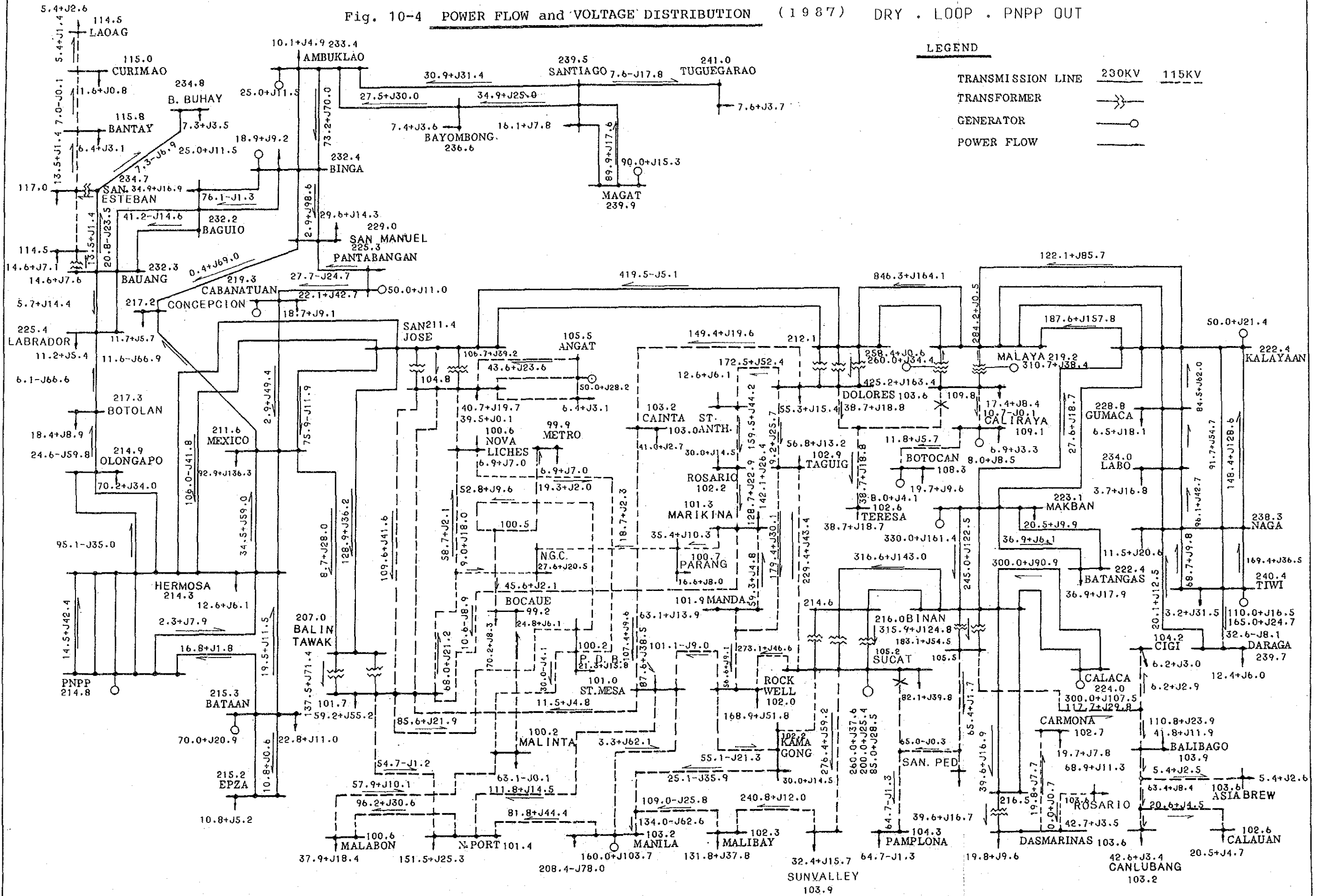
Fig. 10-3 POWER FLOW and VOLTAGE DISTRIBUTION (1987) DRY, SEPARATE, PNPP OUT



LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER ↔
- GENERATOR ○
- POWER FLOW →

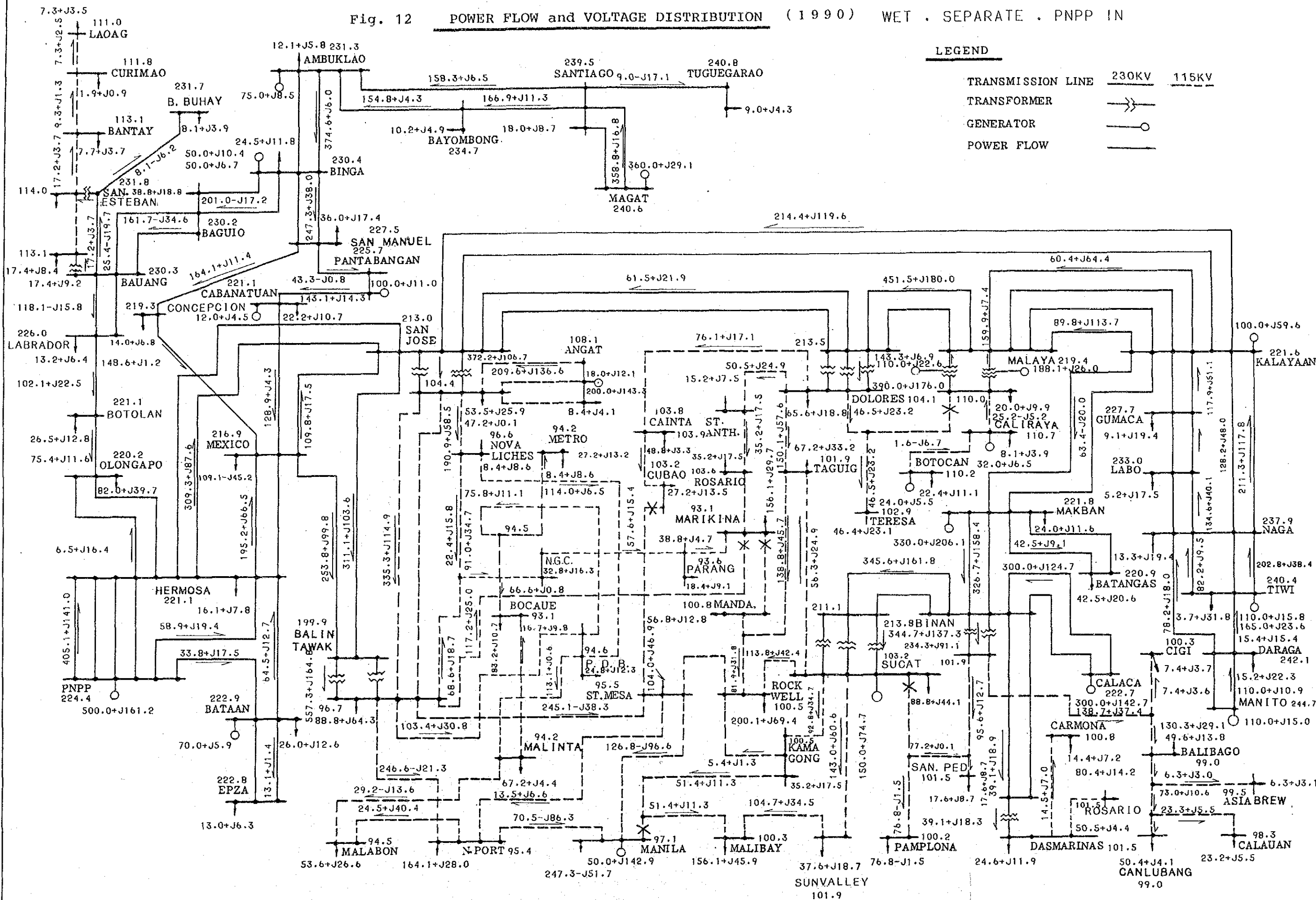
Fig. 10-4 POWER FLOW and VOLTAGE DISTRIBUTION (1987) DRY . LOOP . PNPP OUT



LEGEND

- TRANSMISSION LINE 230KV 115KV
- TRANSFORMER ↔
- GENERATOR ○
- POWER FLOW →

Fig. 12 POWER FLOW and VOLTAGE DISTRIBUTION (1990) WET . SEPARATE . PNPP IN



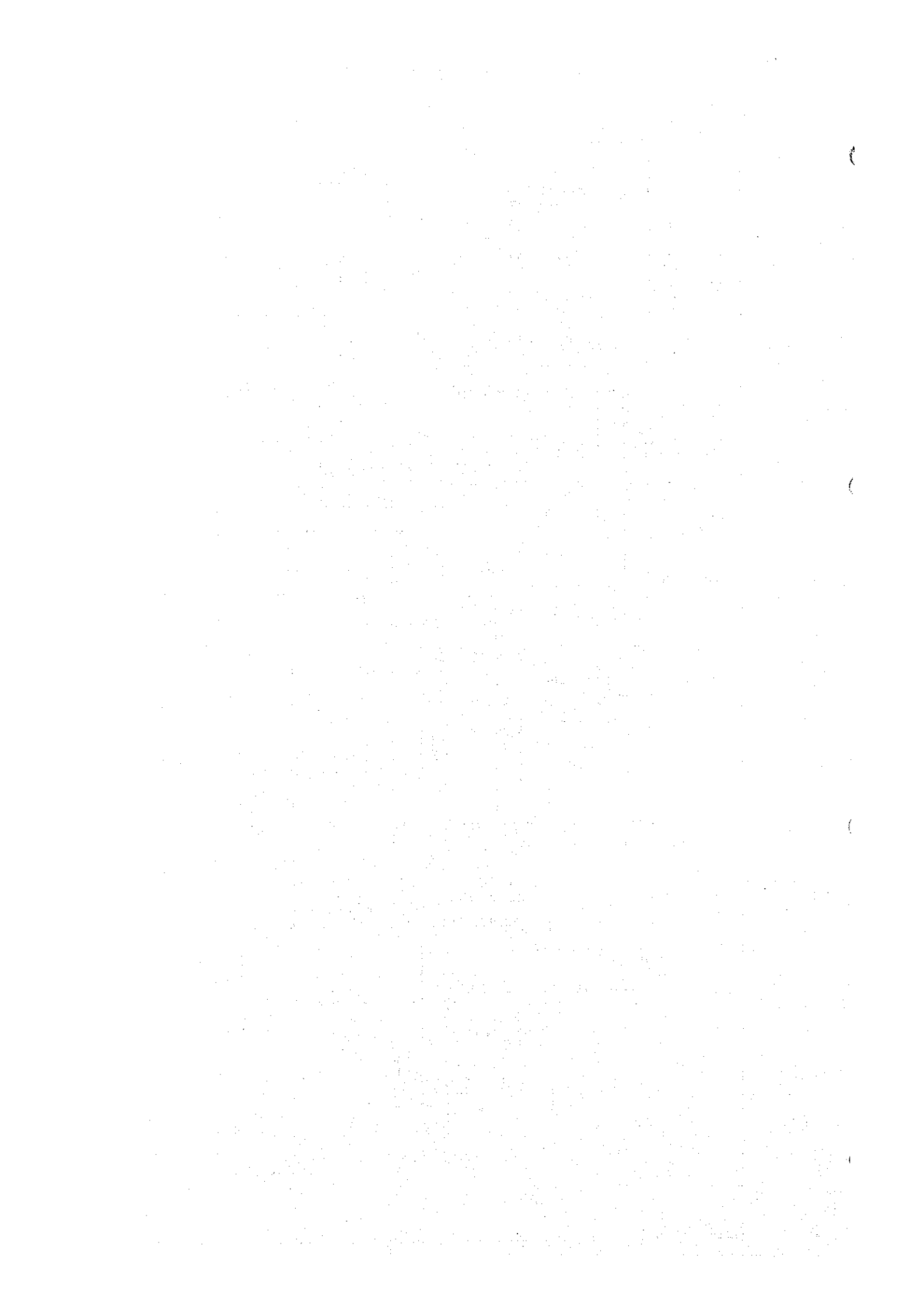


FIG. 13 '05 WET KALAYAAN-OUMACA 3LD OPEN LOOP.

CASE 1

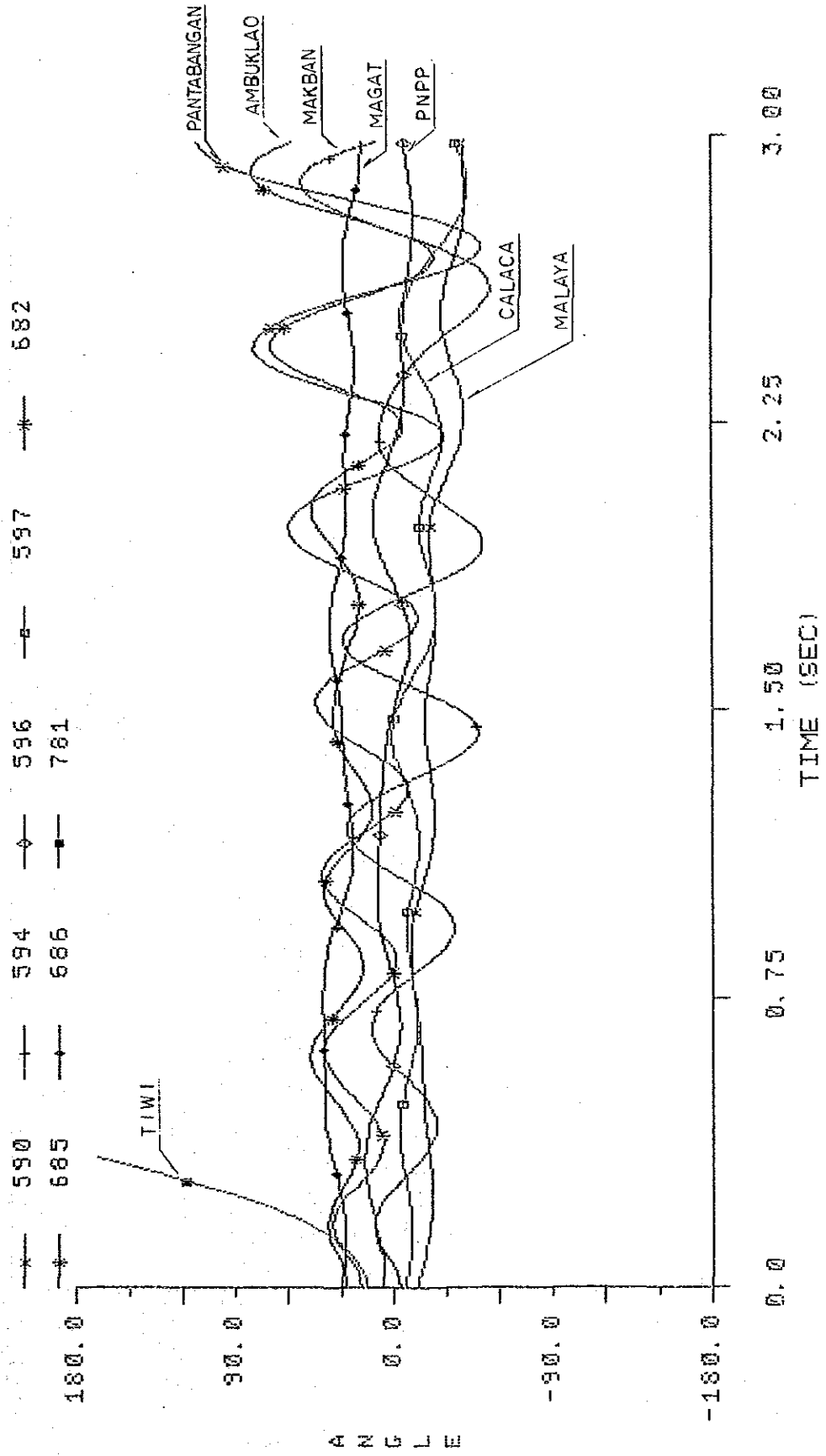


FIG. 14 '05 WET SANMANUEL CONCEPTION FAULT LOOP.

CASE 2

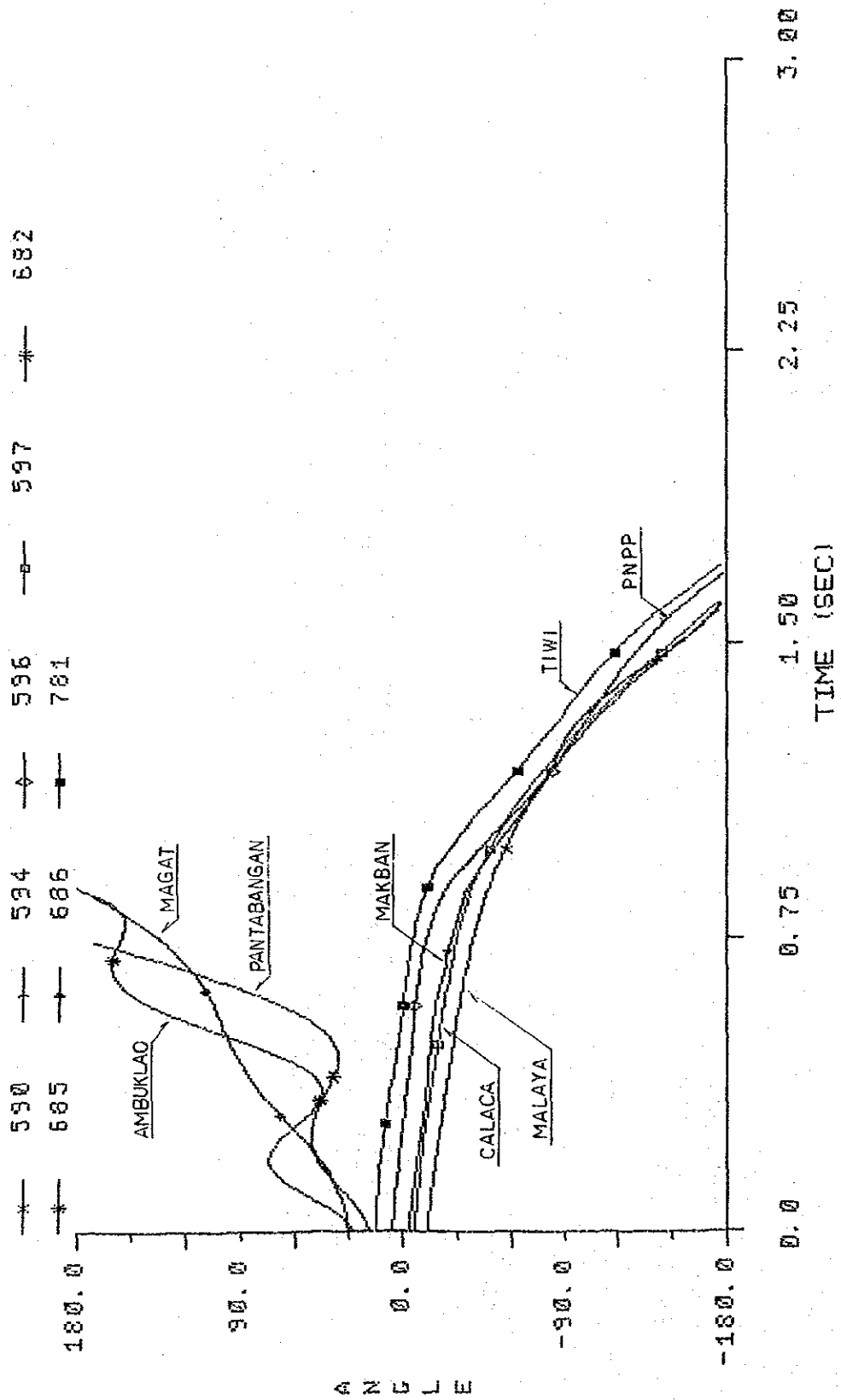


FIG. 15 '05 WET HERMOSA SANJOSE FAULT LOOP.

CASE 3

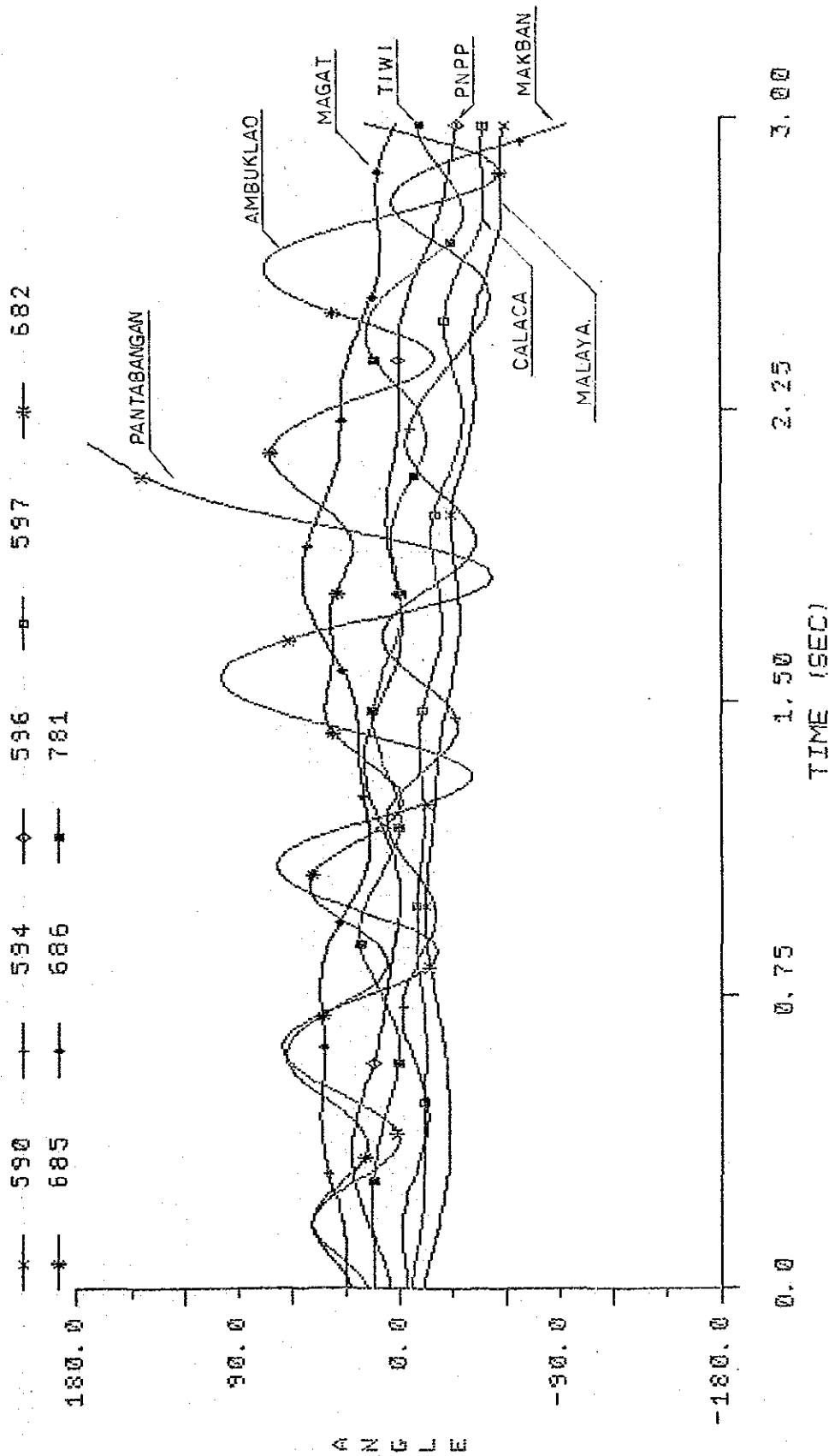


FIG. 16 '85 WET SANJOSE DOLORES FAULT LOOP.

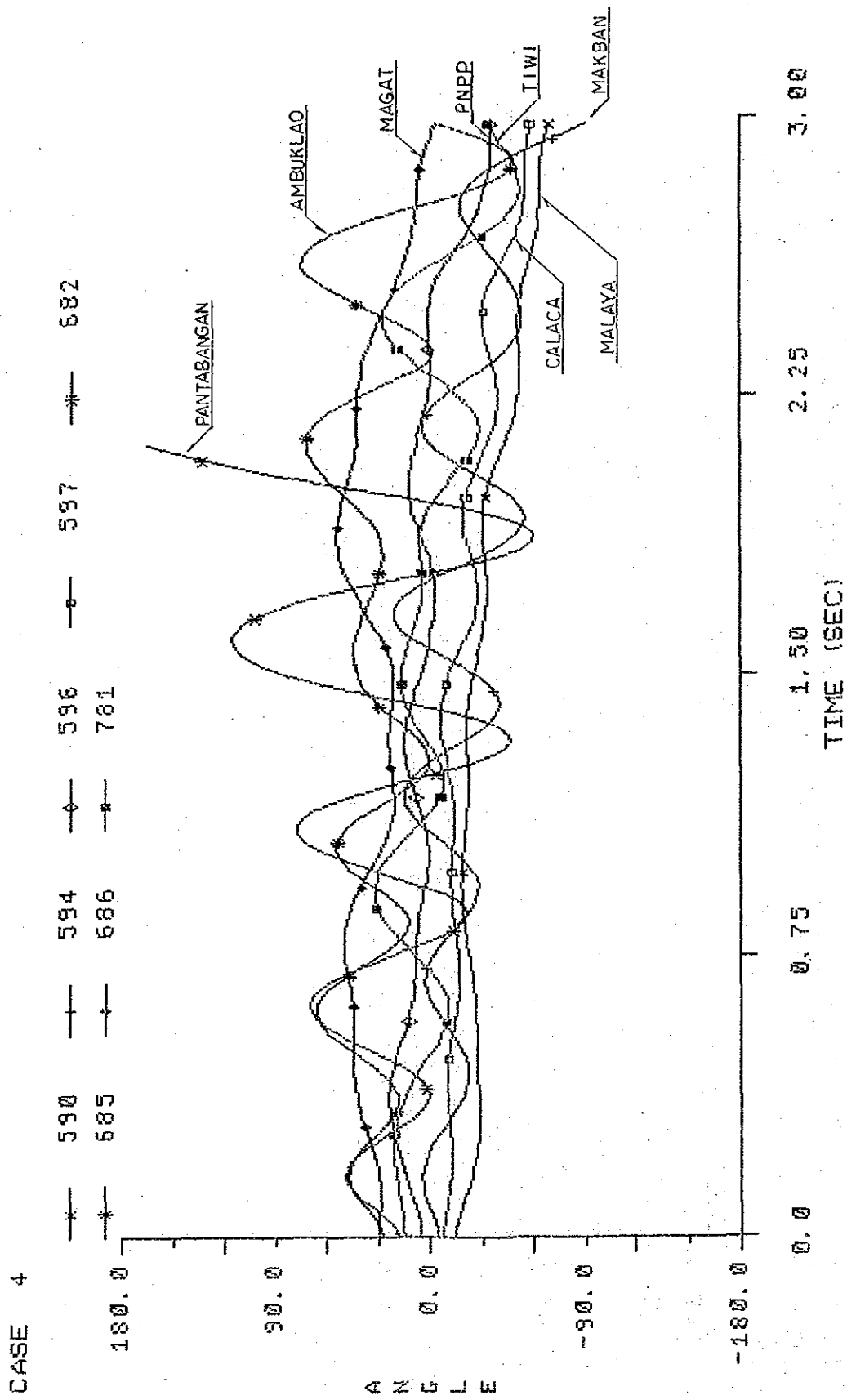


FIG. 17 '05 WET DOLDRES MALAYA FAULT LOOP.

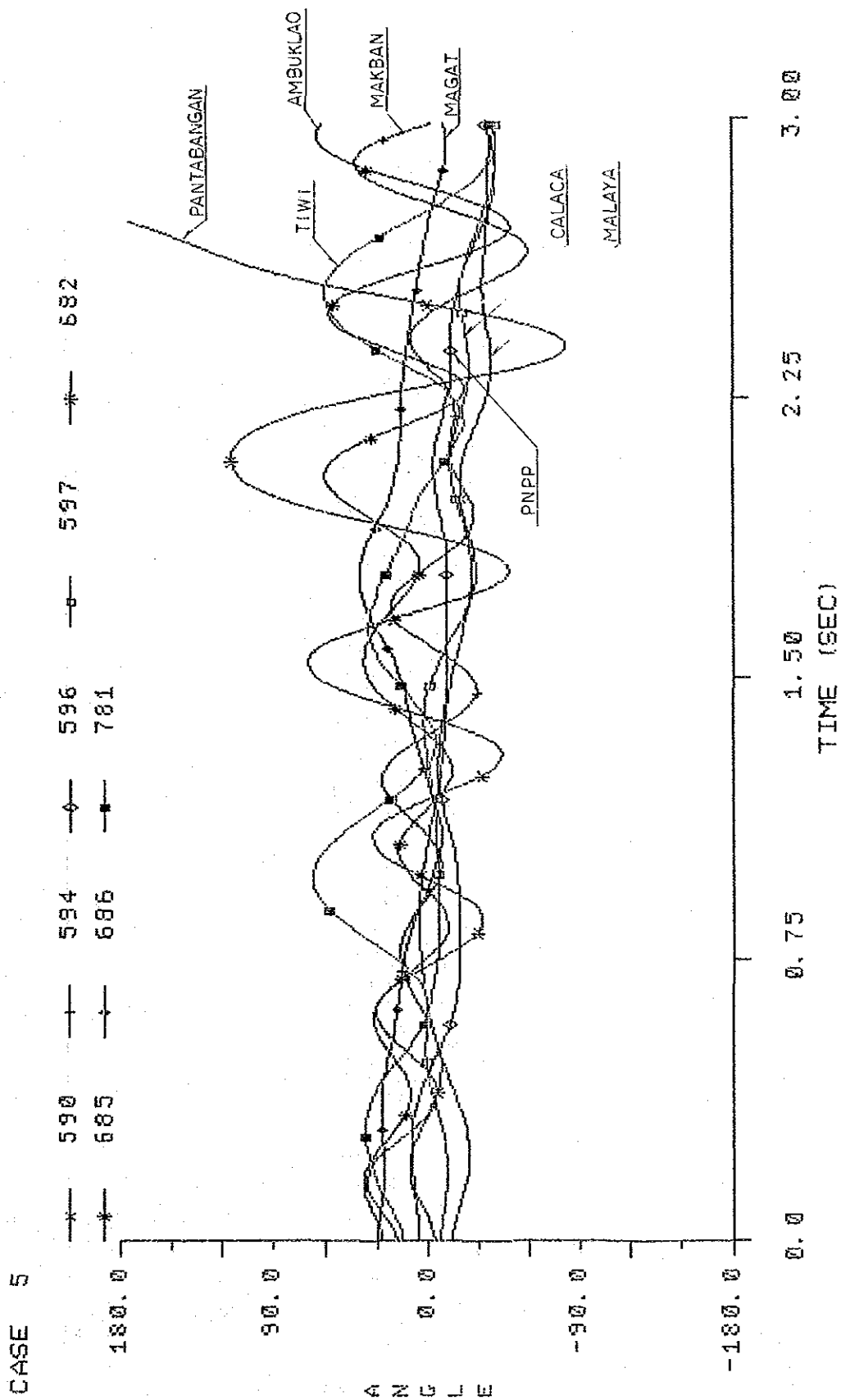


FIG.18 '85 WET KALAYAN-0UMACA 3L0 OPEN

CASE 1

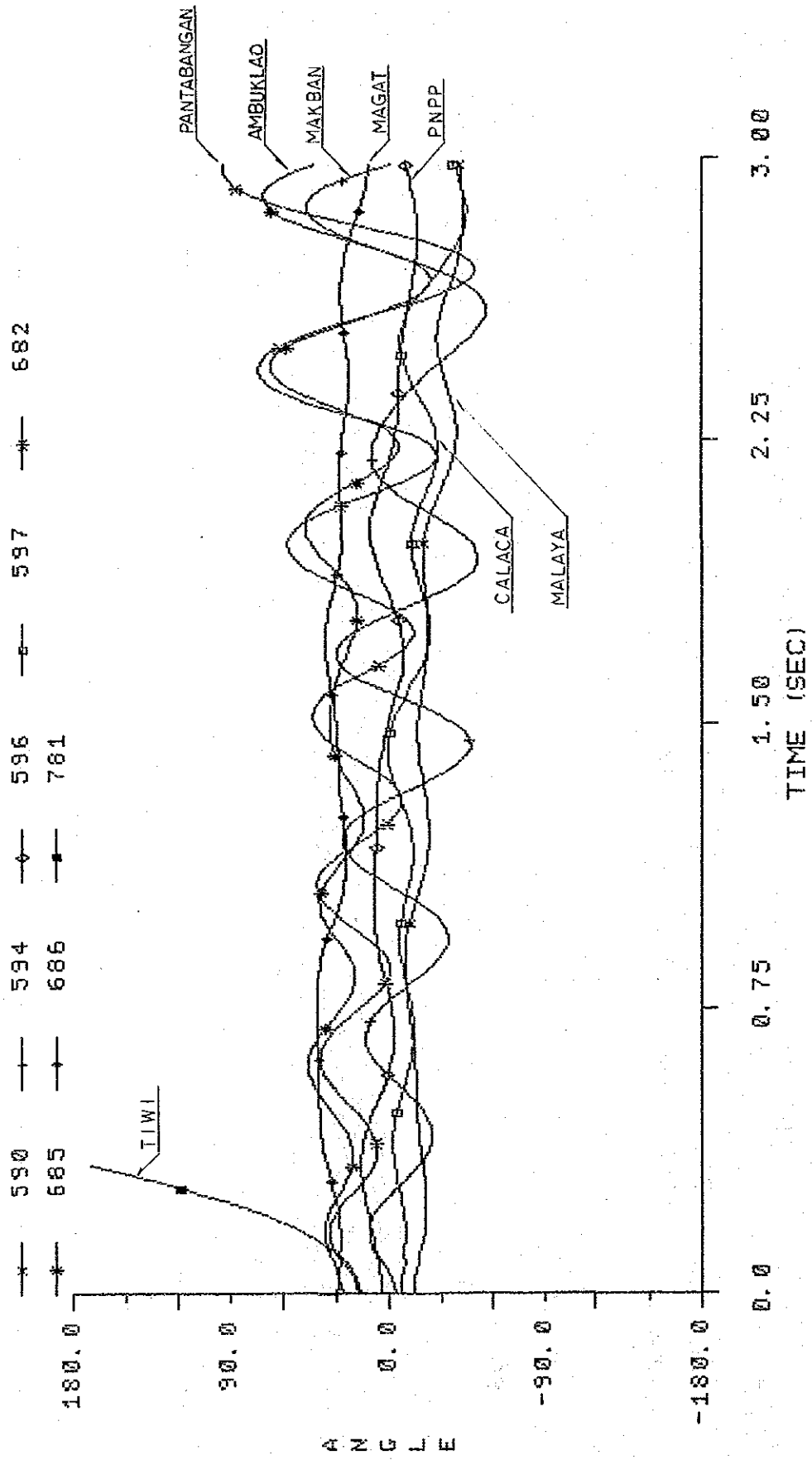


FIG. 19 '85 WET SAN. MANUEL CONCEPTION FAULT

CASE 2

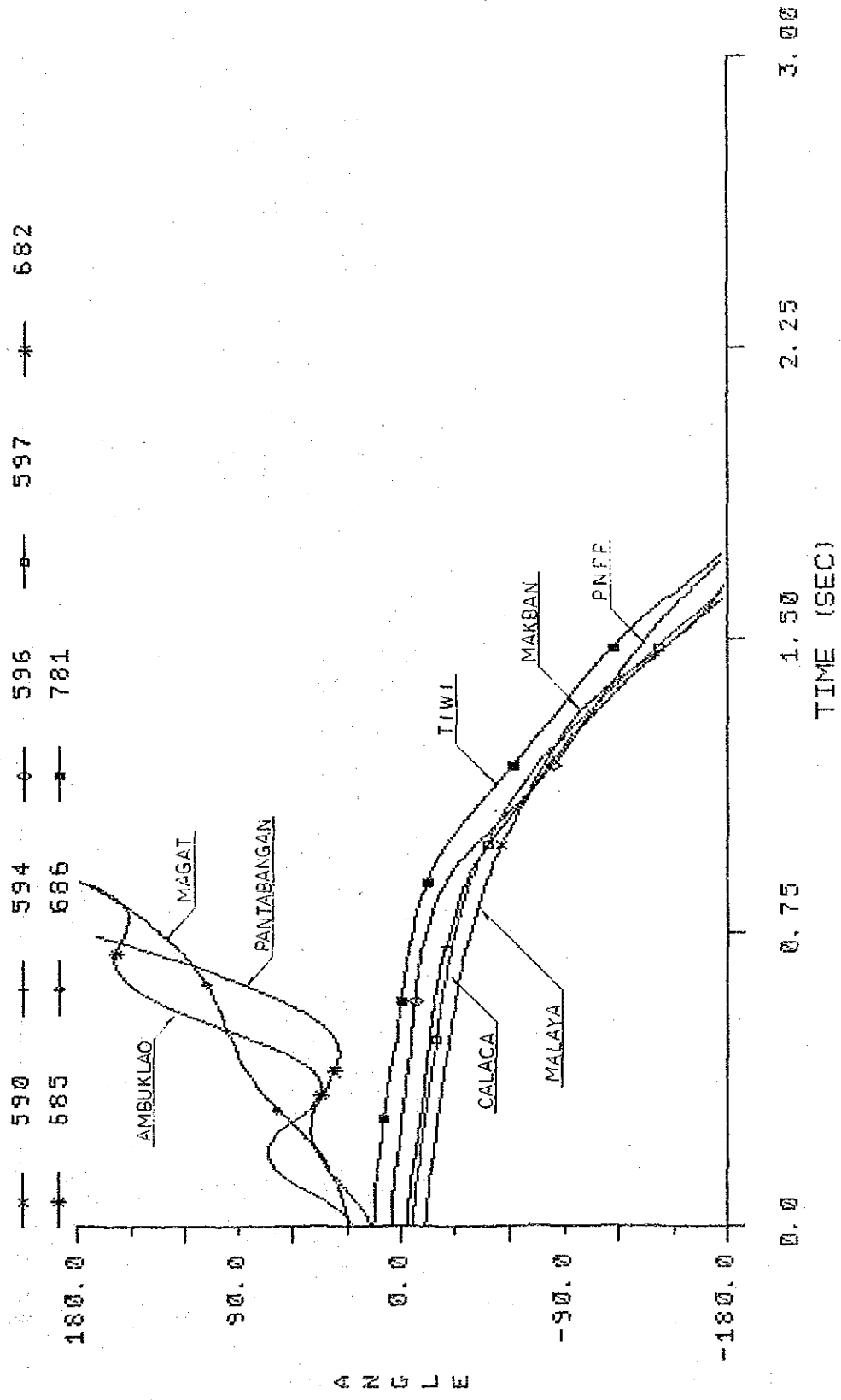


FIG. 20 '05 WET HERMOSA SANJOSE FAULT

CASE 3

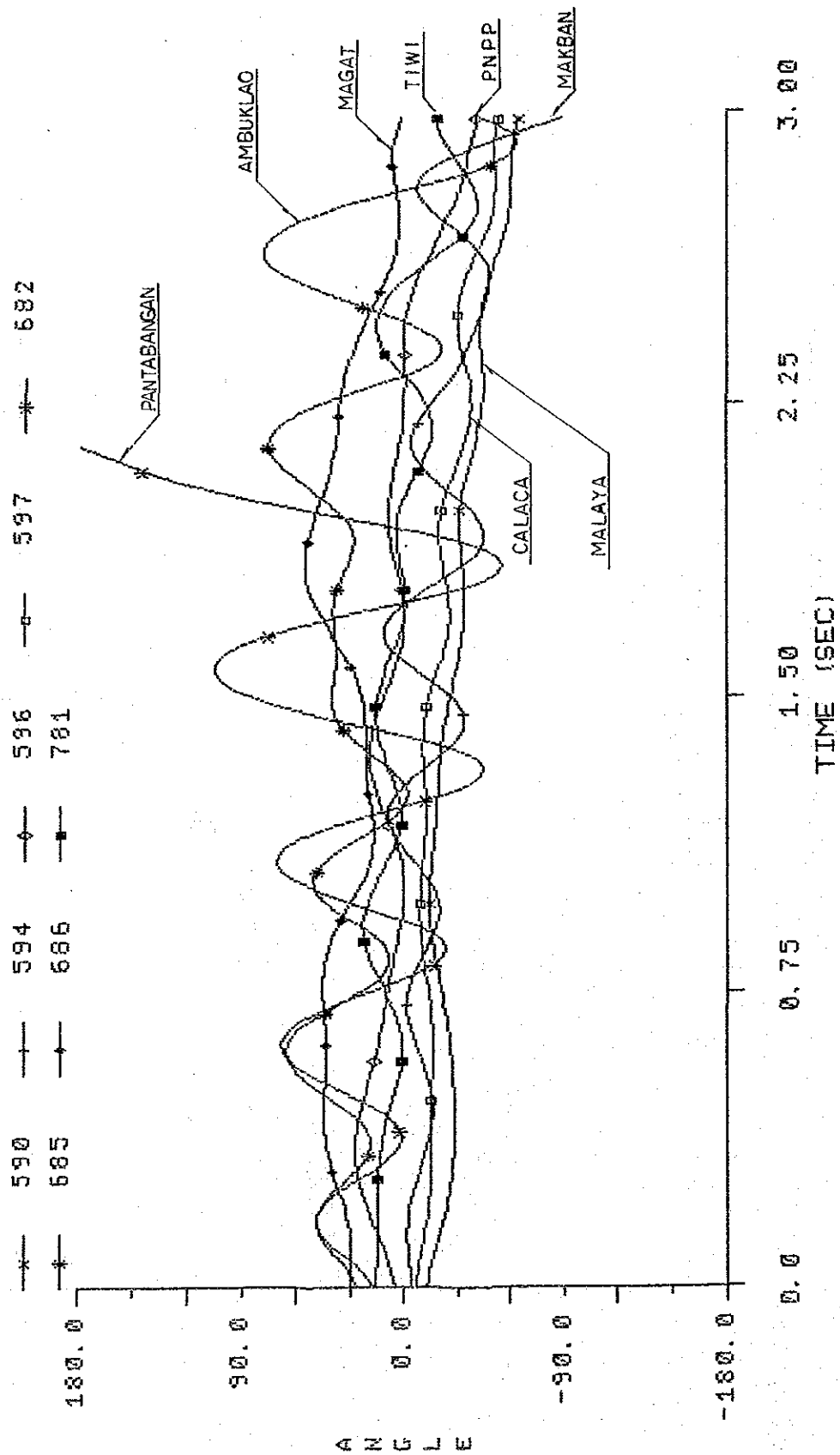


FIG. 21 '85 WET SANJOSE DOLORES FAULT

CASE 4

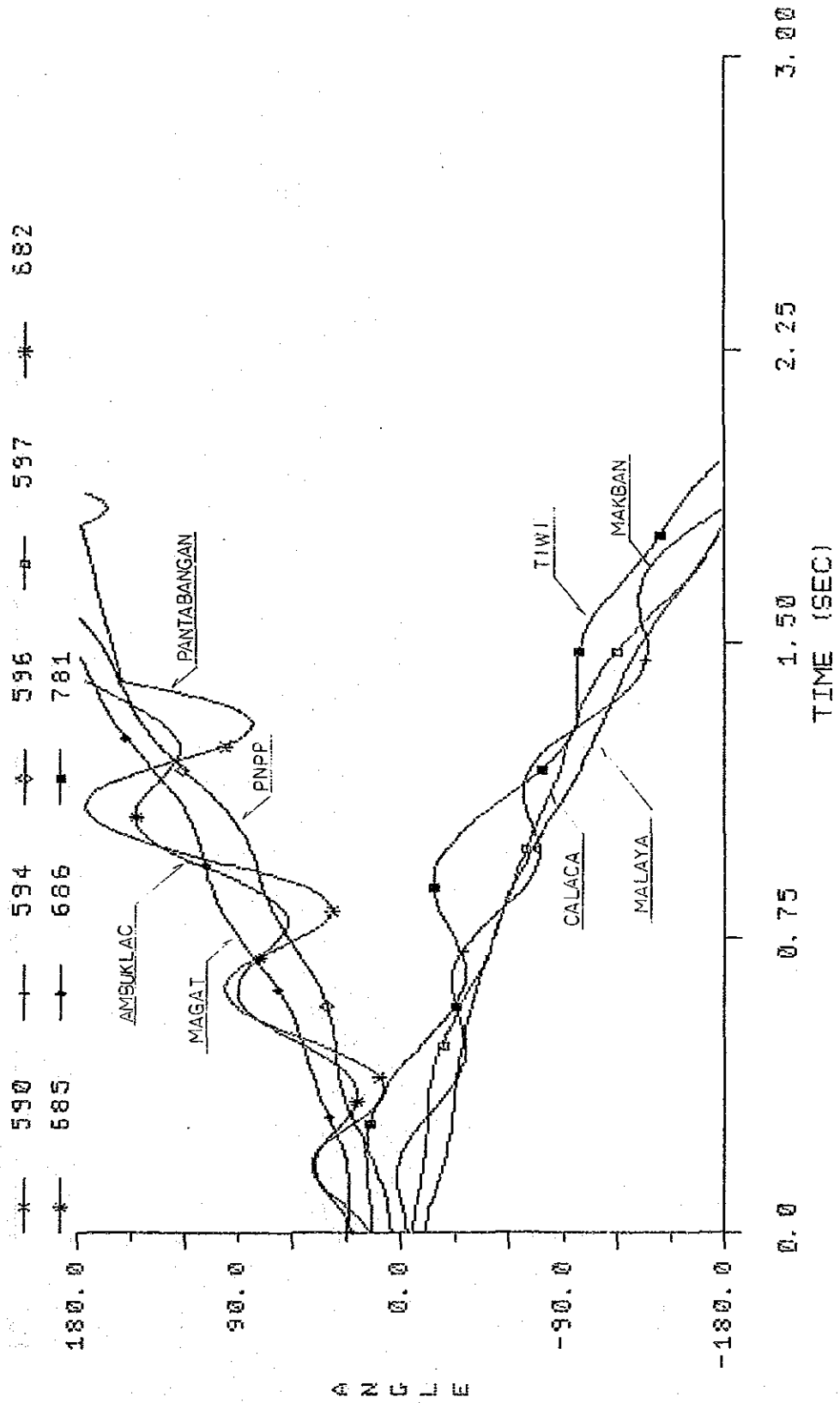


FIG. 22 '05 WET DOLORES MALAYA FAULT

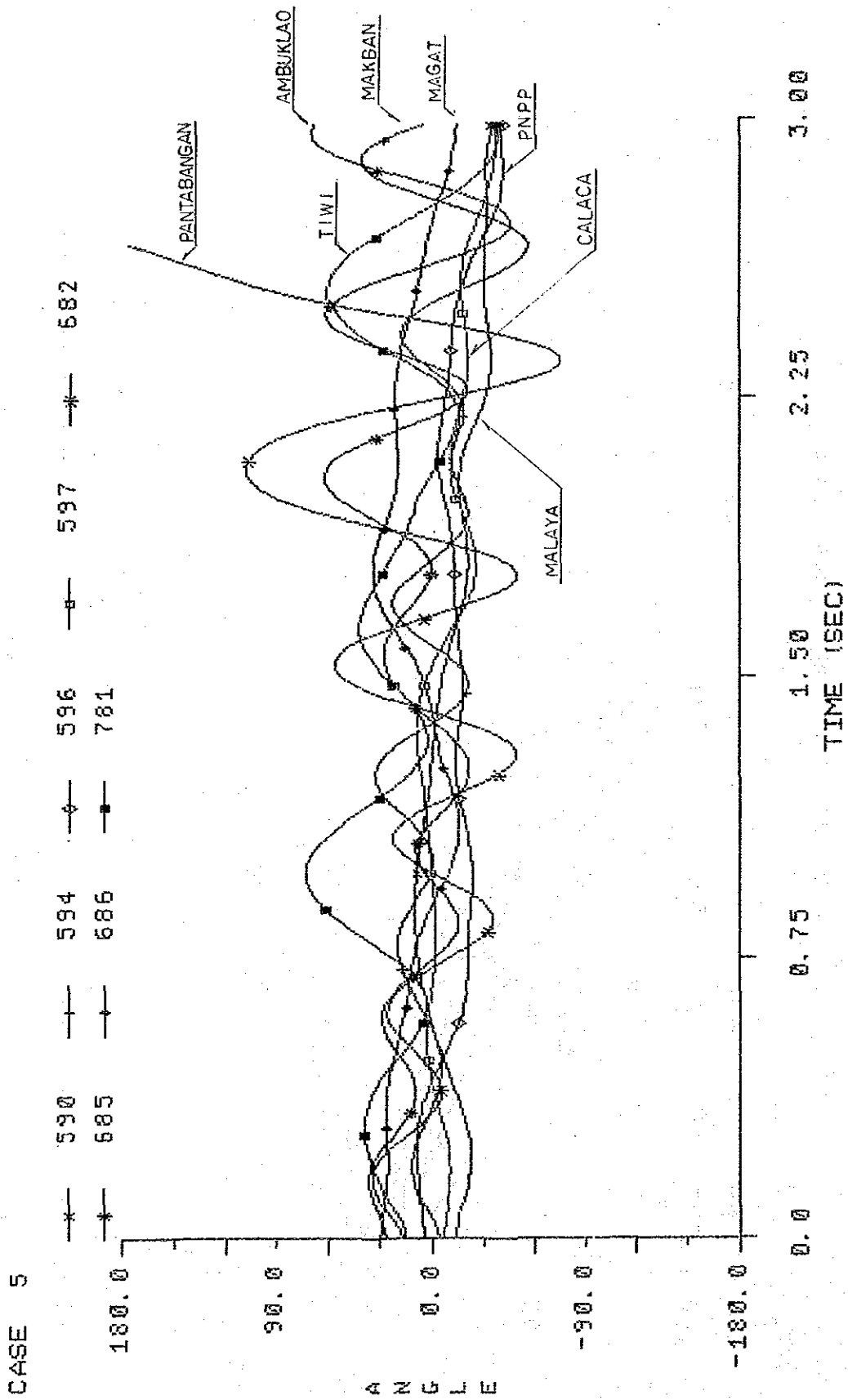


FIG. 23 '85 DRY KALAYAN-GUMACA 3LG OPEN LOOP.

CASE 1

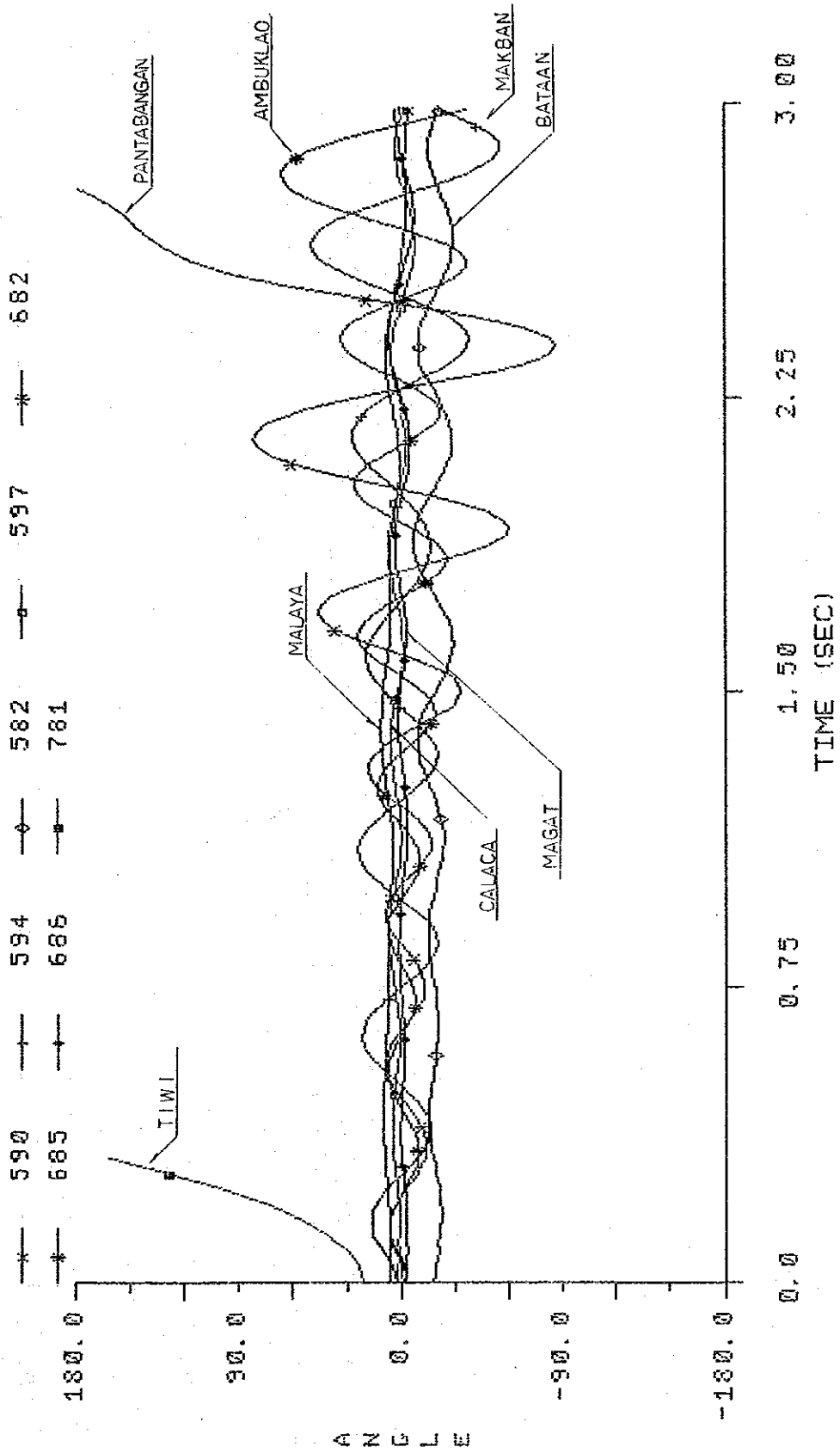


FIG. 24 '85 DRY SANMANUEL CONCEPTION FAULT LOOP.

CASE 2

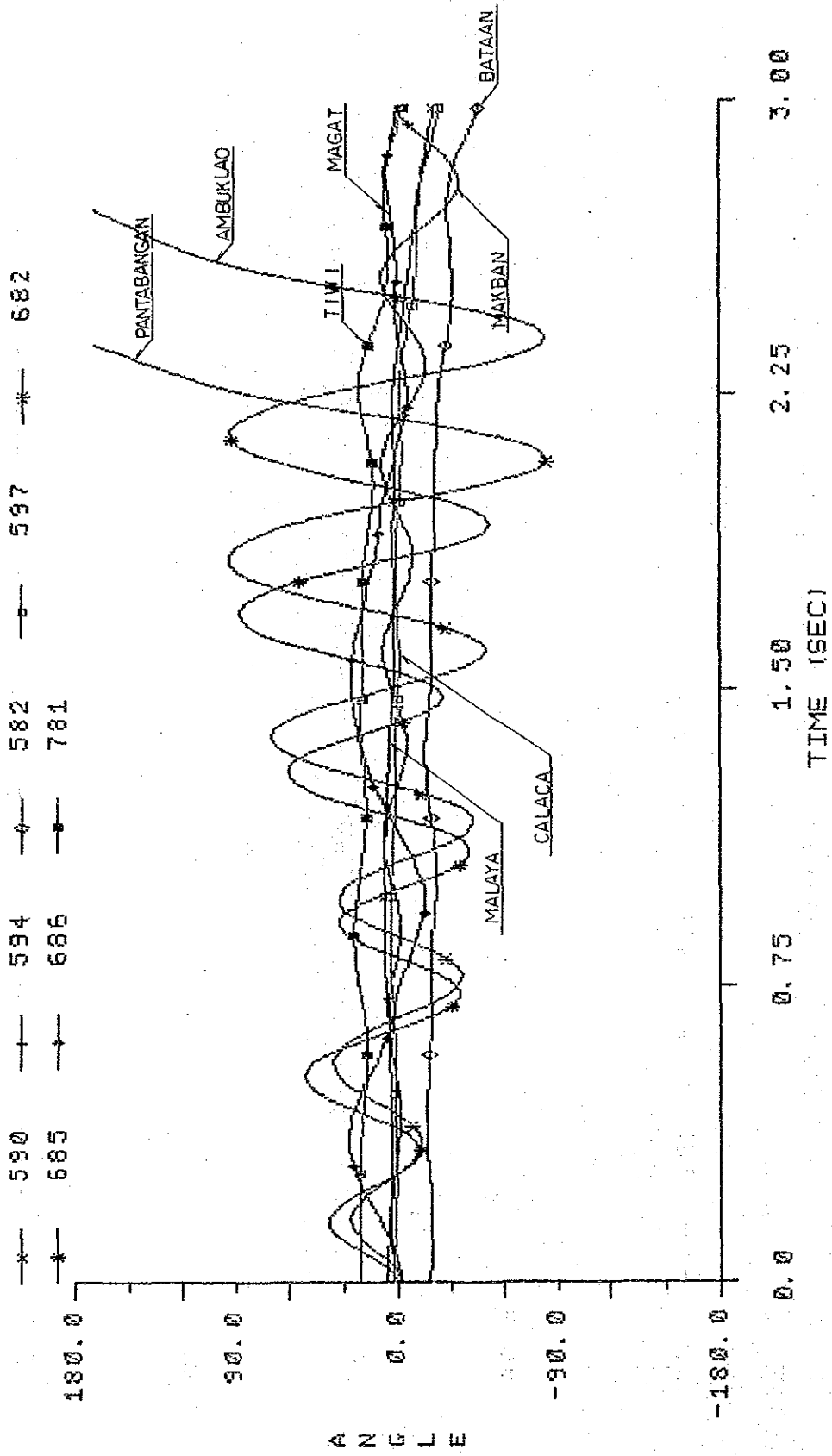


FIG. 25 '05 DRY HERMOSA SANJOSE FAULT LOOP.

CASE 3

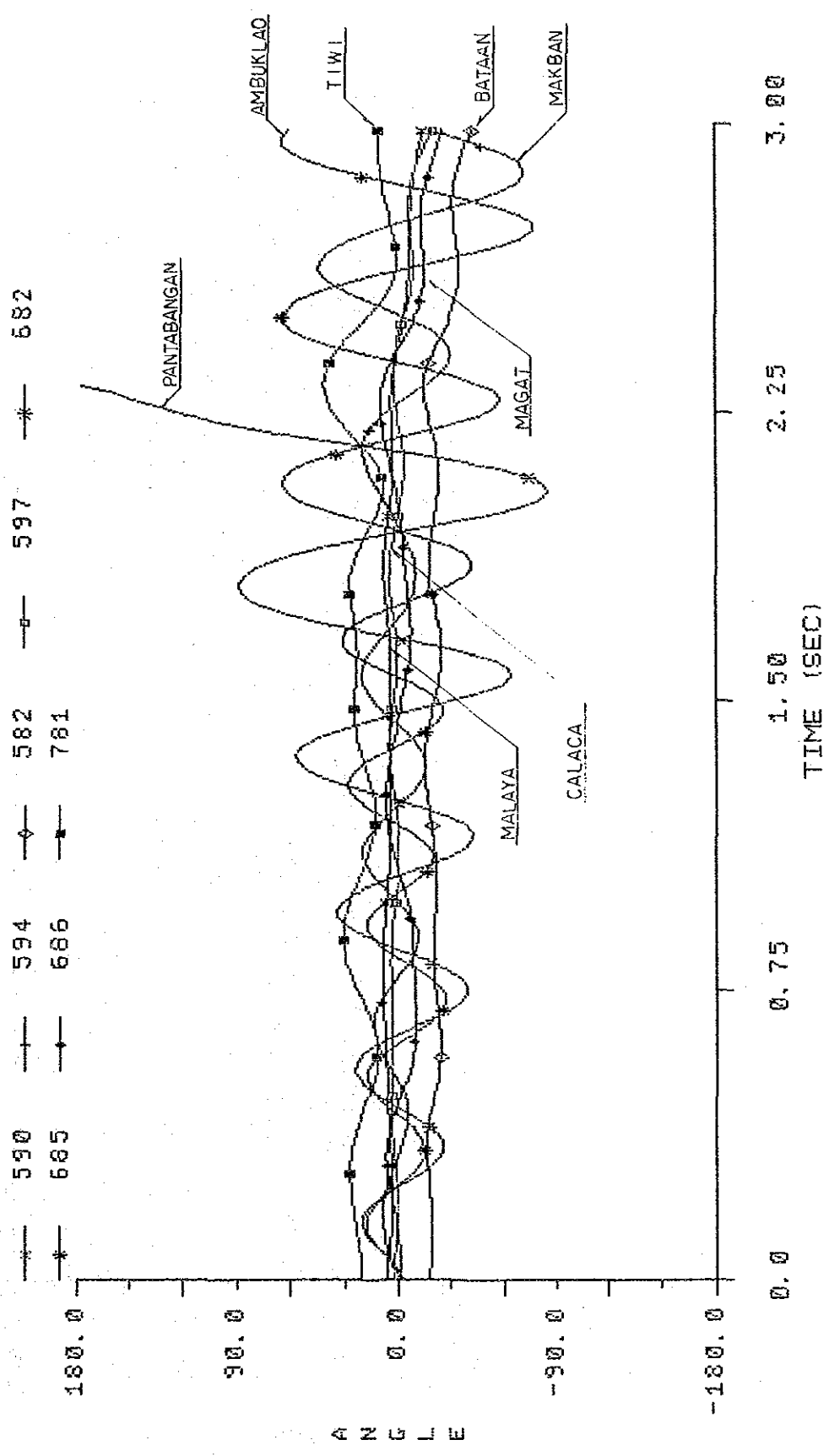


FIG. 26 '05 DRY SANJOSE DOLORES FAULT LOOP.

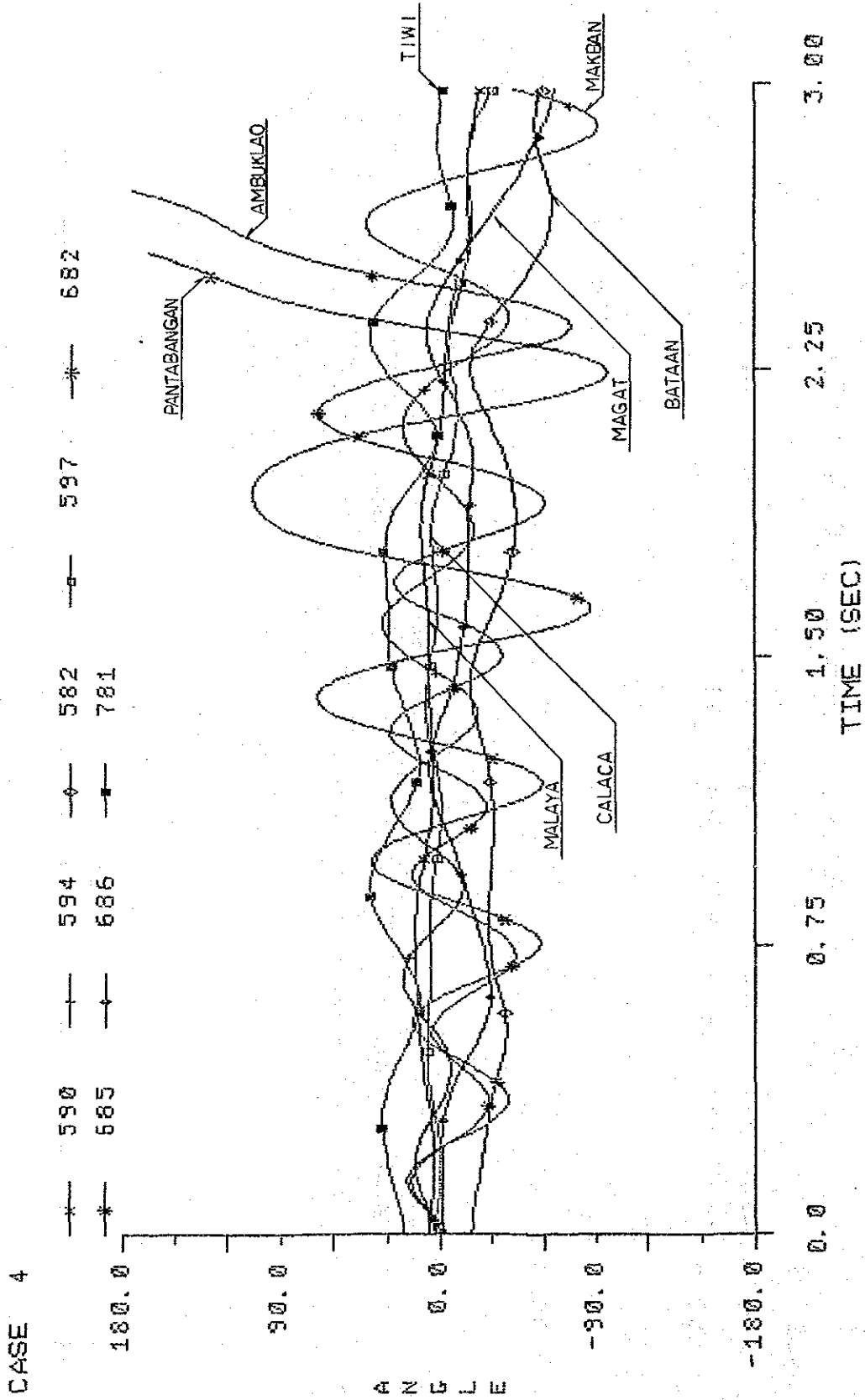


FIG. 27 '65 DRY DOLORS MALAYA FAULT LOOP

CASE 5

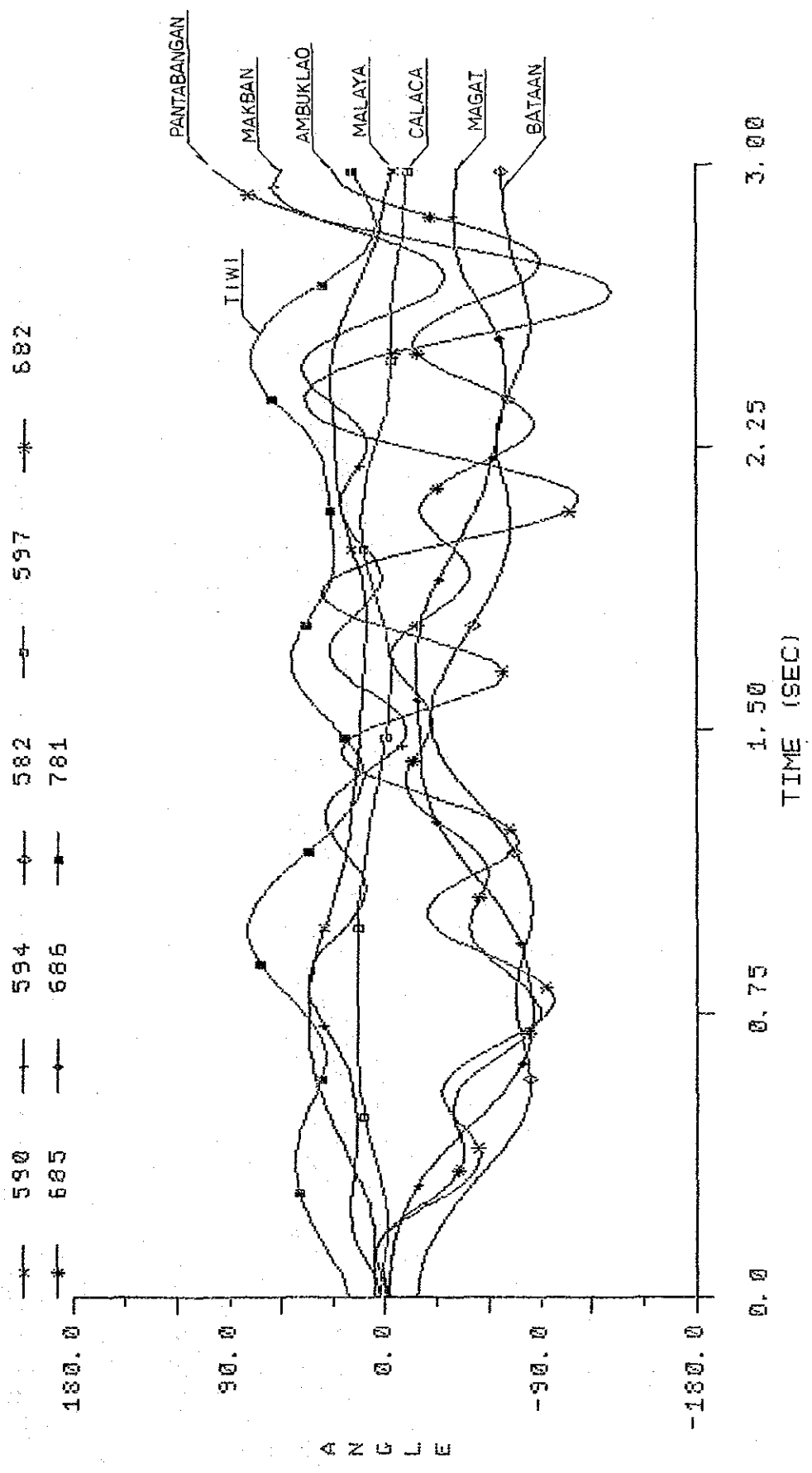


FIG. 28 '07 WET KALAYAAN-BUMACA 3LG OPEN LOOP.

CASE 1

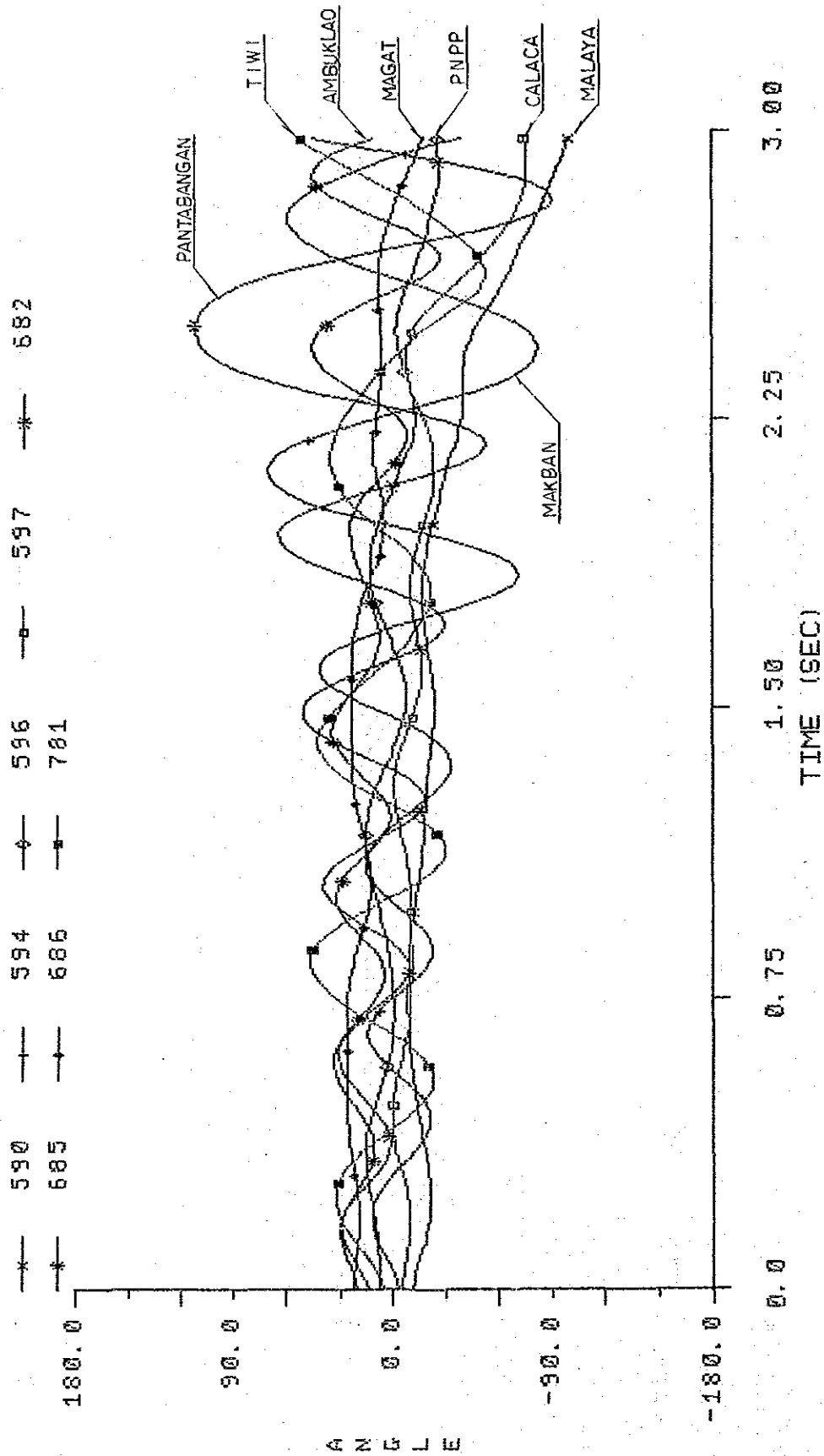


FIG. 29 '07 WET SANMANUEL CONCEPTION FAULT LOOP.

CASE 2

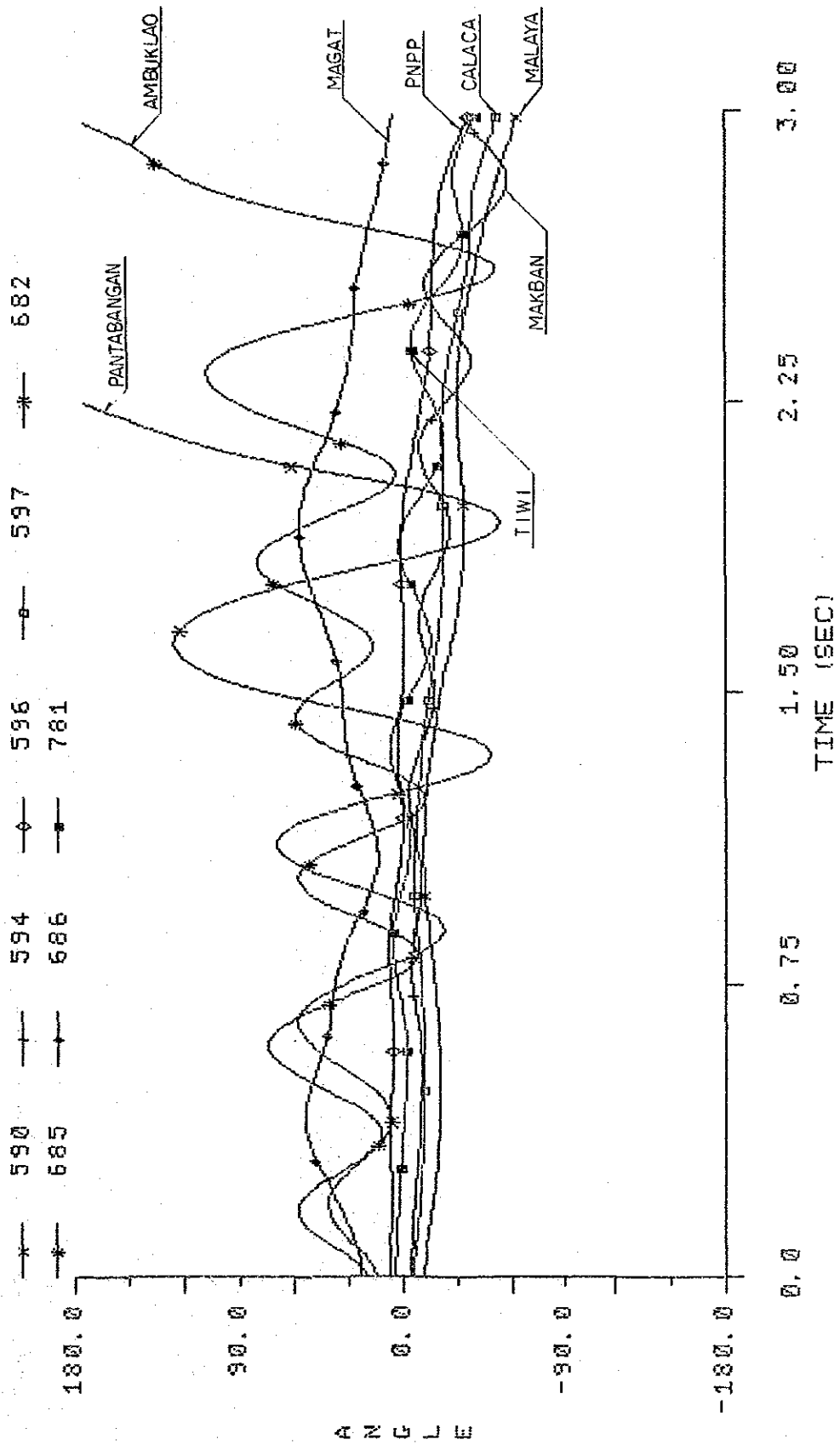


FIG. 30 '87 WET HERMOSA SANJOSE FAULT LOOP.

CASE 3

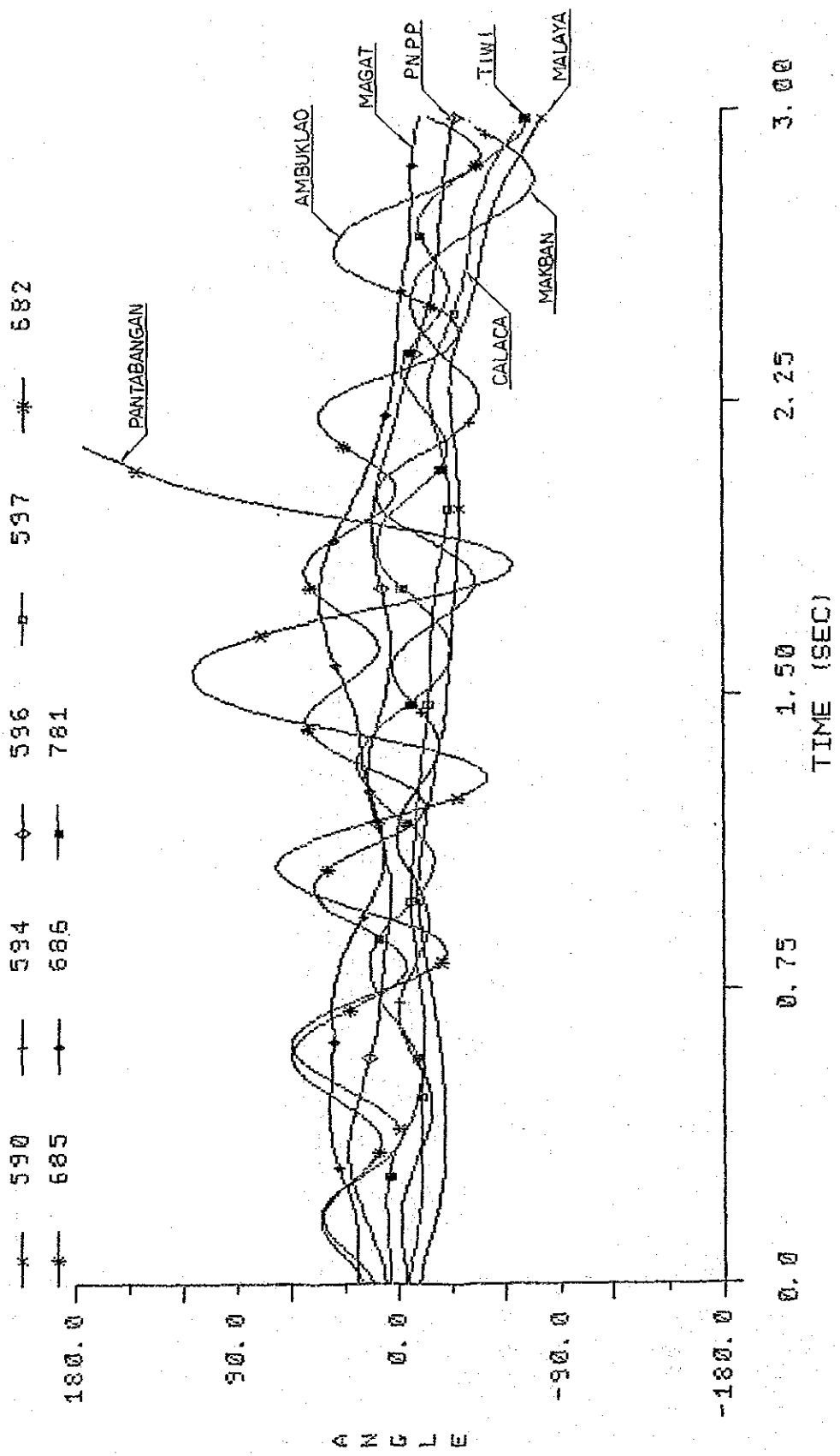


FIG. 31 '87 WET SANJOSE DOLORES FAULT LOOP.

CASE 4

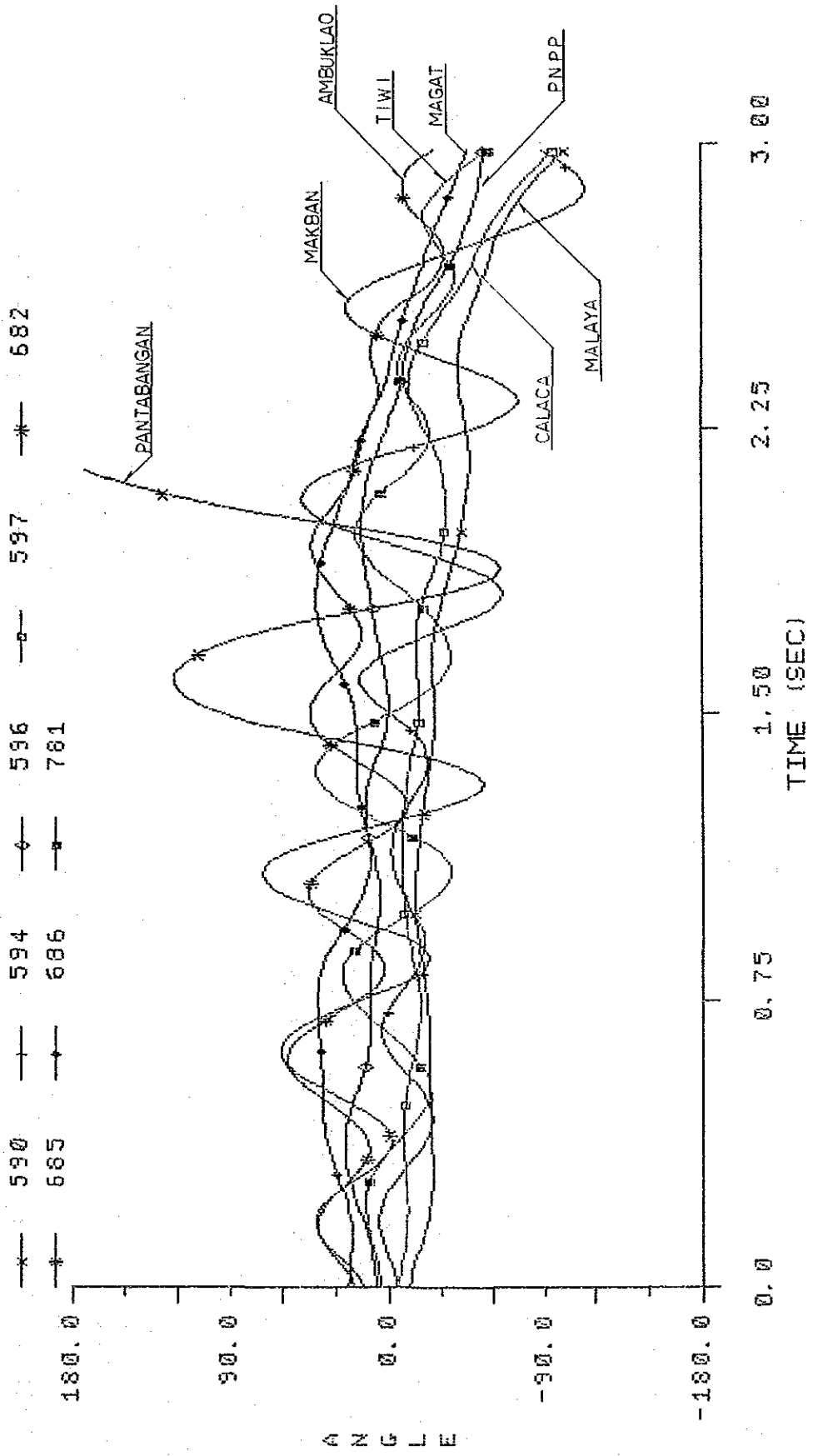


FIG. 32 '07 WET DOLORES MALAYA FAULT LOOP.

CASE 5

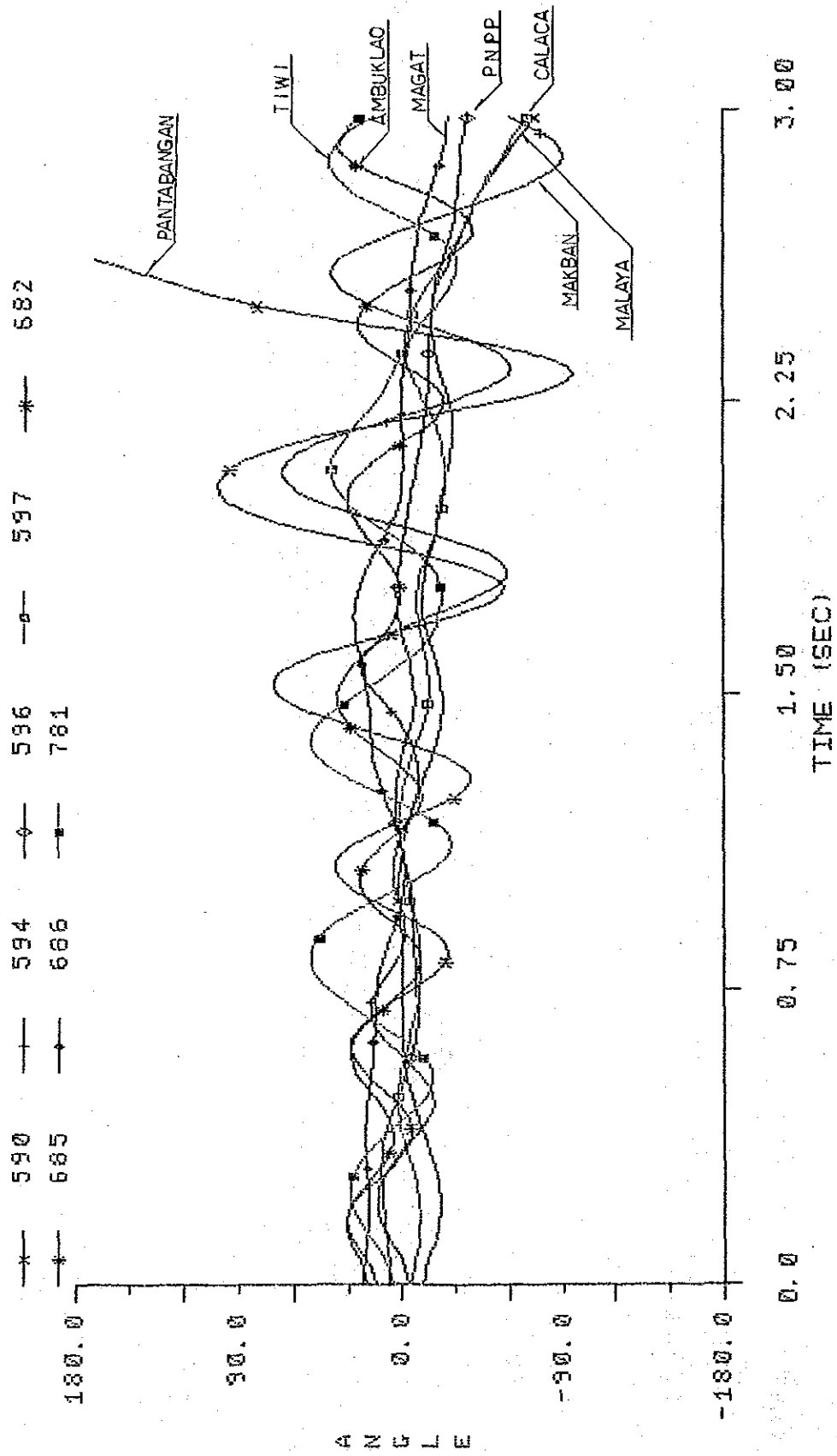


FIG. 33 '90 WET 230KV BINAN-SUGAT FAULT LOOP.

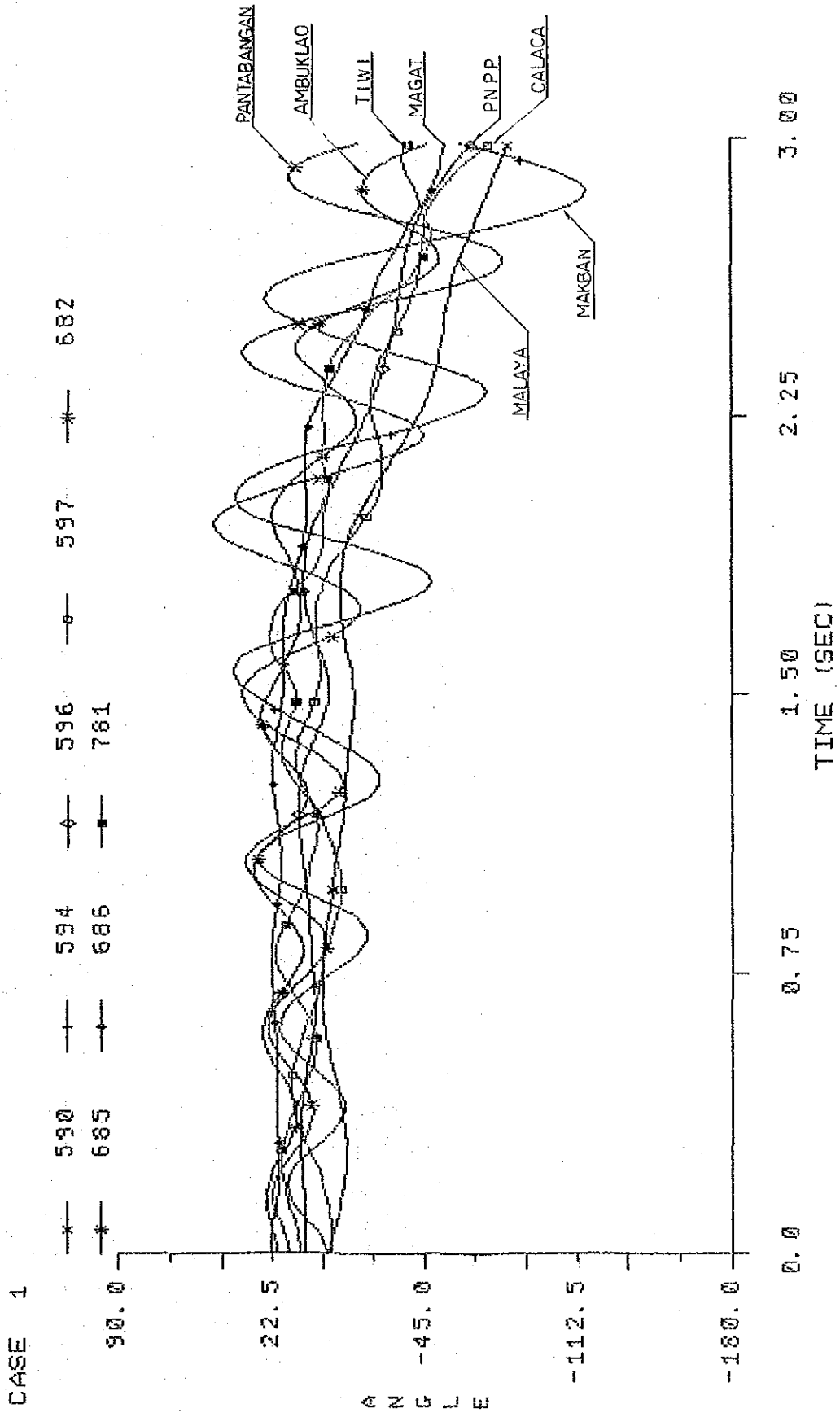


FIG. 34 '90 WET SANMANJEL CONCEPTION FAULT LOOP.

CASE 2

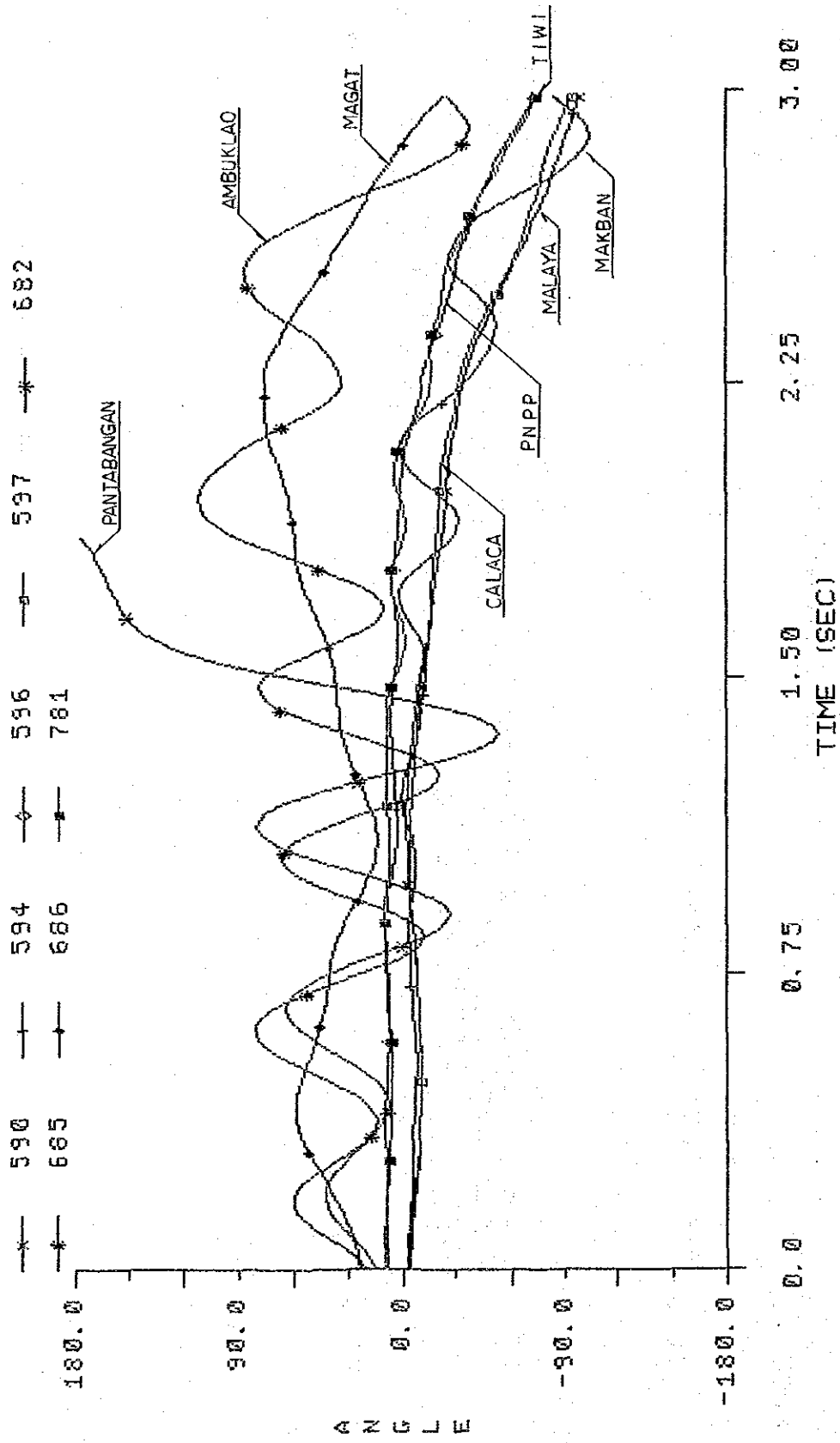


FIG. 35 '90 WET HERMOSA SANJOSE FAULT LOOP.

CASE 3

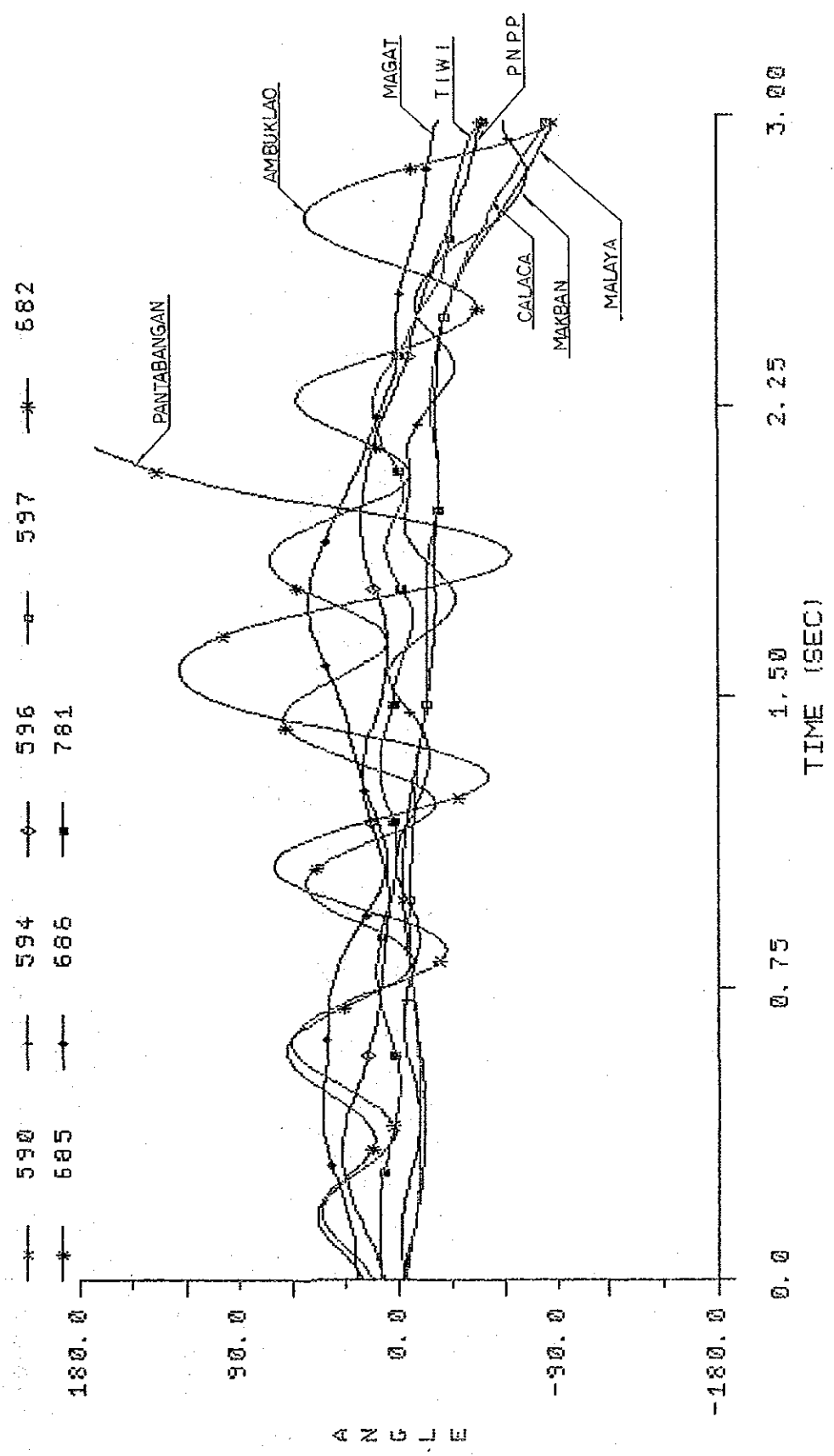


FIG. 36 '90 WET KALAYAAN SANJOSE FAULT LOOP.

CASE 4

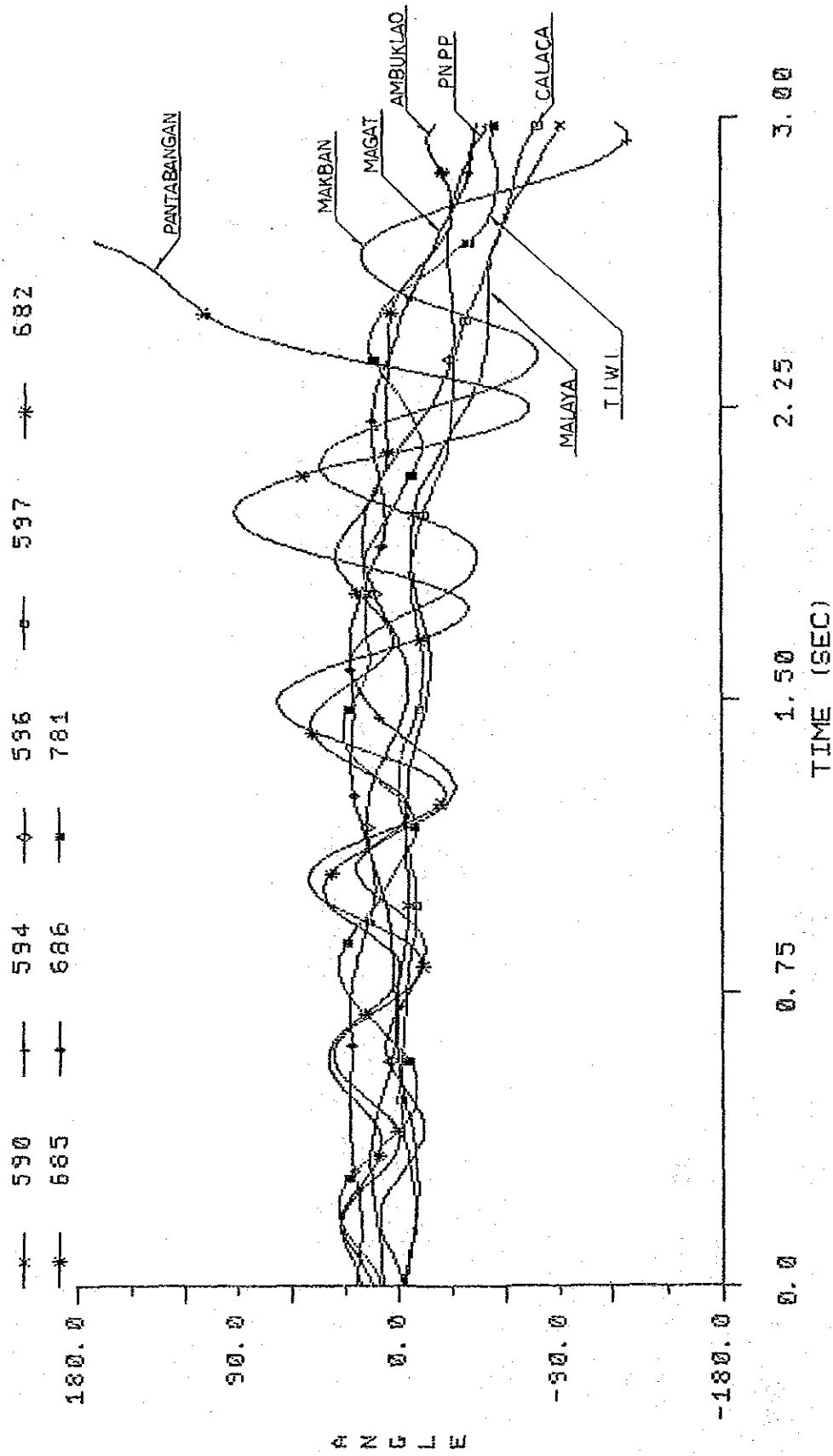


FIG. 37 '90 WET DOLDRES MALAYA FAULT LOOP.

CASE 5

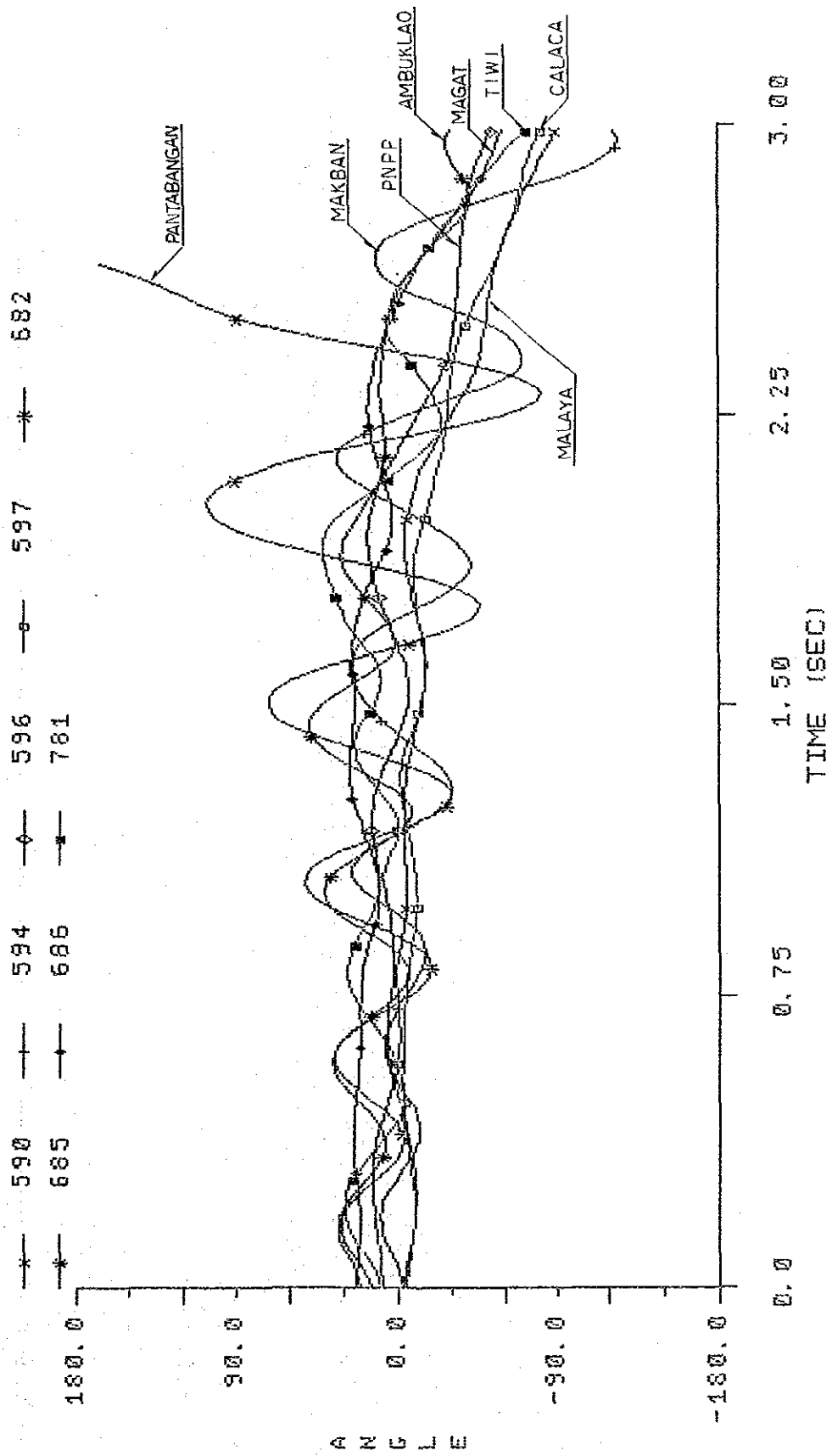
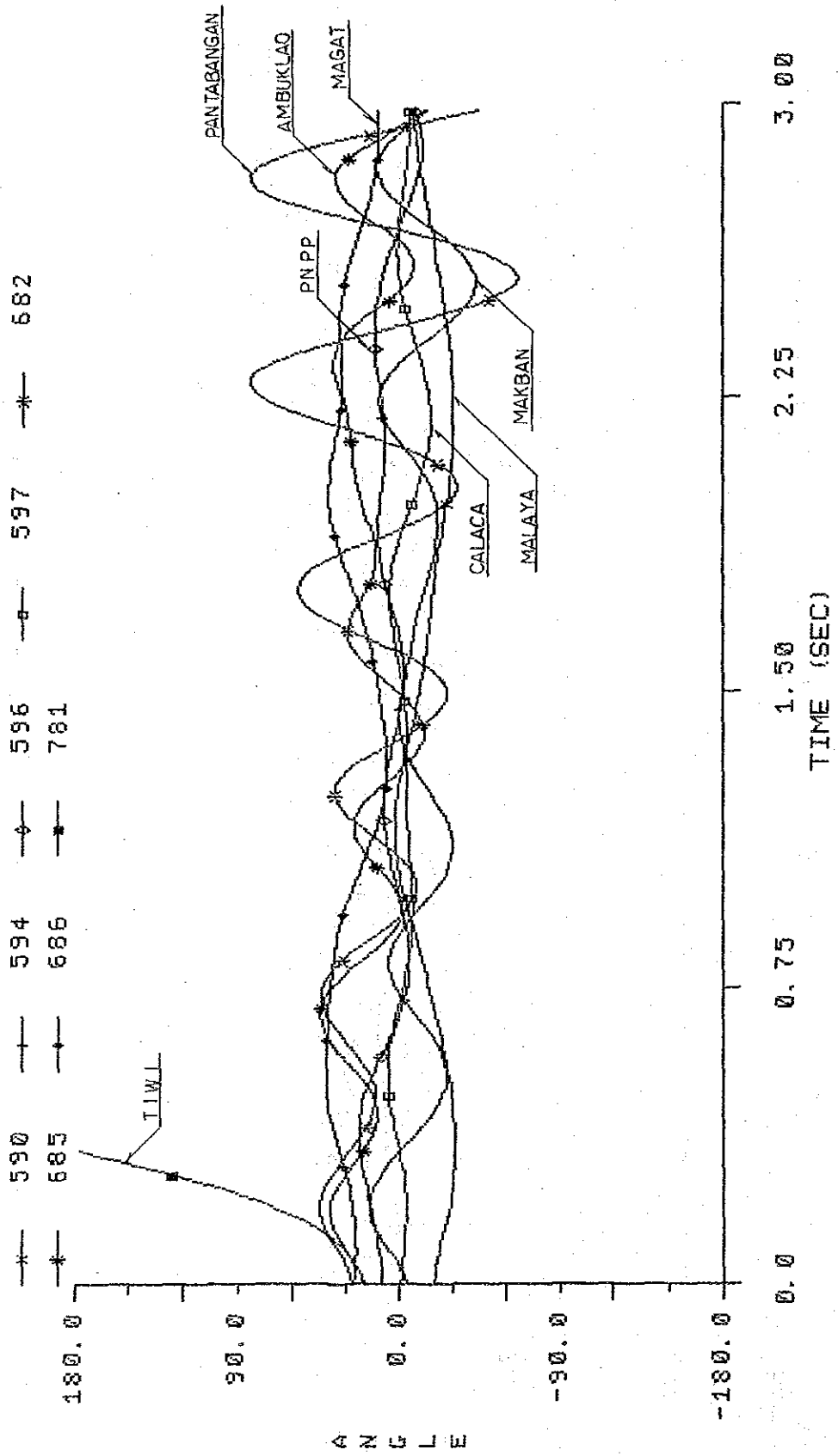


FIG. 38 '85 WET KALAYAN-GUMACA 3LO OPEN



APPENDIX-3

Technical Development Programs - Engineering Training - (1)

Course	Course Content	Suggested Participants
1. Junior Engineers Program	<p>Lecture/each-one-teach-one, On-the-Job Training, Buzz Discussion, Rotational Assignment (1 Year)</p> <ul style="list-style-type: none"> . Project Development . Engineering Design . Construction Management . Operations and Maintenance of Power Plant 	Newly Hired Junior Engineers
2. Advanced Power Systems Analysis	<p>Lecture/Lecturette, Individual/Large Group Exercises, Problem Solving, Illustrations</p> <ul style="list-style-type: none"> . Module A (110 hours) <ul style="list-style-type: none"> - Mathematical Tools, Loadflow Studies, Fault Studies, Transient Stability Studies . Module B (120 hours) <ul style="list-style-type: none"> - Reliability of Generation, Economic Operation of Power Plants, Transmission Planning, Generation Planning 	<p>Electrical Engineers who are involved in System Planning, Operation Planning and Designing of Power System</p> <p>Mechanical Engineers</p>

Technical Development Programs - Engineering Training - (2)

Course	Course Content	Suggested Participants
<p>3. Basic Planning and Scheduling with CPM</p>	<p>Lecture, Individual/Group Exercises, Open-Forum (2 Days)</p> <ul style="list-style-type: none"> . Introduction to CPM . Network Rules . Network Details . Activity Duration . Early Start Dates . Late Start Dates . Event Slack Time . Critical Path . Application of CPM . Time Schedule Network 	<p>Project Managers Principal Engineers Specialists</p> <p>Senior Engineers who are involved in Planning, Scheduling and Controlling Activities of Programs and/or Project</p>
<p>4. Project and Construction Management Course</p>	<p>Lecture, Group Discussion, Individual/Group Exercises, Case Analysis, Simulation</p> <p>(1) Module I - Project Management Organization, Life Cycle & Its Human Side (1 week)</p> <p>(2) Module II - Project Construction Management (6 Days)</p> <p>(3) Module III - Project Estimating and Control</p> <p>(4) Module IV - Contracts and Specification, Material Management and Close out Procedures (1 week)</p>	<p>(1) Project Managers, Project Engineers</p> <p>(2) Engineering Personnel</p> <p>(3) Project Managers, Principal Engineers</p> <p>(4) Project Managers, Project Engineers</p>

Technical Development Programs - Engineering Training - (3)

Course	Course Content	Suggested Participants
<p>5. Abra River Basin Hydroelectric Development Project Training Program</p>	<p>Individual/Group Reporting, Lectures/Seminars, On-the-Job Training (14 Months)</p> <ul style="list-style-type: none"> . Hydrology . Hydraulic Engineering . Structural Engineering . Geology and Geotechnics . Geotechnical Engineering . Hydro Planning 	<p>Civil Engineers/Geologists</p>
<p>6. Echo-Seminar in Hydro Power Development</p>	<p>Lecture-Discussions, Slide Presentations</p> <ul style="list-style-type: none"> . Hydro Power Theory <ul style="list-style-type: none"> - Hydrology, Engineering Geology, Hydraulics, Soil Mechanics, Theory of Structures, Water Turbines and Electrical Equipment . Hydro Power Design and Construction <ul style="list-style-type: none"> - Overall Project Planning, Collection of Required Data, Feasibility Study, Power Plant Lay-Out and Design, Choice of Electrical and Mechanical Equipment, Transmission Lines, Organization and Management . Construction Site, Tender and Evaluation of Contract 	<p>Project Development and Design Engineers</p>

Technical Development Programs - Engineering Training - (4)

Course	Course Content	Suggested Participants
<p>7. Short Courses on Power Projects (Mechanical Design)</p>	<p>Lecture, Case Studies, Film Showing (18 Days)</p> <ul style="list-style-type: none"> . Steam Power Plant . Hydroelectric Power Plant . Internal Combustion Engine power Plant . Fuels and Combustion . Water Treatment for Power Plant . Fire Protection . Power Plant Economics 	<p>Mechanical Planning/Design Engineers</p>
<p>8. Seminar-Workshop for the Civil Design Division Staff</p>	<p>Lecture-Discussion, Workshop & Individual Exercises, Computer Applications</p> <p>(1) Module I - Fundamentals of Statics, Strength of Materials and Hydraulics</p> <p>(2) Module II-A - Structural Engineering</p> <p>(3) Module II-B - Geotechnical and Foundation Engineering</p> <p>(4) Module III - Workshop on Specific Problems in:</p> <ul style="list-style-type: none"> . Embankment Dam . Foundations for Spillways and other Hydraulic Structures . Buried Structures . Machinery Foundations & Systems . Soil/Rock Improvement . Transmission Towers . Structures of Elevated Concentrated Mass 	<p>Civil Design Engineers</p>

Technical Development Programs - Engineering Training - (5)

Course	Course Content	Suggested Participants
<p>9. Orientation on Nuclear Power</p>	<p>Lecture, Film Showing, Group Discussion (5 Days)</p> <ul style="list-style-type: none"> . Basic Principle of Nuclear Power Plant Operation . Nuclear Power Plant Systems . Safety Aspects of Nuclear Plant . Reactor Operation and Maintenance . Nuclear Fuel Cycle and Waste Disposal . Why Go Nuclear? 	<p>Any NPC Employee</p>
<p>10. Self-Study Technical Training Series on Nuclear Power Plant Operation</p>	<p>Self-Study, Examination, Group Discussion/Review (4 Months)</p> <ul style="list-style-type: none"> . Introduction . Licensing & Regulation of Nuclear Power Plant . Fundamentals of Nuclear Energy and Reactor Operation . Nuclear Plant heat Transfer . Reactor & Reactor Coolant Systems Design . Reactor Auxiliary . Steam and Power Conversion Systems . Plant Electrical Systems . Plant Structural Design . Radiation Protection . Radioactive Waste Treatment . Test Program . Nuclear Codes and Standards . Quality Assurance for Design Construction & Operation . Nuclear power Plant materials 	<p>21 NPC Site-based Engineers</p>

Technical Development Programs - Engineering Training - (6)

Course	Course Content	Suggested Participants
<p>11. Instrumentation and Control Engineer/Technicians' Course</p>	<p>Lecture, Laboratory Sessions, Group Discussion (1 Month)</p> <ul style="list-style-type: none"> . Introduction to Basic Nuclear Systems . Process Instrumentation . Rod Control . Reactor Protection . Rod Position Indication . Nuclear Instrumentation 	<p>Instrumentation and Control Engineers/Technicians</p>
<p>12. Health Physics Course</p>	<p>Lecture, Laboratory Sessions, Group Discussion</p> <p>(1) Module I - 2 Weeks Radiation, Its Uses, Effect and Control with Respect to PWR Power Plant</p> <p>(2) Module II - 1 Week Laboratory Session on the Practical and Analytical Aspect of Surveys, Water Sampling, Radiation Dose Control, Contamination and Decontamination</p> <p>(3) Module III - 4 Weeks On-the-Job Training at a PWR Type of Plant</p>	<p>Health Physicist Technicians</p>

Technical Development Programs - Operations Training - (1)

Course	Course Content	Suggested Participants
<p>1. Basic Course on Thermal Power Plant</p>	<p>Lecture Portion (1 Month)</p> <ul style="list-style-type: none"> . Thermal Power Plant Fundamentals & Terminology . Plant Systems, Their Purpose/Function and Equipments . Major Plant Equipment and Its Associated Auxiliaries <ul style="list-style-type: none"> - Purpose/Function, Principle of Operation, Construction Features, Start up and Shutdown Procedure, Tending and Routine Maintenance . Water Conditioning . Basic Instrumentation & Control . Lubrication . System/Equipment Troubles and Its Remedial Measures . Safety Rules & Practices <p>On-the-Job Training (4 Months)</p> <ul style="list-style-type: none"> . Auxiliary Equipment Operation . Boiler Operation . Turbo-Generator Operation 	<p>Newly Hired Plant Operator</p>

Technical Development Programs - Operations Training - (2)

Course	Course Content	Suggested Participants
<p>2. Hydroelectric Power Plant Operation</p>	<p>Lecture-Discussion, Brainstorming, Movie Presentation-Discussion, Plant Tour/Inspection, Simulation, Demonstration, On-the-Job Training</p> <ul style="list-style-type: none"> . Dam and Hydraulic Structure . Hydroplant Equipment . Systems <ul style="list-style-type: none"> - Accessories, Components - Operating Procedures - Stream Flow Regulation, Cleaning of Intake, Watering and Dewatering the Tunnel . Tending the Hydroplant Equipment & Hydraulic Structures in accordance with Established Procedures <ul style="list-style-type: none"> - Hydraulic Structure, Water Turbine, Generator and Excitor . Reacting Quickly and Correctly to Troubles 	<p>Newly Hired Hydroelectric Plant Operating Personnel</p>
<p>3. On-Shift Refresher Course on Thermal Power Plant Operation</p>	<p>Lecture-Discussion, Group Discussion, Case Study, Demonstration, Simulation</p> <ul style="list-style-type: none"> . Auxiliary Equipment Operation . Boiler Operation . Turbo-Generator Operation . Operational Monitoring . Instrumentation & Control . Emergency Procedures 	<p>Regular Plant Operators</p>

Technical Development Programs - Operations Training - (3)

Course	Course Content	Suggested Participants
<p>4. Geothermal Power Plant Operation & Maintenance Course</p>	<p>Lecture-Discussion, Buzz Group, Movie Presentation On-the-Job Training, Demonstration, Simulation (1.5 Month)</p> <ul style="list-style-type: none"> . Operation <ul style="list-style-type: none"> - Geothermal Steam Generation, Major Components, Auxiliaries Systems, Operating Procedures, Tending, Logging & Recording, Emergency Maintenance - Importance/Kinds of Maintenance, Maintenance Scheduling, Machine Shop Practice, Use of Precision & Hand Tools, Reading/Understanding Blueprints, Rigging, Maintenance Procedures, Lubrication, Safety Rules & Practices 	<p>Plant Operations and Maintenance Personnel</p>

Technical Development Programs - Operations Training - (4)

Course	Course Content	Suggested Participants
<p>5. Diesel Power Plant Operation & Maintenance Course</p>	<p>Lecture-Discussion, On-the-Job Training, Case Study, Demonstration, Simulation (2 Weeks)</p> <ul style="list-style-type: none"> • Operation <ul style="list-style-type: none"> - Engine Proper & Accessories Parts and Functions, Cooling Water System, Compressed Air System, Lubricating Oil System, Air Intake and Exhaust System, Power Switch-board Operation, Electrical System, Relay Protection, Starting & Shutting Down Procedures, Logging and Reporting, Emergency Operation, Fuel/Oil and Water Analysis & Interpretation, Safety Rules & Procedures • Maintenance <ul style="list-style-type: none"> - Importance/Kinds of Maintenance, Scheduling, Machine Shop Practice, Use of Precision Tools, Reading & Understanding Blueprints, Rigging, Maintenance Procedures, Lubrication, Safety Rules & Practices 	<p>Diesel Power Plant Operation and maintenance Personnel</p>

Technical Development Programs - Operations Training - (5)

Course	Course Content	Suggested Participants
<p>6. Instrumentation & Control Training Course</p>	<p>Lecture-Discussion, Guided Plant Tour, Demonstration, Simulation (1 Month)</p> <ul style="list-style-type: none"> . Basic Principle and Calibration Procedures of Measuring Instruments . Basic Principle of Pneumatic/Electronic Controls . Trouble Shooting, Repair and Calibration Procedures of Pneumatic/Electronic Measuring Instruments and Controls . Servicing and Fine Tuning Procedures for Proportional, Integral and Derivative Action Controls (Pneumatic/Electronic) . The Plant Interlocking System (BII) . Basic Principle of a Close Loop Control System 	<p>Instrument Engineers/ Technicians</p>
<p>7. Substation Operation and Maintenance</p>	<p>Lecture-Discussion, Individual-Group Exercises, Case Study, Practicum (1/2 Month)</p> <ul style="list-style-type: none"> . Substation Working Diagram . Circuits & Connection of Different Substation Equipment & Instruments . Substation Trouble Shooting . Analysis of power Meters Operation . VHF Radios . Metering & Protective Relay Control Circuits . Standard Switching Procedures . PERT/CPM 	<p>Substation Operators and Control Engineers</p>

Technical Development Programs - Operations Training - (6)

Course	Course Content	Suggested Participants
8. Electrical Maintenance Course	<p>Lecture-Discussion, On-the-Job Training</p> <ul style="list-style-type: none"> . Importance/Kinds of Maintenance . Maintenance Scheduling . Electric Circuits . Principle of Operation and Construction of Electrical Equipment and Instruments . Interpretation of Electrical Prints and Reading Wiring Diagram . Electrical Testing and Measurements . Overhauling, Inspection, Repair and Maintenance Method and Procedures of Different Electrical Equipment . Relay Protection . Electrical Trouble Shooting . Miscellaneous <ul style="list-style-type: none"> - Balancing and Vibration Analysis, Coupling Alignment, Bearings . Electrical Safety 	Electrical Maintenance Personnel

Technical Development Programs - Operations Training - (7)

Course	Course Content	Suggested Participants
<p>9. Mechanical Maintenance Course</p>	<p>Lecture-Discussion, Demonstration-Simulation, Critical Incident, Workshop, On-the-Job Training (2 Months)</p> <ul style="list-style-type: none"> . Machine Shop Equipment & Tools . Maintenance Processes and Materials . Reading/Understanding Blueprints . Repair/Preventive Maintenance of Bearings . Common Equipment Troubles . Preventive Maintenance of Specific Equipment and Accessories . Inspection/Repair/Maintenance of Boiler/Turbine/Auxiliary Equipment and Accessories . Industrial Safety 	<p>Mechanical Maintenance Personnel</p>

Technical Development Programs - Operations Training - (8)

Course	Course Content	Suggested Participants
10. Basic Lineman's Course	<p>Lecture-Discussion, Practicum, Individual-Group Work (1 Month)</p> <ul style="list-style-type: none"> . Theoretical Input <ul style="list-style-type: none"> - Lineman Role/Responsibility in the NPC Organization, First Aid Treatment, Identification/Uses/ Handling of Tools/Equipment, Guys/ Installation/Tensioning Clearance, Pole Loading and Hauling, Conductors, Line Maintenance, Construction of Dummy Line Practicum - Individual/Group Exercise, Preparation of Line Materials, Working on Actual Transformer, Making Splices/Joints/Sleeves, Construction/Dismantling Types A-E Lines, Erecting Poles, Climbing/ Descending Poles, Conductor Riding, Replacement of Crossarms and Insulators 	Lineman A Members of Line Gang

Technical Development Programs - Operations Training - (9)

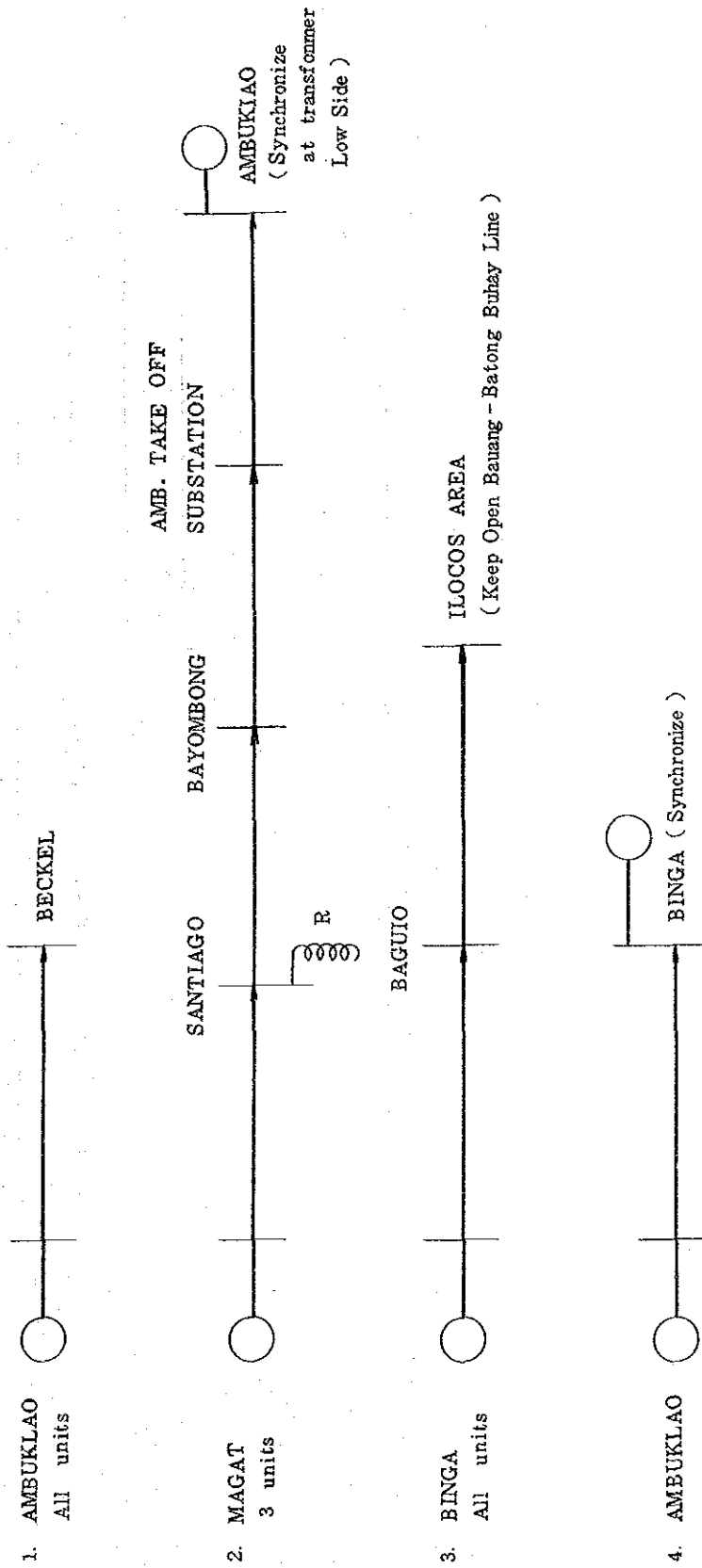
Course	Course Content	Suggested Participants
<p>11. Hotline Maintenance Course</p>	<ul style="list-style-type: none"> . Lecture Portion <ul style="list-style-type: none"> - Live Line Toll Identification and Uses, Live Line Job Planning and Safety, Routine Live Line Work Procedures, Live Line Maintenance, Pole Replacement, Live Line Maintenance of Insulators . Practicum/Field Work Portion <ul style="list-style-type: none"> - Construction of Dummy Lines, Replacement of Pin-Type Insulator, Replacement of Suspension-Type Insulator, Maintenance of 69 kV Lines, Maintenance of 230 kV Lines (1 Month) 	<p>First Priority - Linemen B and Foremen Second Priority - Linemen A (Requirement: Completion of Basic Lineman's Course)</p>
<p>12. Chemical Technician's Course</p>	<p>Lecture-Discussion, Workshop, Laboratory (1 Month)</p> <ul style="list-style-type: none"> . Chemistry of Water . The Chemical Examination of Water . Primary Water Treatment . Trouble Shooting and Solutions . Secondary Water Treatment . Fuel Oil Analysis and Additive Application <ul style="list-style-type: none"> - Physical & Chemical Properties of Oil, Fuel Oil Tests in Thermal Plant Laboratory, Instruments used in Oil Analysis, Fuel Oil Treatment by Additive 	<p>Chemical Operations Personnel</p>

Technical Development Programs - Operations Training - (10)

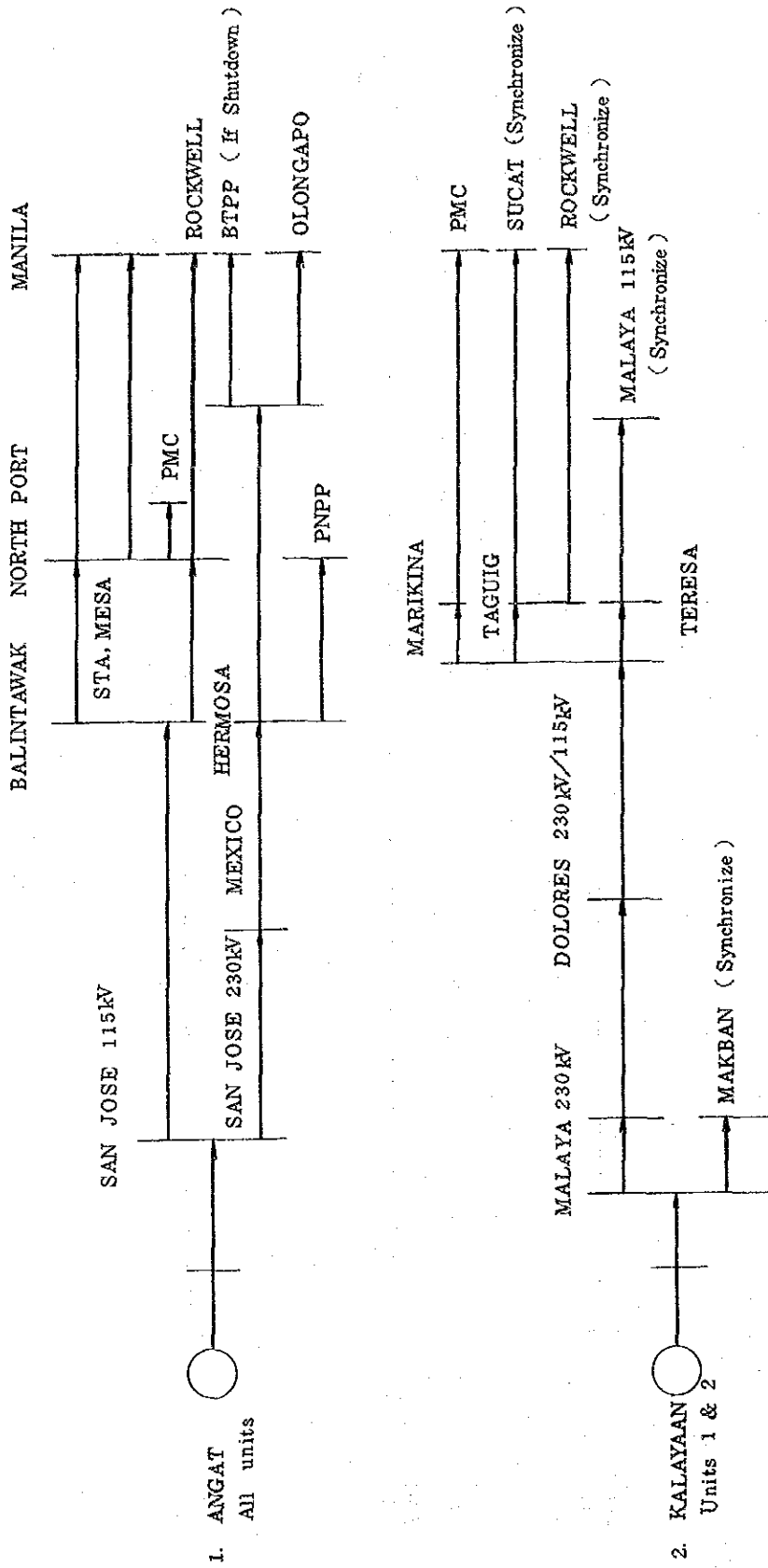
Course	Course Content	Suggested Participants
13. Corrosion and Pollution Course	<p>Lecture-Discussion, Case Study, Workshops, Experimentation, Demonstration (1 Month)</p> <ul style="list-style-type: none"> . Corrosion <ul style="list-style-type: none"> - Introduction to Corrosion, Fundamental Process of Corrosion, General Types of Corrosion, Corrosion Control Methods . Pollution <ul style="list-style-type: none"> - General and Working Environment, Pollution Appraisal, Types of Pollutants, Methods of Air Pollution Control, Waste Disposal, Methods of Noise Pollution Control, Water Purification and Treatment 	Design and Operation Engineers
14. Basic Welding Course	<p>Lecture-Discussion, Practicum, Workshop, Demonstration (1 Month)</p> <ul style="list-style-type: none"> . Overview of the Welding Process . Oxy Acetylene Welding . Direct Current Arc Welding . AC Arc Welding . Inert Gas Arc Welding . Soldering . Brazing, Barbe Welding . Metal Surfacing . Inspection and Testing Welds . Metal Properties, Identification . Heat Treatment of Metals 	New Welders

APPENDIX-4

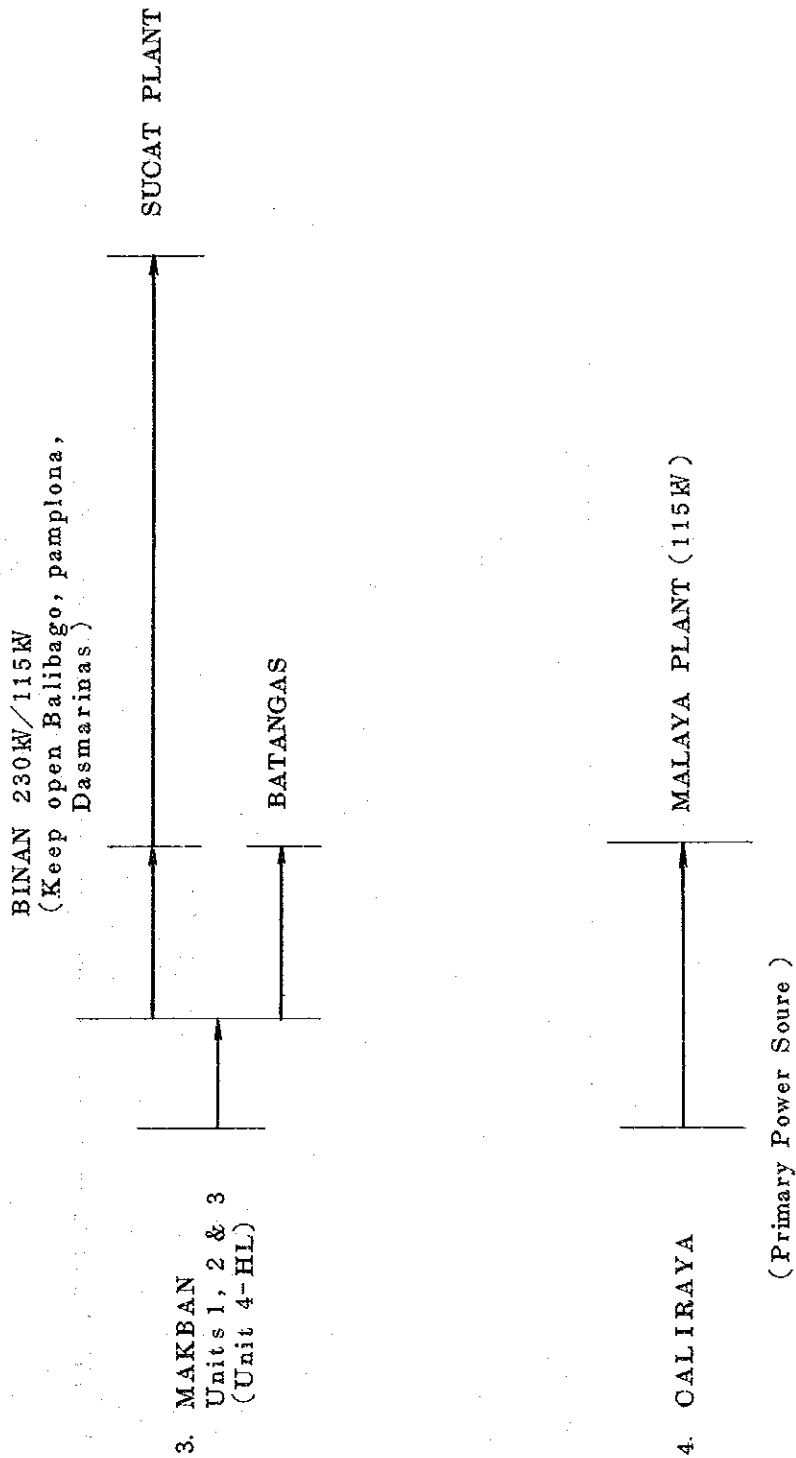
BLACKOUT OPERATION FLOW DIAGRAM OF NORTHERN LUZON GRID



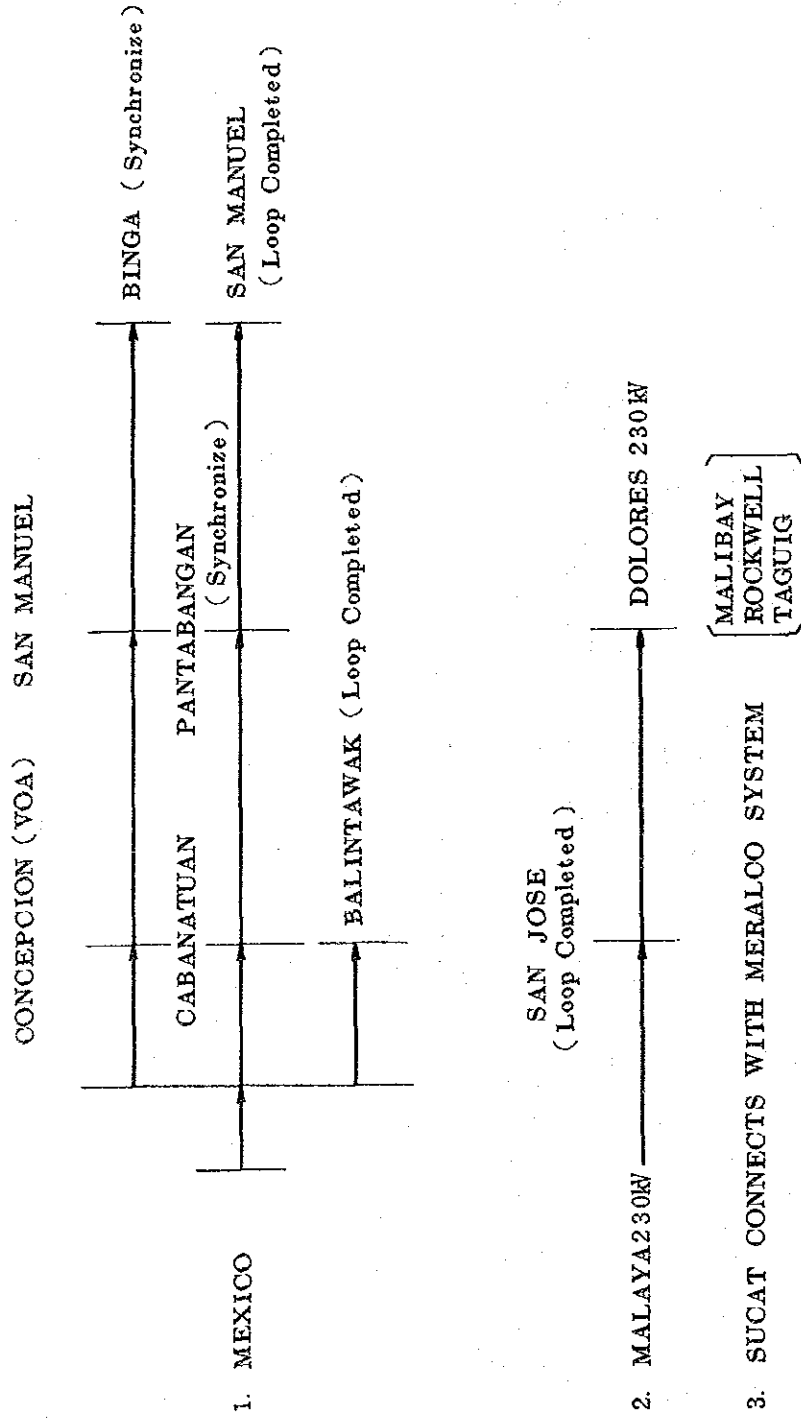
BLACKOUT OPERATION FLOW DIAGRAM OF CENTRAL AND SOUTHERN
LUZON GRID



BLACKOUT OPERATION FLOW DIAGRAM OF CENTRAL AND SOUTHERN
LUZON GRID



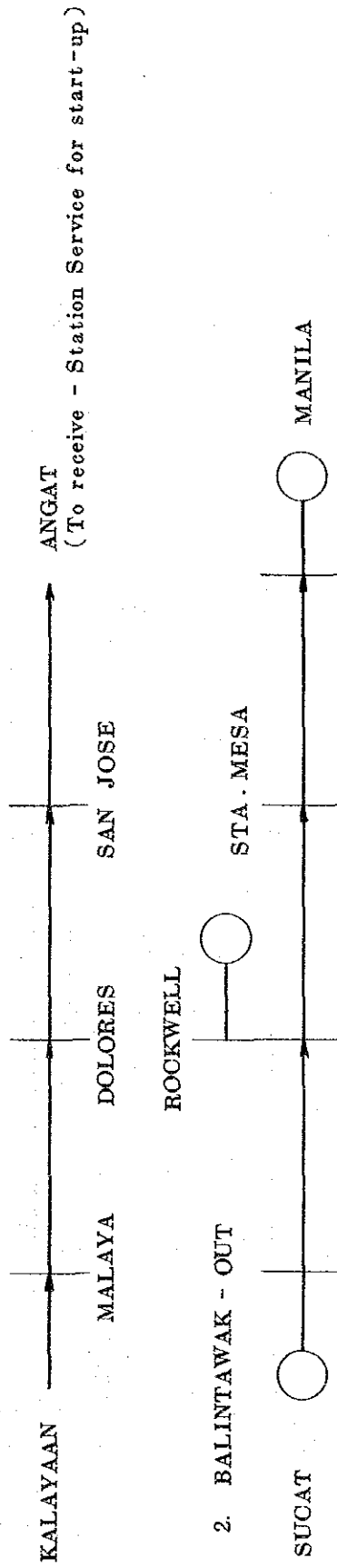
BLACKOUT OPERATION FLOW DIAGRAM - NORMALIZATION OF THE GRID -



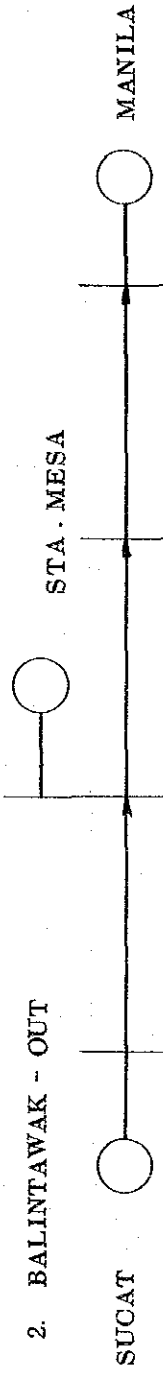
BLACKOUT OPERATION FLOW DIAGRAM - CONTINGENCY PLANS -

A. ALTERNATIVE GENERATION SOURCES

1. ANGAT - OUT



2. BALINTAWAK - OUT



B. WHEN SYSTEM VOLTAGE IS HIGH (greater than 10% of rated)

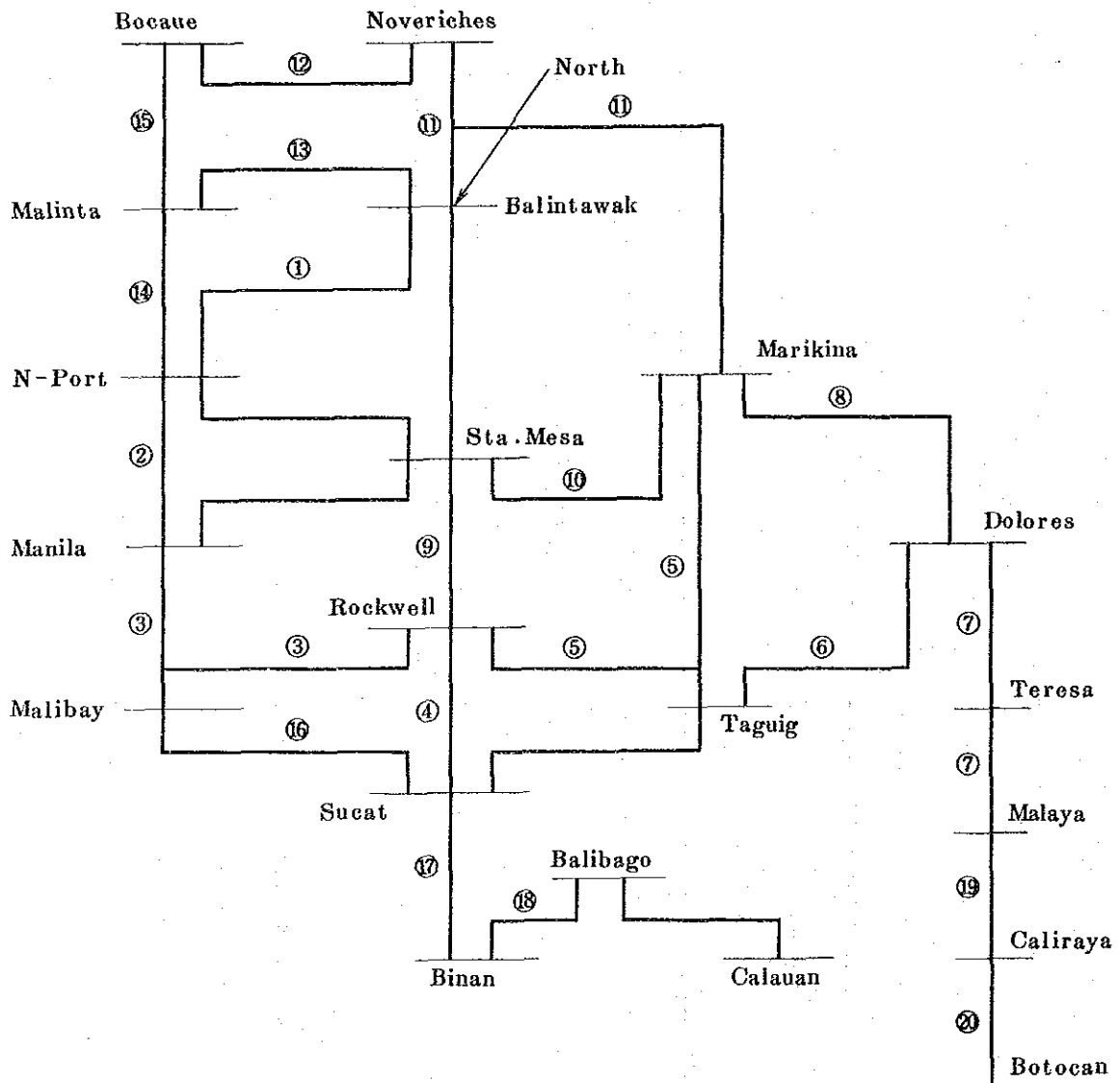
1. Open Bauang - Batong Buhay line
2. Open Ambuklao - Santiago lines, both ends

NOTE : Overvoltage relays at Ambuklao & Santiago set 265W, 3 secs.

BLACKOUT OPERATION FLOW DIAGAM OF MERALCO GRID

Case I - A All generating stations out.

Start - up power available from North Hydro.

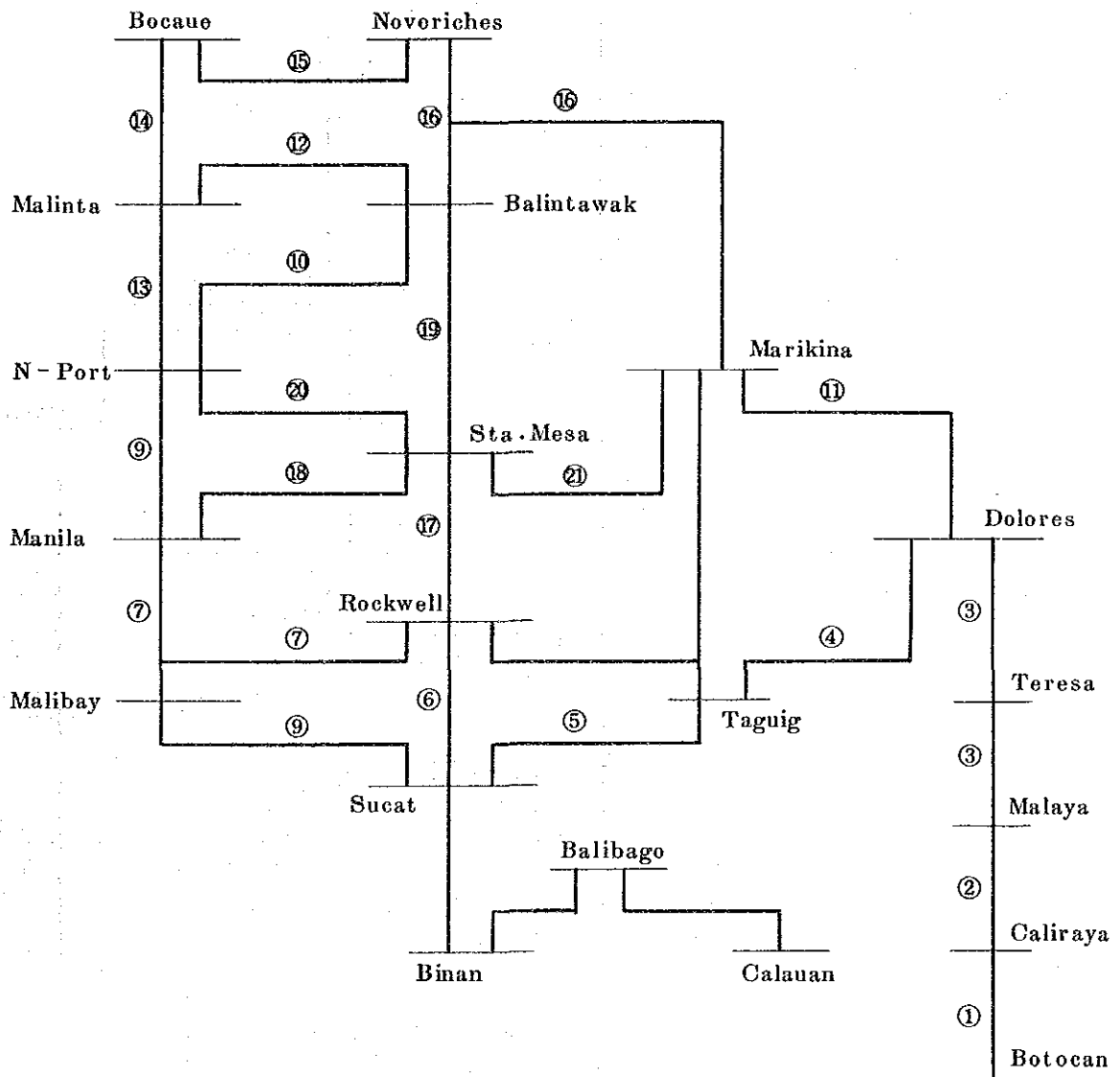


BLACKOUT OPERATION FLOW DIAGRAM OF MERALCO GRID

Case I - B All generating stations out.

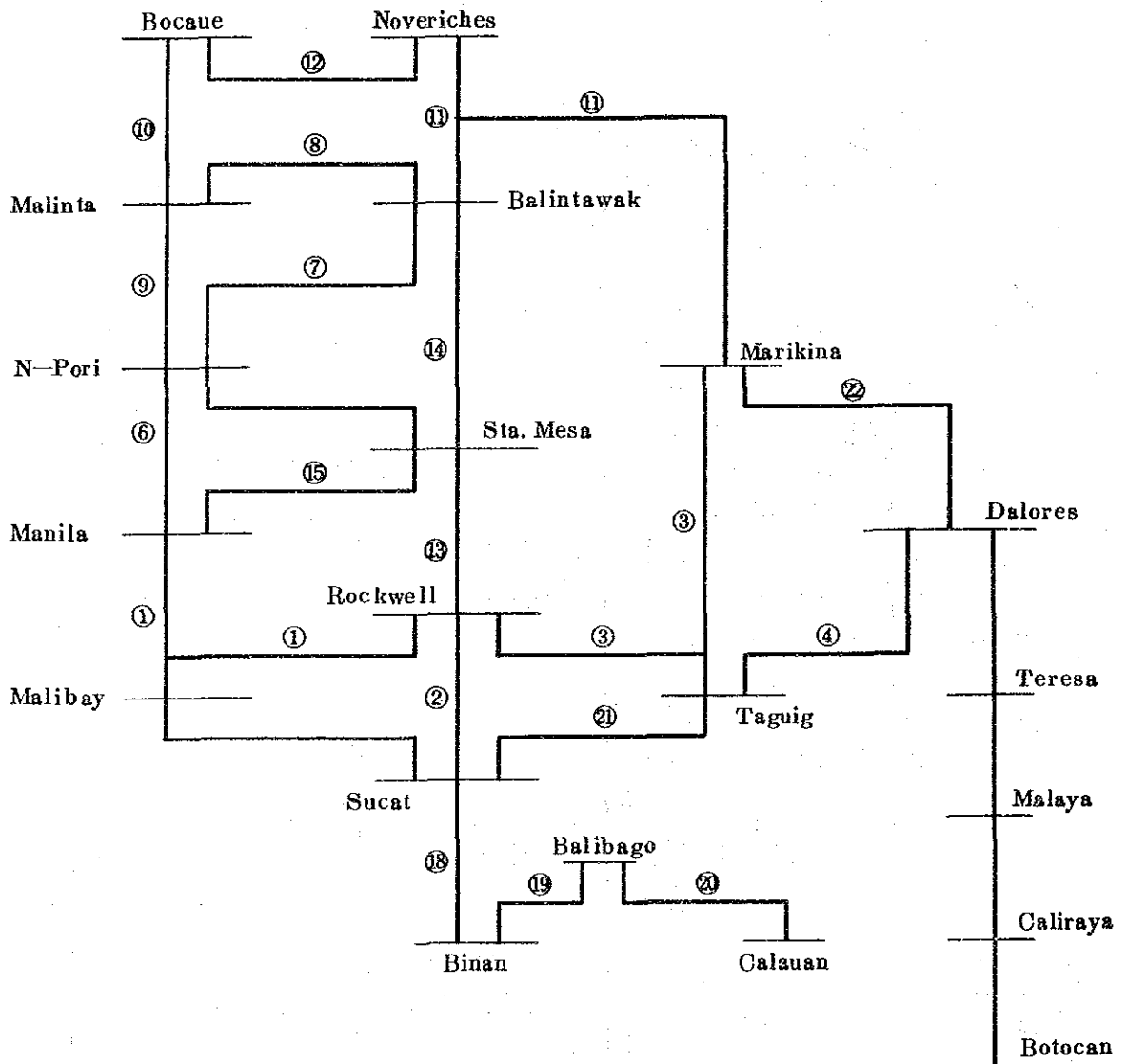
Start - up power available from South Hydro.

(Caliraya and Botocan)



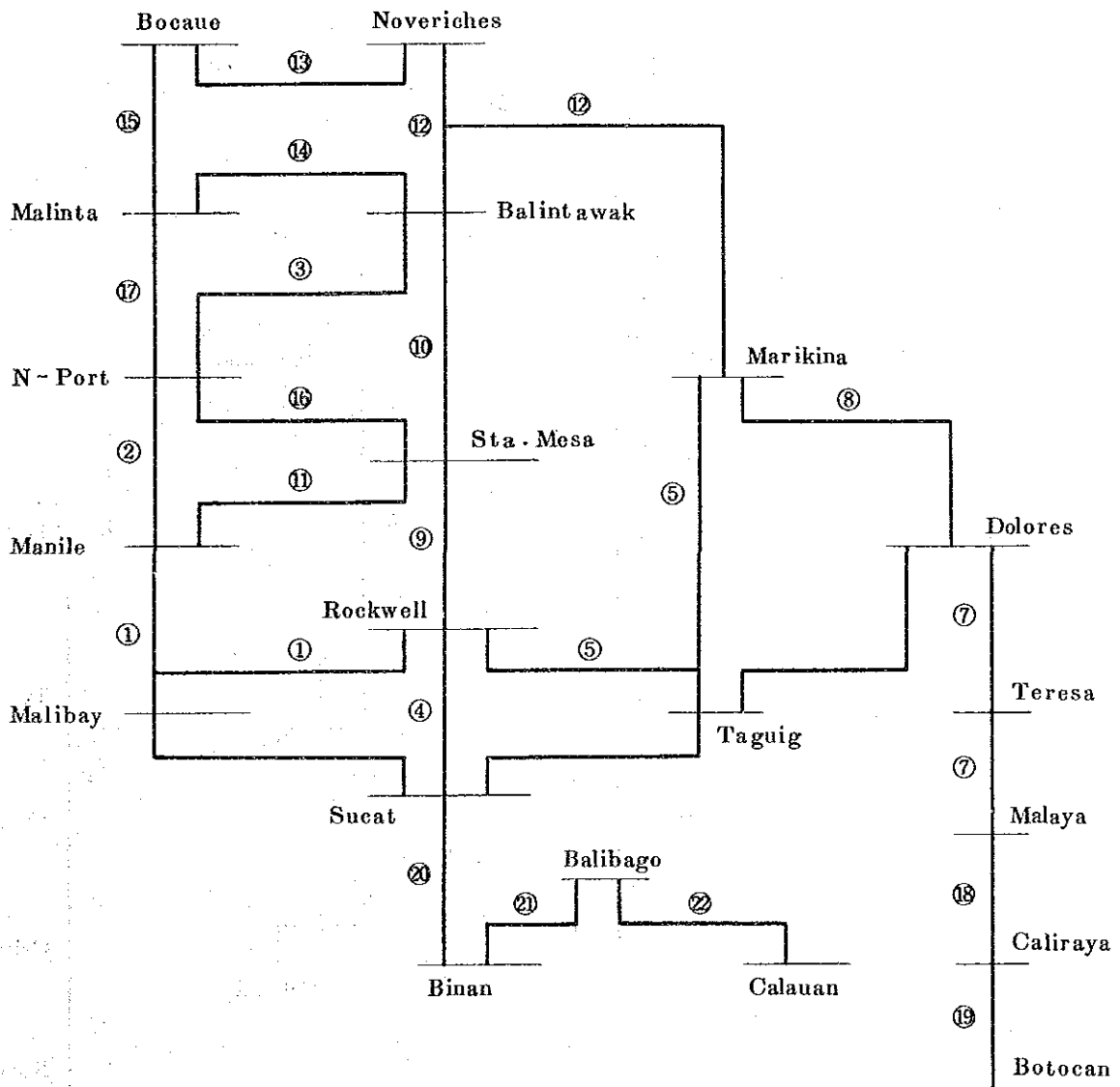
BLACKOUT OPERATION FLOW DIAGRAM OF MERALCO GRID

Case II All generating stations are out except Rockwell Station



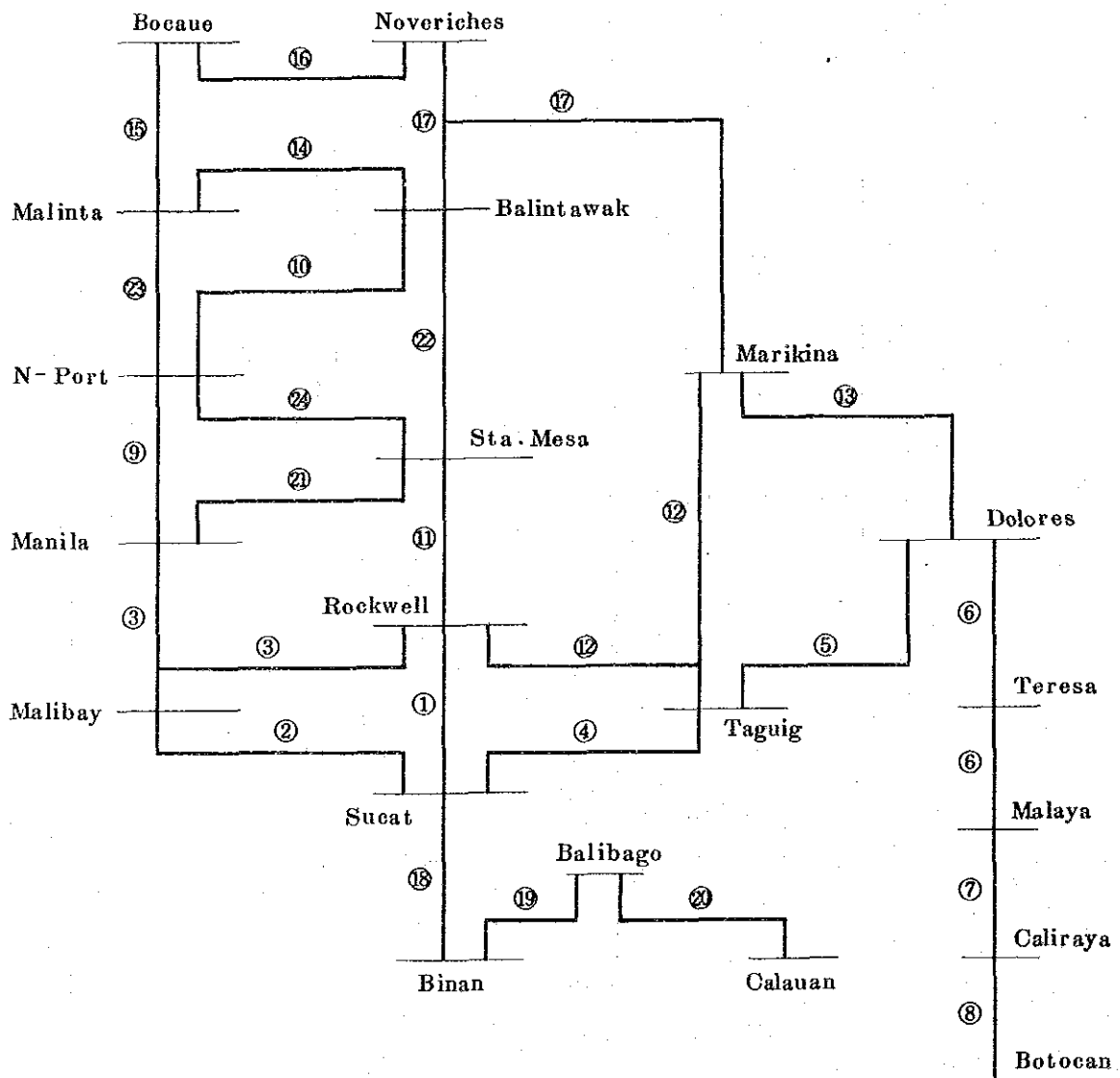
BLACKOUT OPERATION FLOW DIAGRAM OF MERALCO GRID

Case III All generating stations are out except Manila Station



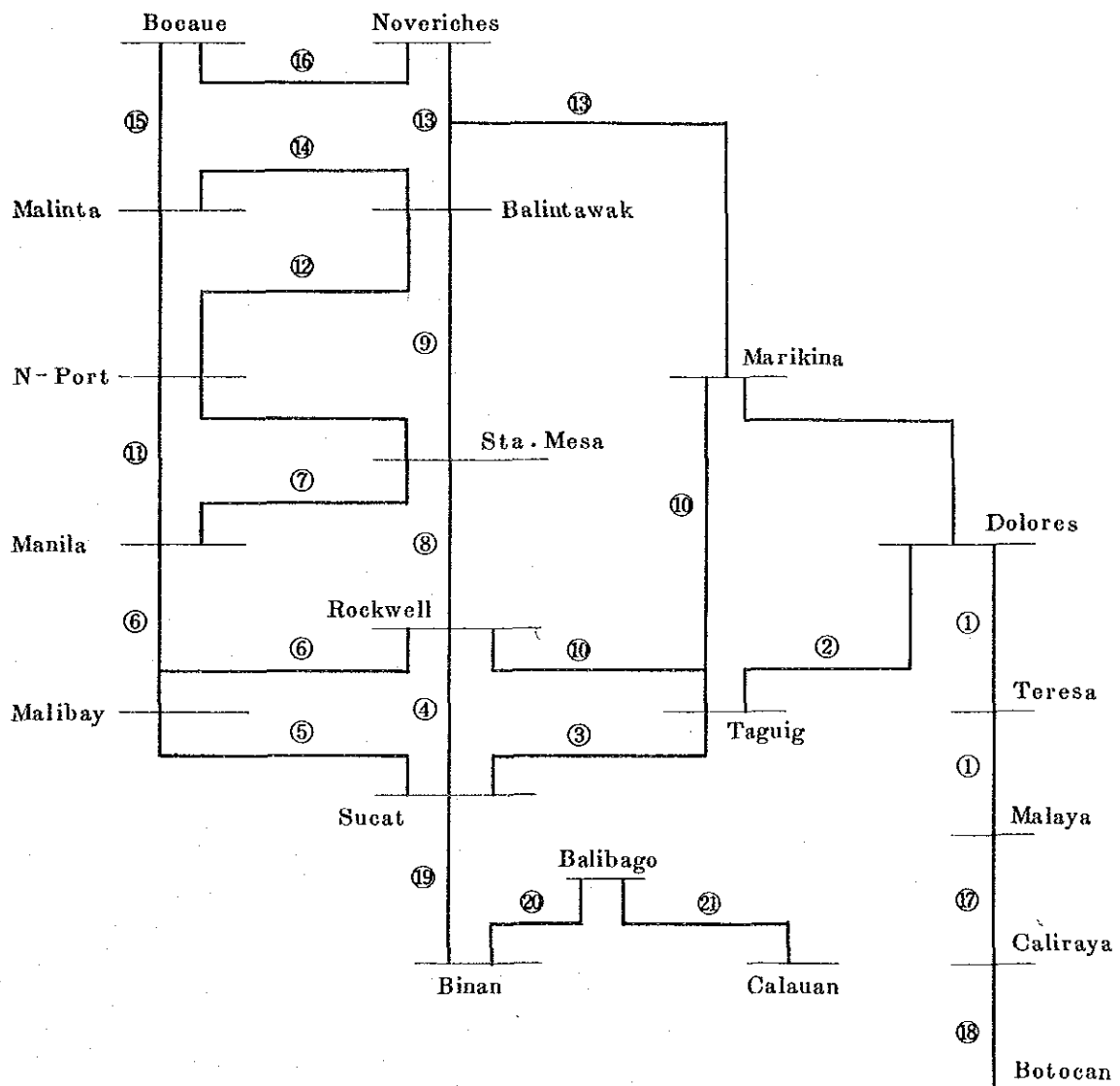
BLACKOUT OPERATION FLOW DIAGRAM OF MERALCO GRID

Case IV All generating stations are except Sucat Station



BLACKOUT OPERATION FLOW DIAGRAM OF MERALCO GRID

Case V All generating stations are out except Malaya Station



JICA