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AZ CORP COMMISSION
DOCUMENT CONTROL

Our File Number 43431-00001

January 31, 2005

VIA HAND DELIVERY

Arizona Corporation Commission
Docket Control – Utilities Division
1200 W. Washington Street
Phoenix, Arizona

Re: In the matter of the 2006 Biennial Electric Transmission Assessment for 2006 through 2015
Docket No: E-00000D-05-0040

Attached for filing in the above docket is the original and thirteen (13) copies of Southern California Edison Company's 2005-2014 Ten-Year Plan.

Very truly yours,

LEWIS AND ROCA LLP

Tom Campbell

Thomas H. Campbell
Attorneys for Southern California Edison Company

THC/bjg
Attachments

cc: Michael Mackness (w/encs.)

Arizona Corporation Commission
DOCKETED

JAN 31 2005

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SOUTHERN CALIFORNIA EDISON COMPANY

2005-2014

TEN-YEAR PLAN

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Prepared for the

Arizona Corporation Commission

January 2005

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN

General Information

Pursuant to A.R.S. § 40-360.02, Southern California Edison ("SCE") submits its 2004-2013 Ten-Year Plan ("Plan") to the Arizona Corporation Commission ("Commission"). The attached Plan (contained in Attachment A) describes planned transmission facilities of 115 kV or higher voltage that SCE may construct in Arizona over the next ten-year period. Pursuant to A.R.S. § 40-360(1), underground facilities are not included.

This Plan provides tentative information that, pursuant to A.R.S. § 40-360.02(F), is subject to change at the discretion of SCE without notice based on land usage, growth pattern changes, regulatory or legal developments, or for other reasons. At this time, SCE plans to go forward with one of the projects, the Series Capacitor Upgrade Project (2006)("Series Capacitor I"). However SCE cannot be certain that it is going forward with the other two projects described in the Plan, the Devers-Palo Verde No. 2 (2009) ("DPV2") and the Series Capacitor Upgrade Project (2010) ("Series Capacitor II"). SCE is in the process of performing the technical studies and economic analyses to cost-justify and design the second and third projects.

Series Capacitor I was approved late last year by the California Independent System Operator ("CAISO"), the Western Arizona Transmission System Group, and the Western Electricity Coordinating Council. DPV2 is under review for final approval by the CAISO and will be reviewed by the California Public Utilities Commission and others. Series Capacitor II will be analyzed in several stakeholder processes, including those before the California Independent System Operator's Southwest Transmission Expansion Plan process, the Western Arizona Transmission System process, and the Western Electricity Coordinating Council Regional Planning Process. In addition, both of the Series Capacitor Upgrade Projects described in Attachment A

must be coordinated with other utilities that own or have rights on the 500 kilovolt transmission lines whose series capacitors would be upgraded.

As the Commission is aware, transmission projects are complex and many issues will need to be resolved. Regulatory requirements, changes in underlying assumptions such as generation expansion, and other utilities' plans, may substantially affect the Plan, and could result in changes to anticipated in-service dates and project scopes.

The three maps (shown as Diagrams 1, 2 and 3) attached to this report provide a general illustration of line routing. They are general maps and subject to revision. SCE anticipates that specific routing in Arizona will be determined by the Arizona Power Plant and Transmission Line Siting Committee when issuing a Certificate of Environmental Compatibility and through subsequent right-of-way acquisition.

Different levels of certainty are associated with each project in the Plan's ten-year period. Series Capacitor I is under construction, DPV2 is under review, and Series Capacitor II is undergoing initial studies. All three projects increase transfer capability.

Series Capacitor I is currently in the engineering and construction stage. It involves SCE's joint participation in upgrading series capacitors in two 500 kV lines interconnecting Arizona, Southern Nevada, and Southern California (defined as the East of the River path or Path 49), scheduled for operation in 2006. SCE will be upgrading one of the two lines, which is the Devers-Palo Verde 500 kV line. The final design of the project may not require changes to transmission lines, towers, or poles, but SCE has included the project in the Plan in case that assumption is incorrect.

The DPV2 project will be a second 500 kV transmission line from SCE's existing Devers Substation (near Palm Springs) to the Harquahala Generating Station switchyard (west of Phoenix, Arizona), tentatively scheduled for operation in 2009. Further project planning may result in SCE extending the proposed line 15 miles farther east to terminate in the Palo Verde/Hassayampa area.

The most tentative project is Series Capacitor II, which involves SCE upgrading series capacitors in the Moenkopi-Eldorado 500 kV line. The operating date of this project is expected to be after operation of the new DPV2 line in 2010. The final design of the project may not require changes to transmission lines, towers, or poles, but SCE has included the project in the Plan in case that assumption is incorrect.

Again, finalizing SCE's commitment to proceed with the three projects will depend on the location of future power generation development, continued customer load growth at currently forecast levels, economic transmission congestion relief, coordination with other transmission owners, and regulatory actions.

Pursuant to A.R.S. § 40-360.02(c)(7), where available the submitted Plan should also include technical study results and power flow stability analyses showing the effect on the current Arizona electric transmission system for the project identified. The available studies that have been performed are provided in Attachment B (WECC Accepted Path Rating Study - Southwest Power Link and Palo Verde – Devers 500 kV Series Capacitor Upgrade Project – Final Report) and Attachment C (Devers-Palo Verde No. 2 Project – WECC Comprehensive Progress Report). More technical details that support these narrative reports are available by contacting SCE. Written descriptions of each of the proposed transmission projects are provided in Attachment A.

Diagram 1
Series Capacitor Upgrade Project (2006)

Series Capacitor Upgrades:

1. **Palo Verde – Devers 500 kV Line**
2. **Hassayampa-N.Gila 500 kV Line**

Devers Upgrades:

1. Add SVC
2. Add New Transformer

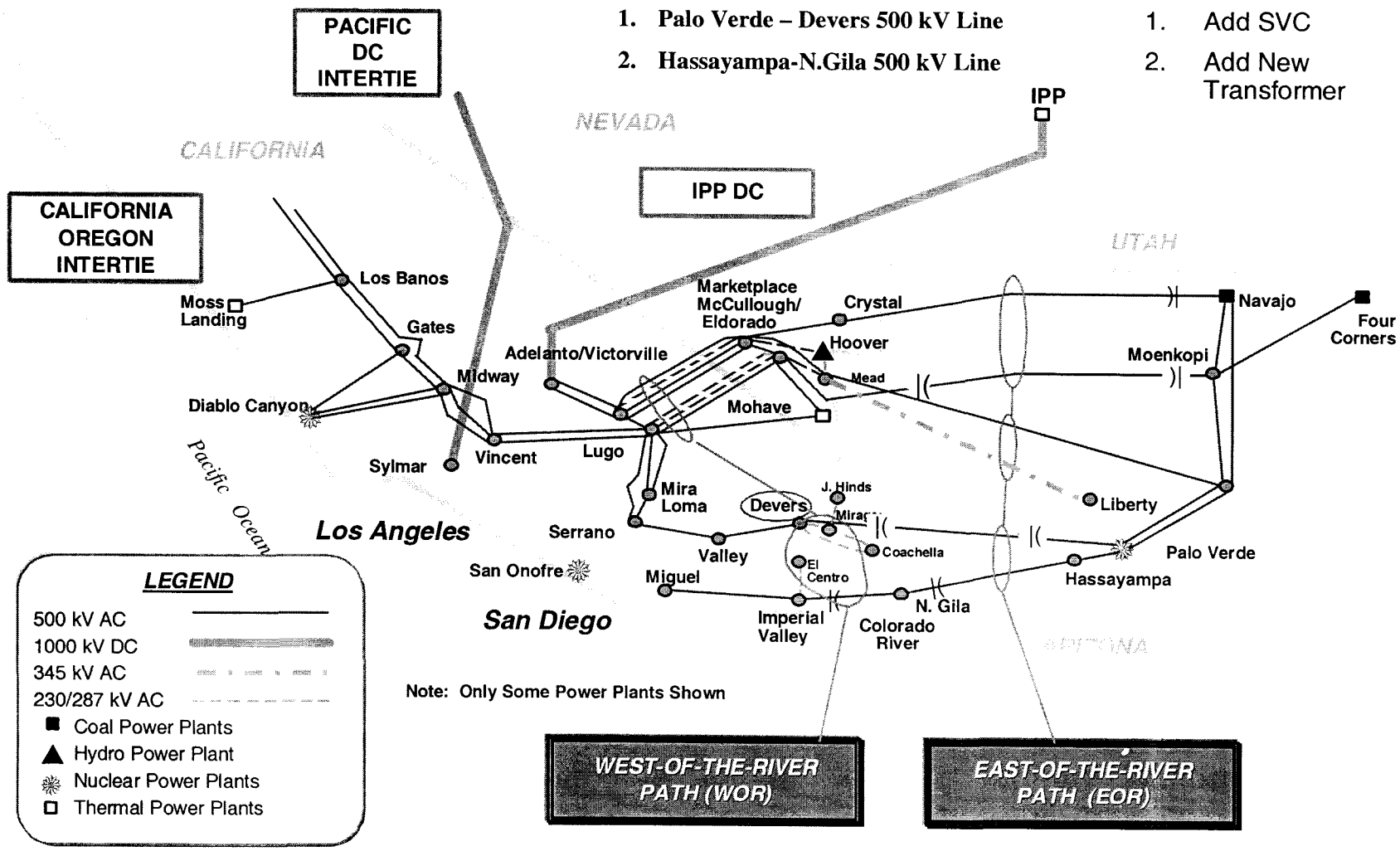


Diagram 2
Devers – Palo Verde No. 2 (2009)

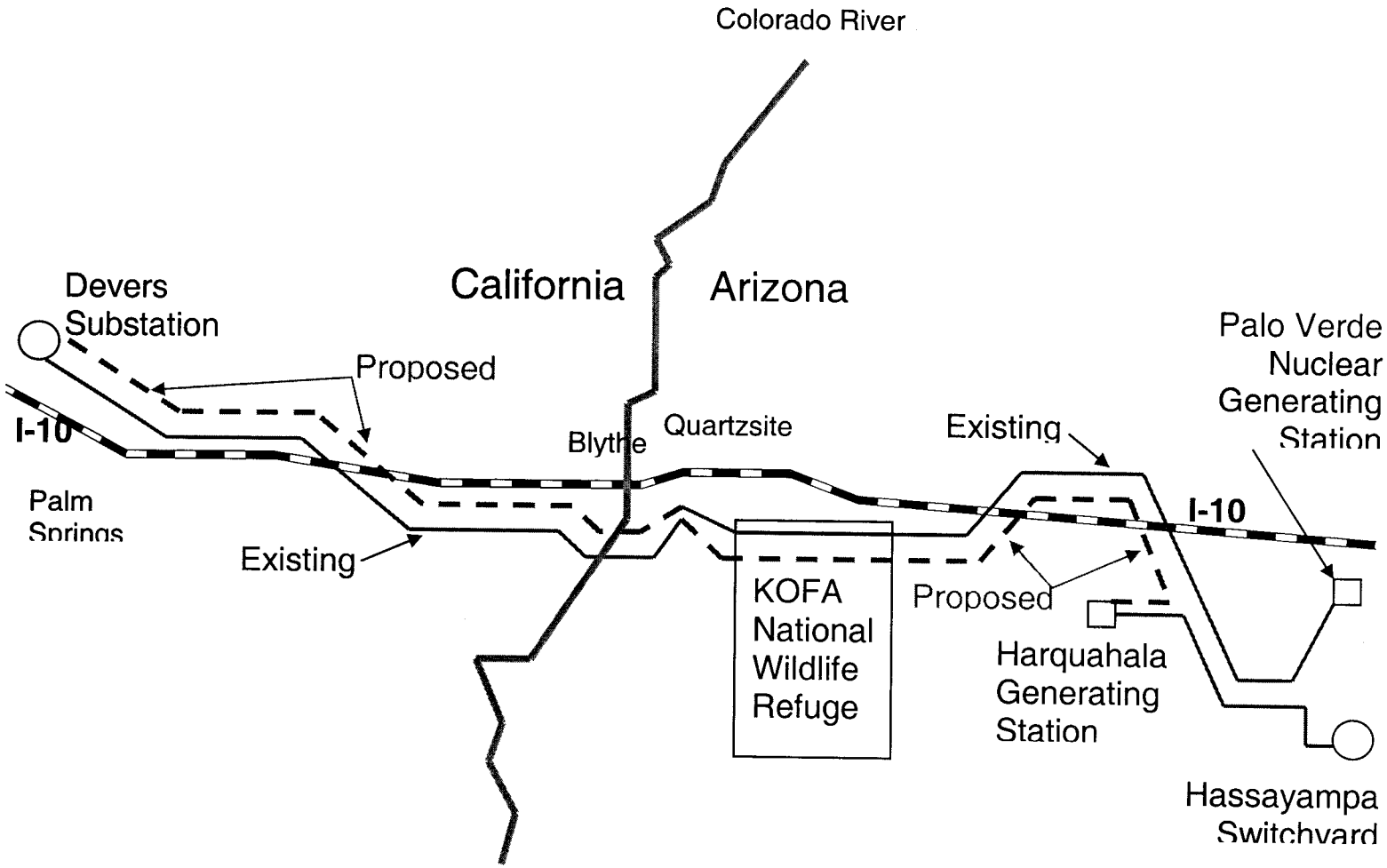
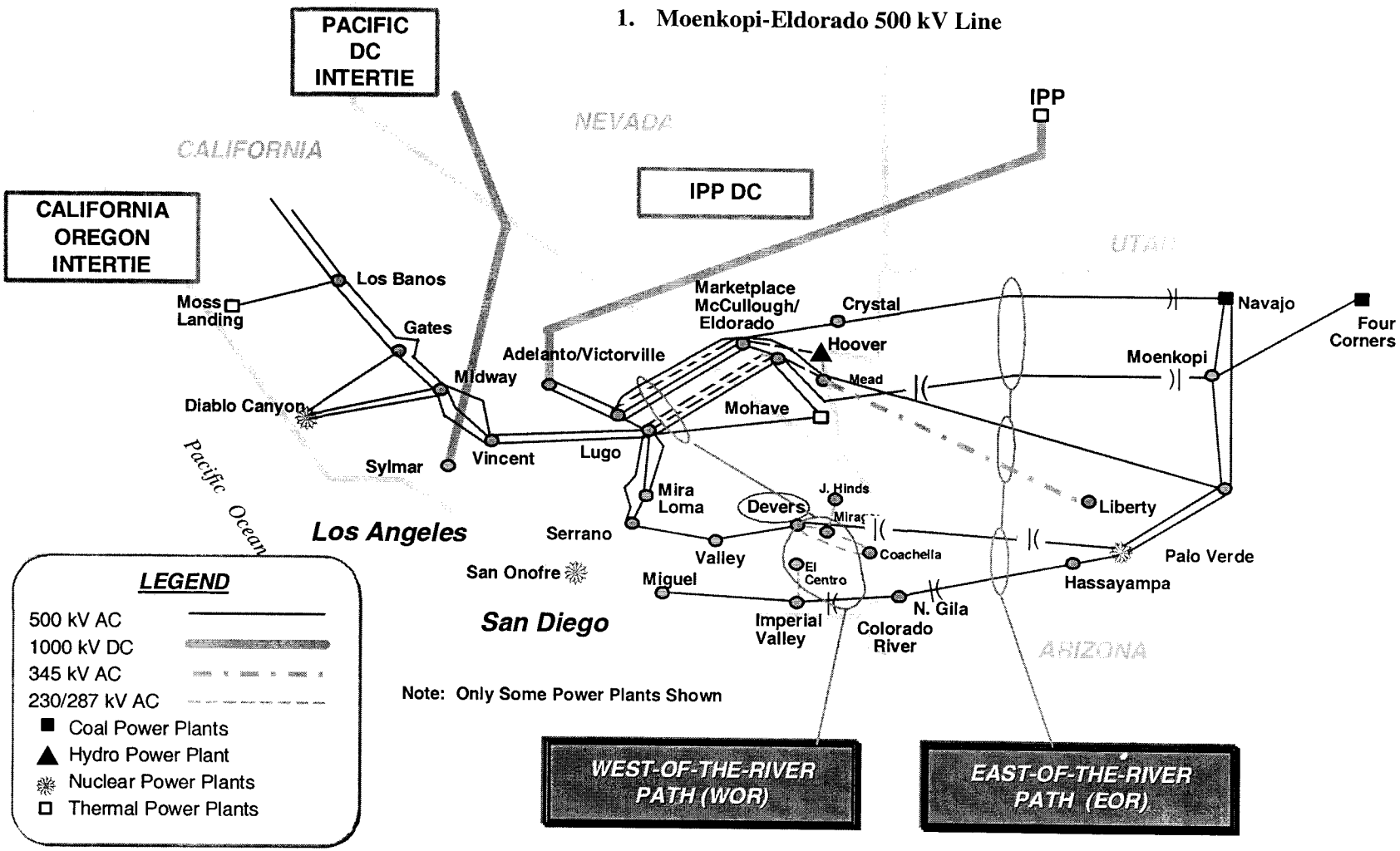


Diagram 3
Series Capacitor Upgrade Project (2010)

Series Capacitor Upgrades:

1. **Moenkopi-Eldorado 500 kV Line**



ATTACHMENT A

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN

Planned Transmission Project Descriptions

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN
2006

Line Description	Series Capacitor Upgrade Project
	SCE's Participation:
	Palo Verde-Devers 500 kV line
Size	
a) Voltage	500 kV AC
b) Capacity	252.5 MW
c) Point of Origin	Palo Verde Switchyard
d) Intermediate Point	None
e) Point of Termination	Devers Substation
f) Length	N/A
Routing	The upgraded series capacitors will replace the existing series capacitors in the SCE's 500 kV line without a change of location.
Purpose	The upgrading of the series capacitors allows for the increase in transfer capability from Arizona and Southern Nevada to Southern California and has an economic value from an adequacy stand point.
Date	
a) Construction Start	2005
b) Estimated In-Service	2006

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN
2009

Line Description	Devers-Palo Verde No. 2
Size	
a) Voltage	500 kV AC
b) Capacity	1200 MW
c) Point of Origin	Harquahala Substation
d) Intermediate Point	None
e) Point of Termination	Devers Substation
f) Length	230 miles (104 miles in Arizona and 126 miles in California)
Routing	The proposed line route between Devers and Harquahala parallels SCE's existing Palo Verde-Devers 500 kV line. Twenty miles of new right of way acquisition is required, assuming the existing BLM right of way is still available to SCE for the remaining 210 miles of the line route.
Purpose	This 500 kV line will increase transfer capability between Arizona to Southern California.
Date	
a) Construction Start	2006
b) Estimated In-Service	2009

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN
2010

Line Description	Series Capacitor Upgrade Project SCE's Participation With APS: Moenkopi-Eldorado 500 kV line
Size g) Voltage h) Capacity i) Point of Origin j) Intermediate Point k) Point of Termination l) Length	 500 kV AC to be determined Moenkopi Substation None Eldorado Substation N/A
Routing	The upgraded series capacitors will replace the existing series capacitors in the SCE's 500 kV lines without a change of location.
Purpose	The upgrading of the series capacitors allows for the increase in transfer capability from Arizona and Southern Nevada to Southern California and has an economic value from an adequacy stand point.
Date c) Construction Start d) Estimated In-Service	 2009 2010

ATTACHMENT B

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN

WECC Accepted Path Rating Study
Southwest Power Link and Palo Verde – Devers 500 kV Series Capacitor Upgrade Project
Final Report

WECC Accepted Path Rating Study

Southwest Power Link and Palo Verde – Devers 500 kV Series Capacitor Upgrade Project

Increasing the East of River Path (Path 49) rating from 7550 MW to 8,055 MW

Final Report
December 2, 2004

Approved by the WECC Peer Review Group and Western Arizona Transmission System (WATS) Task Force on November 30, 2004

Executive Summary

The East of River (EOR) path, WECC Path 49, consists of five 500 kV lines and one 345 kV line. The present non-simultaneous east to west rating is 7,550 MW. The six transmission lines connect the EHV system in Arizona with the EHV system in southern Nevada and southern California. Recent generation development in Arizona, in particular in the vicinity of the Palo Verde Nuclear Generating Station, has caused the southern EOR system (the Palo Verde – Devers and Hassayampa – North Gila 500 kV lines) to experience substantial congestion over the last few years. Unless system upgrades take place, this congestion is expected to increase further as the need to import power from new reliable sources into California grows.

This project proposes to replace the existing series capacitors on the Palo Verde – Devers and Hassayampa – North Gila – Imperial Valley 500 kV lines with series capacitors with higher thermal ratings. Also a second 500/230 kV transformer bank is needed at Devers Substation and a 230/230 kV phase-shifter to control the flow on the Imperial Valley – El Centro 230 kV line is part of this project. One 400 MVAR Static Var Compensator (SVC) will be added to support the simultaneous increase of EOR flow and import to Southern California (SCIT). A detailed list of the Plan of Service can be found in Section 2.B.

In response to the need for increased transfer capability on the two southern EOR lines, San Diego Gas and Electric (SDG&E) submitted on behalf on Sempra Energy Resources (SER) a consolidated initial project announcement and a comprehensive progress report to WECC to increase the rating of WECC Path 49 on March 28, 2003. The upgrade of the two southern EOR lines was also identified in the regional stakeholder forum called "STEP" (Southwest Transmission Expansion Plan) and is referred to in that forum as the "Short Term Upgrade". All the necessary upgrades are located within the fences of existing substations. The planned in-service date of this project is June 1, 2006.

The studies performed in this report concluded that the rating of the East of River interface can be increased by 505 MW from 7,550 MW to 8,055 MW with the Plan of Service as outlined in this report and meet the NERC/WECC Planning Standards. In addition, the voltage support devices added as part of the project enable the Southern California Import Transmission (SCIT) system limit to be increased by 505 MW as well based on the studies described in this report. No negative impact on any other WECC path from the increased flow on EOR was identified in the studies.

Since the Palo Verde – Devers and Imperial Valley – North Gila 500 kV lines are part of West of River (WOR), it is expected that a WOR rating study will be performed to match the increase of the EOR upgrade, or a curtailment procedure shall be implemented to ensure safe operation of the WOR.

It is expected that the WECC Review Group/WATS approved version of this report will enable the project to enter Phase III of the WECC path rating process.

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Appendix A Powerflow Diagrams and Study Results for Non-Simultaneous Cases

Appendix B Powerflow Diagrams and Study Results for EOR/SCIT Simultaneous Cases, Low Inertia with Mohave offline

Appendix C Powerflow Diagrams and Study Results for EOR/SCIT Simultaneous Cases, Low Inertia with Mohave online

Appendix D Powerflow Diagrams and Study Results for EOR/SCIT Simultaneous Cases, High Inertia (Mohave off)

Appendix E EOR/SCIT Sensitivity Study with maximum EOR flow

Appendix F EOR/Palo Verde Transmission System (PVTS)

Appendix G EOR/Valley Voltage

Appendix H EOR/G-2 of SONGS

Appendix I.1 EOR/Path 26 Sensitivity, COI at 4,800 MW and Path 15 at 2,200 MW

Appendix I.2 EOR/Path 26 Sensitivity, COI at 4,400 MW and Path 15 at 3,250 MW

Appendix J List of Study Participants

1. CONCLUSIONS

- Non-simultaneous studies performed with the EOR path modeled at 8,055 MW did not identify any element with loading above it's applicable rating during conditions with all lines in service or with a single element or a credible double element out of service.

- The status of the Mohave Generating Station (1580 MW) does not impact 8,055 MW as a new EOR path rating.

- The non-simultaneous studies demonstrate that all applicable voltage criteria including transient stability and post-transient voltage stability (reactive margin and voltage deviation) are met with the EOR path modeled at 8,055 MW.

- The existing interaction between East of River and the Southern California Import Transmission (SCIT) system was analyzed as part of this study. Various scenarios with different inertia levels in Southern California and with different scheduling of the proposed 505 MW increase in EOR and SCIT together with the Mohave Generating Station being on/off are described in this report. The studies demonstrated that with the voltage support equipment as outlined in the Plan of Service, SCIT can be increased by the same amount as EOR, by 505 MW.

- Transient stability studies performed as part of the EOR/SCIT simultaneous studies identified the Welton Mohawk 161 kV bus in the Yuma area as experiencing the highest first swing voltage dip with the Project in service. Historically, as well as in the pre-project cases, the buses with the highest voltage dip have been located around Devers/Valley Substations.

- The addition of the dynamic voltage support devices at Devers and Valley Substations serve a dual purpose; to mitigate transient voltage dip at Devers and Valley Substations and to provide dynamic reactive support in the post transient timeframe to sustain the loss of major elements in the system, like the loss of Serrano – Valley 500 kV line, a two unit outage of the San Onofre Nuclear Generating Station or loss of the Imperial Valley – Miguel 500 kV line with subsequent generation tripping and cross tripping of the La Rosita – Imperial Valley 230 kV line. The shunt capacitors at the Valley 500 kV bus are needed to provide reactive support to the system during normal operations during times with high load or high imports.

- All non-simultaneous and EOR/SCIT simultaneous studies performed demonstrated that the system retains angular stability after the loss of the major outlet lines from Palo Verde Nuclear Generating Station and the Navajo Generating Station with a 7% unit margin applied to each plant.

- Several sensitivity studies as specifically requested by the WECC Review Group/Western Arizona Transmission System ("WATS") were performed as part of this study. None of the sensitivity studies identified any negative impacts on the system studied. Also, no simultaneous interaction with other paths other than SCIT was identified.

2. INTRODUCTION

2.A Introduction

East of River (EOR) or WECC Path 49 currently consists of six transmission lines:

Navajo – Crystal 500 kV (metered at Navajo)
Moenkopi – Eldorado 500 kV (metered at Eldorado)
Liberty – Mead 345 kV (metered at Liberty)
Perkins – Mead 500 kV (metered at Perkins)
Palo Verde – Devers 500 kV (metered at Palo Verde)
Hassayampa – North Gila 500 kV (metered at Hassayampa)

The present east to west, non-simultaneous EOR rating is 7,550 MW. This rating is based on normal system conditions, all lines in service and full series compensation as outlined in the 2004 Arizona Security Monitoring Manual. The current 7,550 MW limit is due to the continuous rating of the series capacitors on the Palo Verde – Devers and the Hassayampa – North Gila 500 kV lines. Also, various line outages may result in loadings of close to 100% of applicable emergency ratings on several EOR lines in addition to the 500/230 kV transformer at Devers Substation.

Given the current constraints in the EOR interface and the recent development of new generation in Eastern Arizona, the two southern 500 kV lines (Palo Verde – Devers and Hassayampa – North Gila) have experienced significant congestion that is projected to increase during the next few years unless system upgrades take place. Technical and economic studies performed have shown that an upgrade of the Palo Verde – Devers and the Hassayampa – North Gila – Imperial Valley 500 kV lines provides substantial technical and economic benefits[1].

On March 28, 2003, San Diego Gas and Electric (SDG&E) submitted on behalf on Sempra Energy Resources (SER) a consolidated initial project announcement and a comprehensive progress report to WECC to upgrade the rating of WECC Path 49. The comprehensive progress report entitled "SWPL & PV – Devers 500 kV Series Capacitor Upgrade Transfer Capability Study" proposed to increase the path rating by 760 MW to 8,310 MW through various series capacitor upgrades and substation additions. SDG&E also initiated the WECC Review Group process pursuant to the WECC document "Procedures For Regional

[1] For more information related to the economic benefits of upgrading the EOR system see the "2003 Status Report for the Southwest Transmission Expansion Plan (STEP)" posted on the California ISO's website at http://www2.caiso.com/docs/2004/03/08/2004030814004810105.doc

Planning Project Review and Rating Transmission Facilities", issued in December 2001 and revised on 5-21-02. The WECC accepted the Path 49 Regional Planning Report on May 19, 2004.

The WECC Path 49 Review Group and the Western Arizona Transmission System (WATS) have conducted joint meetings with the kick-off meeting taking place in San Diego on May 16, 2003. On June 24, 2004, the sponsorship of the upgrades was transferred from SER to the California ISO. Formal Phase 2 status for the project was granted by WECC on October 18, 2004.

Through various study work performed after March 28, 2003 as part of the Review Group process, the scope of the facilities needed to upgrade EOR was modified and the proposed increase was reduced from 760 MW to 505 MW. The upgrade of the series capacitor at Navajo on the Navajo – Crystal 500 kV line was found to be not needed, and the emergency rating on the Perkins – Mead 500 kV series capacitors limited the new rating to 8,055 MW for the outage of the Palo Verde – Devers 500 kV line.

2.B Plan of Service

The increased rating of the East of the River interface from 7,550 MW to 8,055 MW includes the following upgrades to the system:

- Increase the current carrying capability of the series capacitors on the Hassayampa – North Gila – Imperial Valley 500 kV line to 2200 A normal with 135% overload capability.

- Increase the current carrying capability of the series capacitors on the Palo Verde - Devers 500 kV line to 2700 A normal with 135% overload capability.

- Install a second 1120 MVA 500/230 kV transformer at Devers Substation.

- Install a 300 MVA 230/230 kV phase-shifting transformer at Imperial Valley Substation. This phase-shifter will be used to control the flow on the Imperial Valley – El Centro 230 kV line.

- Install a 400 MVAR Static Var Compensator (SVC) at Devers 500 kV Substation.

The California ISO Board of Governors approved these upgrades on June 24, 2004. The projected in-service date is June 1, 2006.

2.C Voltage support at Valley

To meet the NERC/WECC reliability criteria, SCE will install the following equipment at Valley Substation:

- Install 2 x 100 MVAR Static Var Compensators (SVC's) at Valley 115 kV Substation.

- Install 2 x 150 MVAR shunt capacitors at Valley 500 kV Substation

The planned in-service date for the Valley voltage support project is May 2006.

The purpose of the installation of the voltage support equipment at Valley and Devers Substations is two-fold; to mitigate the transient voltage dip in the Devers/Valley area for loss of the Hassayampa – North Gila 500 kV line and to provide additional voltage support at Valley Substation during conditions with heavy loads and/or high import to Southern California.

2.C Geographic Map of Major Transmission Lines in the Southwest

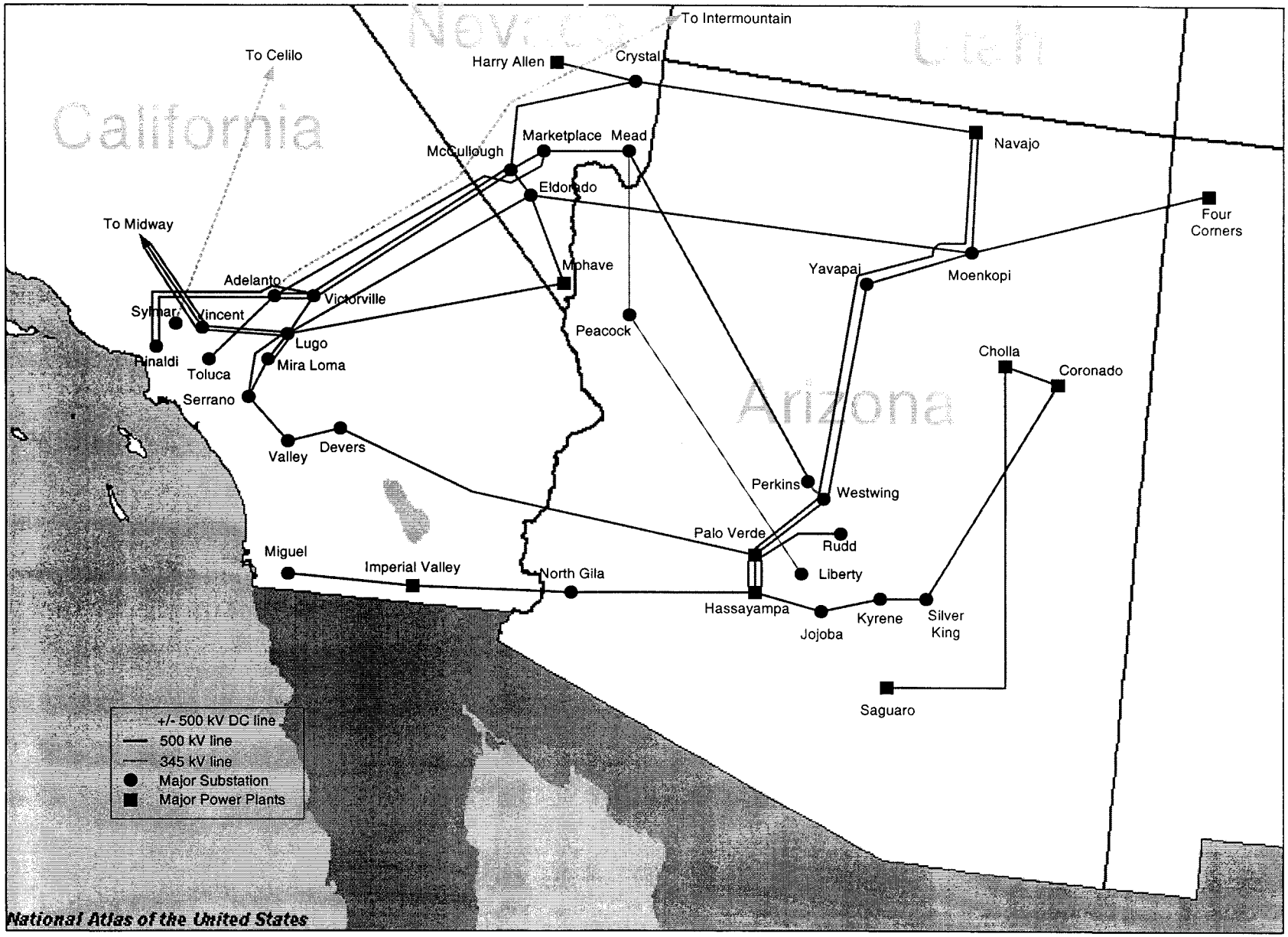


Figure 4; Geographic map of major transmission lines in the Southwest

2.D One Line Diagram of East and West of Colorado River Interfaces

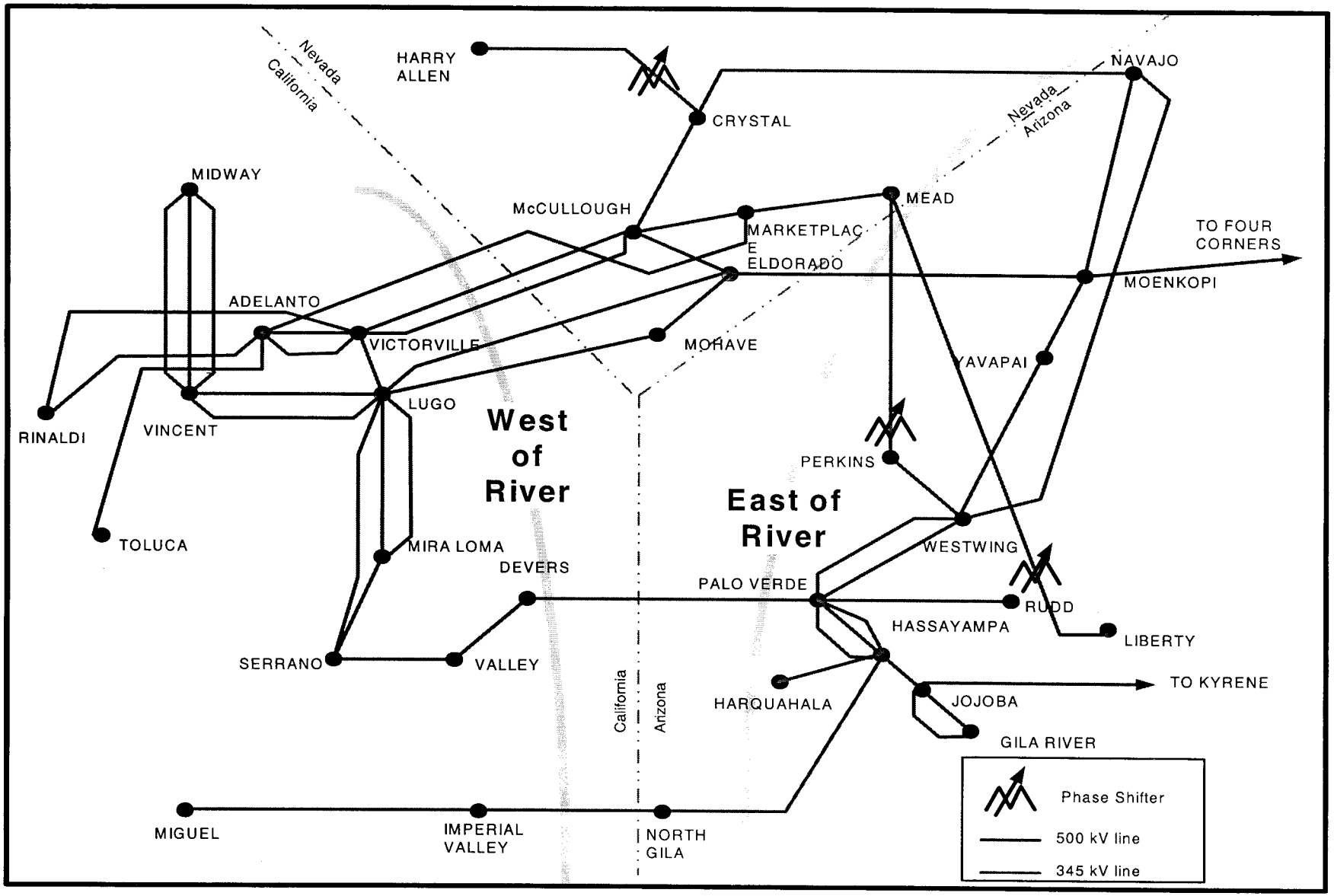


Figure 5; Map of 500 and 345 kV lines - East and West of River

3. STUDY OBJECTIVES

The objective of the study is to demonstrate that the rating of EOR can be increased from 7,550 MW to 8,055 MW and meet all applicable WECC/NERC Planning Standards. To achieve this increment of 505 MW, the Plan of Service as listed in 2.A is assumed. Technical assessment will be performed through powerflow, transient stability, and post-transient voltage stability analyses. The study effort will culminate in an Accepted Rating Report for submission to WECC Planning Coordination Committee giving the project WECC Phase 3 status.

4. STUDY CRITERIA AND STUDY ASSUMPTIONS

4.A Study Criteria

Powerflow

1. All line and transformer loadings must be below normal continuous ratings under pre-contingency conditions. For a single contingency, no transmission element will be loaded above its emergency rating.
2. Pre-disturbance bus voltages must be maintained between 0.95 p.u. and 1.05 p.u. and voltages for the major 500 kV buses in the Southwest cannot exceed 1.09 p.u.
3. The net VAR flow interchange with each interconnected utility shall be within limits established by the transmission owners.
4. Bus voltage deviations during contingency conditions shall not exceed 5% for single contingencies and 10% for double contingencies unless approved by the utility.

Transient Stability and Post Transient Voltage Deviation

1. Transient stability performance criteria are included in the WECC Standards. They are briefly summarized in the following table.

WECC DISTURBANCE-PERFORMANCE TABLE OF ALLOWABLE EFFECTS ON OTHER SYSTEMS

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard (See Note 2)
A	Not Applicable	Nothing in addition to NERC		
B	≥ 0.33	Not to exceed **25%** at load buses or **30%** at non-load buses. Not to exceed **20% for more than 20 cycles** at load buses.	Not below **59.6** Hz for 6 cycles or more at a load bus.	Not to exceed **5%** at any bus.
C	0.033 – 0.33	Not to exceed **30%** at any bus. Not to exceed **20% for more than 40 cycles** at load buses.	Not below **59.0** Hz for 6 cycles or more at a load bus.	Not to exceed **10%** at any bus.
D	< 0.033	Nothing in addition to NERC		

2. All machines in the system shall remain in synchronism as demonstrated by their relative rotor angles.
3. System stability is evaluated based on the damping of the relative rotor angles and the damping of the voltage magnitude swings.
4. The transient voltage dip should be maintained above 0.80 p.u. at Adelanto and Sylmar.
5. 7% unit margin should be applied to the Navajo Generating Station and the Palo Verde Nuclear Generating Station to demonstrate angular stability.

Reactive Margin/Post Transient Governor Load Flow

1. To demonstrate conformance with the NERC/WECC Planning Standards, the path flow level should be increased by 5 percent for single contingencies, and increased by 2.5% for double contingencies. Positive reactive margin is required in all cases.
2. For post-transient studies, generating units that cannot respond to low frequency with additional mechanical power will be modeled in the powerflow cases with the base load flag set to "1". This is consistent with WECC's Modeling and Validation Work Group's recommendation.
3. Generator MVAR limits are modeled as a single value for each generator since the reactive power capability curve can not be modeled in the powerflow program.
4. Shunt capacitors (132 MVAR) at Adelanto and Marketplace will be used if the post-transient voltage deviation exceeds 5% at those buses. Although modeled as shunt capacitors, the actual devices are automatically controlled SVC's.
5. Automatic Generation Control (AGC) is assumed to be suspended in the post transient time frame
6. Phase shifters are assumed to hold a fixed angle.
7. Voltage regulating transformers are modeled in the pre-disturbance position except where there is specific information to do otherwise.
8. Switched Shunt Devices: Switched shunts are locked in the pre-disturbance position unless specified by the utility. Note: SCE's Centralized Grid Capacitor Control (CGCC) will be utilized. The control scheme divides the 3000 MVAR of RMR capacitors into four regions, only one capacitor per region is switched on at a time in Sequential, Remote Operation Mode (based on local voltage and Von/Voff switching thresholds).

4.B Study Assumptions

1) Generation assumptions:

a. Mountainview units, connected at SCE's San Bernardino 230 kV Substation were assumed to be online in the cases.
b. Mountain Vista units 3 and 4 connected at SCE's Etiwanda 230 kV Substation were assumed to be offline in this study
c. A total of 6,300 MW of new generation is included in and around the Hassayampa switchyard. The details of the new generation in Arizona are as follows:

Harquahala	6 units 1170 MW
Arlington Valley	3 units 600 MW
Mesquite	6 units 1250 MW
Red Hawk	6 units 1000 MW
Gila River	12 units 2080 MW

d. The following new generation is included near Las Vegas in the Southern Nevada area:

Apex (Mirant)	3 units 550 MW
Bighorn	3 units 570 MW
Silverhawk	3 units 590 MW

e. Palo Verde nuclear units 1 and 2 were assumed to have completed the upgrade of their steam turbine:

Palo Verde Unit 1:	1,403 MW
Palo Verde Unit 2:	1,400 MW
Palo Verde Unit 3:	1,352 MW

f. Both SONGS units are online in this study.
g. Blythe I Generation Project of approximately 520 MW is included.

2) New Transmission Project Assumptions

a. The Centennial Project in Southern Nevada is assumed to be in service.
b. The Miguel-Mission No. 2 230 kV line and the second Miguel 500/230 kV transformer are assumed to be in-service.
c. The third Sylmar 220/230 kV transformer is included.
d. The upgrade of PDCI (1550MW/1550MW) is assumed to have been completed.
e. In the study cases with Mohave offline, the compensation on the Mohave – Lugo 500 kV line was assumed to be 70% (both series capacitors in service). In the scenarios with Mohave online the compensation was modeled at the current level of 26 %.

3) WECC Major Path Flow/Path Rating Assumptions

The transmission paths listed below are the major paths for California. The non-simultaneous rating of each path is listed.

	Transfer Path	Path Rating (MW)
Path 49	EOR	8055
Path 46	WOR	10118
Path 26	M-V	3400(N-S)/3000(S-N)
Path 27	IPPDC	1920
Path 65	PDCI	3100
Path 66	COI	4800(N-S)/3675(S-N)
Path 45	CFE-SDG&E	800 (S-N)/408 (N-S)

4) Updates to the study cases

Numerous updates to the powerflow cases were received from the peer review group during the study process. Two changes had significant impact on the study results as compared to previous studies; the updated impedance on the Navajo – Crystal 500 kV line and the enhanced modeling of the Palo Verde – Devers 500 kV line (a five section line model replaced the old three section line model).

5. NON-SIMULTANEOUS STUDY

5.A Study Methodology

(1) The powerflow base cases and dynamic stability data including the new WECC approved governor models were developed in General Electric PSLF 13.1 format.

(2) For all areas outside the study area (Southern Nevada, Arizona and Southern California), the network topology and loads reflect information provided to WECC by each respective area.

(3) Compliance with the WECC/NERC Planning Standards is required.

A Heavy Autumn (HA) 2006 case was used to perform the non-simultaneous study. Due to the uncertainty surrounding the operational status of the Mohave Generating Station beyond 2005, two post-project scenarios were developed; with and without Mohave online. The pre-project cased modeled the EOR interface at the current path rating of 7,550 MW and the post-project cases modeled EOR at 8,055 MW. This resulted in the following three cases for the non-simultaneous portion of the path rating study:

Case 1:2006 HA pre-project case with Mohave offline
Case 2:2006 HA post-project case with Mohave offline
Case 3:2006 HA post-project case with Mohave online

In Case 3, with Mohave online, the 1,500 MW from Mohave was scheduled to the following entities:

SCE:	500 MW
SDG&E:	95 MW
DWP:	175 MW
NPC:	280 MW
PG&E:	450 MW

It should be noted that this does not reflect the ownership of Mohave. The powerflow cases are "flow based"; specific contracts and unit ownership are not modeled. In the cases with Mohave offline, the compensation on the Mohave – Lugo 500 kV line was set to 70% (35% compensation in each end of the line). 26% compensation was assumed in the scenario with Mohave online.

The generation from Imperial Valley was modeled at a reduced level to achieve the desired flow on the Hassayampa – North Gila 500 kV line; 120 MW of generation was modeled as online in the non-simultaneous cases.

5.B Summary Results Non-Simultaneous Cases

5.B.1 Powerflow

1. No transmission element was loaded above 100% of its continuous rating under base case conditions in the pre or post-project cases. For loss of a single element or loss of a credible double element, no transmission system element was loaded above its applicable emergency rating.

2. The series capacitor on the Hassayampa – North Gila 500 kV line was loaded at 98% of its 30 minute rating for loss of the Palo Verde – Devers 500 kV line and the Palo Verde – Devers 500 kV line was loaded at 93% of its 30 minute rating for loss of the Hassayampa – North Gila 500 kV line in the pre-project case.

3. The following table summarizes the flow distribution between the six EOR lines in the pre and post-project scenarios:

	Pre-Project (Mohave off)	Post-Project (Mohave off)	Post-Project (Mohave on)
Navajo – Crystal 500 kV	1464.6 MW	1497.3 MW	1472.6 MW
Eldorado – Moenkopi 500 kV	1418.7 MW	1454.9 MW	1415.3 MW
Liberty – Mead 345 kV	450.0 MW	450.0 MW	450.4 MW
Perkins – Mead 500 kV	1298.6 MW	1298.4 MW	1300.0 MW
Palo Verde – Devers 500 kV	1649.4 MW	1732.5 MW	1740.8 MW
Hassayampa – North Gila 500 kV	1268.9 MW	1622.3 MW	1676.3 MW

   Powerflow diagrams of all EHV lines in the study area can be found in Appendix A.

4. The El Centro 230/161 kV transformer was loaded at 100% of its emergency rating for loss of the North Gila – Imperial Valley 500 kV line in the pre-project case.

5. The thermal limitation in the post-project cases was found to be the 30 minute rating on the series capacitors on the Perkins – Mead 500 kV line for loss of the Palo Verde – Devers 500 kV line.

6. The scenario with Mohave online increased the Palo Verde West flow as compared to the scenario with Mohave offline.

5.B.2 Post Transient Voltage Deviation

1. Bus voltage deviations did not exceed 5 percent of its initial voltage during single contingency conditions or 10 percent during double contingency conditions.

5.B.3 Reactive Margin

1. Positive margins were established following all contingencies applied in the pre and post-project cases. EOR was increased by 5% during single contingency conditions and by 2.5% during double contingency conditions.

2. The reactive margin was measured at four locations as described in the studyplan (Adelanto 500 kV (measured at Victorville 500 kV), Kyrene 230 kV, Pinnacle Peak 230 kV and Iron Mountain 230 kV Substations). The reactive margin was within criteria for each substation for all contingencies applied. Detailed results can be found in Appendix D.7.

5.B.4 Transient

1. All machines in the WECC interconnection remained in synchronism and were well damped. All disturbances met the NERC/WECC transient stability criteria. The SVC's at Devers and Valley Substations were not needed in any of the post-project cases in order to comply with the transient stability criteria.
2. The system retained angular stability after the loss of either the Navajo – Crystal 500 kV line or the Moenkopi – Eldorado 500 kV line with 7% unit margin on the Navajo units (additional 171 MW output). Also, with 7% unit margin on the Palo Verde units (additional 374 MW) the system retained angular stability after the loss of either the Palo Verde – Devers 500 kV line or the Hassayampa – North Gila 500 kV line.

Detailed results can be found in Appendix A.

6. SIMULTANEOUS EOR/SCIT STUDY

6.A Study Methodology

Powerflow cases were developed to assess the impact from the increased East of River flow on the Southern California Import Transmission (SCIT) system. Thermal, post-transient studies (reactive margin and voltage deviation) and transient stability studies were performed to study the relationship between SCIT and a heavily stressed EOR system in the projected 2006 timeframe. The WECC Review Group requested that two sets of scenarios be developed; low and high SCIT inertia.

The following methodology developed by the Review Group was used to stress the EOR and SCIT transmission paths in the simultaneous EOR/SCIT study cases:

1. The scenario with low inertia should have a reduced load level modeled in the study area (off-peak, about 75% of peak load) and the SCIT inertia should be around 75,000 MWS. The study cases with high inertia needs to model anticipated peak load conditions in Arizona, Southern Nevada and Southern California. The SCIT inertia should be around 100,000 MWS in the heavy summer cases.

2. The EOR and SCIT interfaces will be stressed in the pre-project cases to establish the simultaneous EOR/SCIT stability limit. The case that is marginally stable (any further increase in EOR or SCIT will cause a stability violation) will be used as a pre-project benchmark case. The benchmark case needs to meet all applicable reliability criteria.

3. The benchmark case needs to be at or above the SCIT nomogram (no margin) developed in 1996.

4. In the post-project cases, both EOR and SCIT will be increased by the proposed increment in EOR path rating, 505 MW. Additional voltage support will be added until the post-project case meets all applicable reliability criteria.

5. Available generation in the Hassayampa/Palo Verde area will be utilized to increase the EOR and SCIT flow in the post-project cases. Power will be scheduled in two different ways, to SCE/DWP/SDG&E based on a 55/30/15 split and to SCE/SDG&E based on a 85/15 split. The SCE/DWP/SDG&E units have to be located geographically inside Southern California.

6.B. Low Inertia EOR/SCIT Study

6.B.1. Study Assumptions and Methodology to stress EOR and SCIT

The following six cases were developed to perform the low inertia, simultaneous EOR/SCIT study:

1) Pre-project case with Mohave offline.
2) Post-Project with Mohave offline. The 505 MW increase in EOR and SCIT was scheduled to SCE and SDG&E based on a 85/15 split. Generation from Encina (SDG&E), Ormond Beach (SCE) and Alamitos (SCE) were reduced and generation from units connected to the Hassayampa 500 kV switchyard were increased.
3) Post-Project with Mohave offline. The 505 MW increase in EOR and SCIT was scheduled to SCE, DWP and SDG&E based on a 55/30/15 split. Generation from Encina (SDG&E), Ormond Beach (SCE), Alamitos (SCE), Castai (DWP) and Haynes (DWP) were reduced and generation

from units connected to the Hassayampa 500 kV switchyard were increased.

4) Pre-project case with Mohave online.
5) Post-Project with Mohave online. The 505 MW increase in EOR and SCIT was scheduled to SCE and SDG&E based on a 85/15 split. Generation from Encina (SDG&E), Ormond Beach (SCE) and Alamitos (SCE) were reduced and generation from units connected to the Hassayampa 500 kV switchyard were increased.
6) Post-Project with Mohave online, the 505 MW increase in EOR and SCIT was scheduled to SCE, DWP and SDG&E based on a 55/30/15 split. Generation from Encina (SDG&E), Ormond Beach (SCE), Alamitos (SCE), Castai (DWP) and Haynes (DWP) were reduced and generation from units connected to the Hassayampa 500 kV switchyard were increased.

In the scenarios with Mohave online, the 1,500 MW from Mohave was scheduled to the following entities:

SCE:	500 MW
DWP:	300 MW
NPC:	210 MW
PG&E:	490 MW

It should be noted that this does not reflect the ownership of Mohave, the powerflow cases are "flow based"; specific contracts and unit ownership are not modeled. In the cases with Mohave off the compensation on the Mohave – Lugo 500 kV line was set to 70% (35% compensation in each end of the line). 26% compensation was assumed in the scenario with Mohave online.

The following steps were taken to establish the stability limit in the pre-project benchmark study cases:

1) The flow on the Hassayampa – North Gila and Palo Verde – Devers 500 kV lines (PV West) was maximized. Due to the pre-project ratings on the series capacitors on these two lines, the flow could not exceed about 2900 MW (limited by the N-1 rating on Hassayampa – North Gila 500 kV line for loss of Palo Verde – Devers 500 kV line). (The current scheduling limit on Palo Verde West is 2,823 MW).
2) The SCIT paths were increased by removing generating units from SCE's coastal areas and San Diego, replacing internal generation with imports from outside the boundary of SCIT. Powerflow diagrams including flows on various paths and constrained interfaces in addition to the load, generation, and import levels in the study area can be found in Appendix B and C for each scenario.

3) The number of Hassayampa units online was kept at a minimum. Previous Palo Verde Transmission System (PVTS) studies have shown the inertia/reactive support from the Hassayampa/Palo Verde units to impact the EOR/SCIT stability limit. It should be noted that high Palo Verde East flow adds stress to the system. High generation output from the units online at Hassayampa was therefore modeled. (A separate sensitivity study was performed with maximum Palo Verde East flow to assess the impact on the EOR/SCIT stability limit).
4) One of the two Mountainview plants (2 CT's and one ST) was assumed to be offline. Previous studies have shown that the presence of the Mountainview units has a positive impact on the voltage dip in the Devers area, which is the main limitation in the EOR/SCIT nomogram. The Mountainview plant will connect to SCE's San Bernardino 230 kV Substation which is connected to the Devers 230 kV Substation via two 230 kV transmission lines. The Etiwanda 3&4 units were assumed to be retired.
5) The amount of generation online at Imperial Valley was minimized in order to stress the PV West flow and mitigate the loss of the Imperial Valley – Miguel 500 kV line. Only 400 MW of the 1660 MW of generation recently completed in Mexico near Imperial Valley Substation was assumed to be online (any further reduction caused the Hassayampa – North Gila to experience an N-1 overload).
6) The phase shifters in the Four Corners area (TOT2A and TOT2B) were used to stress the EOR system in the pre and post-project cases.

6.B.2. Study Conclusions EOR/SCIT Simultaneous Study with Low Inertia

Based on the results of the study, the following conclusions can be made:

1. The SCIT flow in the pre-project benchmark cases was found to be almost 3,000 MW (with Mohave offline) and about 1,600 MW (with Mohave online) above the line in the 1996 SCIT nomogram (see Appendix B.6 and C.6).

2. In the pre-project study cases, 62.6 % (with Mohave offline) and 63.4 % (with Mohave online) of total load in SCE, DWP and SDG&E was served from imports through the five SCIT paths. In the post-project cases the corresponding import number is 64.8% (with Mohave offline) and 65.5 % (with Mohave online).

3. The pre-project benchmark cases were limited by the loss of Imperial Valley – Miguel 500 kV line due to very low level of generation online in SCE's coastal areas and at the same time high import. Any further

increase of either SCIT or EOR in the pre-project cases would have caused a voltage collapse for this outage.

4. The historically known voltage dip criteria violation in the Devers area was not the limiting element in the pre-project cases. Compared to similar previous studies this was attributed in large by the replacement of the three section line model of the Palo Verde – Devers 500 kV line by the more correct five section line model. (Transient stability studies showed that the five section line model reduced the need for dynamic voltage support at Devers by about 300 MVAR as compared to studies with the three section line model).

5. The status of Mohave did not impact the need for additional voltage support in the post-project cases. This conclusion is based on that both pre-project cases (with and without Mohave) are stressed to their respective stability limits. The stability limit for each scenario is different; the cases with Mohave offline have a higher operating point in the SCIT/EOR nomogram as compared to the cases with Mohave online. This can be attributed to the increase in the West of River flow in the scenarios with Mohave online. The inertia from the two Mohave units is also included in the total SCIT inertia as it is calculated today. Conditions with high WOR and EOR flow are more limiting with respect to the EOR/SCIT stability limit as compared to conditions with high EOR flow and high Path 26 flow (total SCIT flow is the same).

6. Transient voltage violations were identified in the post-project cases in the Devers/Valley area without additional voltage support. A four cycle, three phase fault on the Hassayampa 500 kV bus with subsequent loss of the Hassayampa – North Gila 500 kV line was identified to be the most limiting contingency. The addition of the voltage support devices as outlined in the Plan of Service mitigated these violations and significantly improved the voltage performance in the Devers/Valley area. With the addition of the voltage support in the post-project cases the bus with the highest transient voltage dip was identified to be the Welton Mohawk 161 kV bus (WAPA) in the Yuma area. (The bus with the highest transient voltage dip in the pre-project cases was the High Desert 115 kV bus (SCE), connected under Devers Substation). No significant difference was observed between the scenarios with the 505 MW increase in EOR and SCIT scheduled to SCE/SDG&E based on a 85/15 split and when the increase was scheduled to SCE/DWP/SDG&E based on a 55/30/15 split.

7. The addition of voltage support at Devers and Valley Substations in the post-project cases was also needed to prevent a voltage collapse after loss of the Imperial Valley – Miguel 500 kV line.

8. All machines in the WECC interconnection remained in synchronism and were well damped for all contingencies studied. All disturbances met the NERC/WECC transient stability criteria in all pre and post-project cases. Transient stability plots of the most limiting outage, a four cycle, three phase fault on the Hassayampa 500 kV bus with subsequent loss of the Hassayampa – North Gila 500 kV line can be found in Appendix B and C. Additional transient stability plots are available upon request.

9. The system retained angular stability after the loss of either the Navajo – Crystal 500 kV line or the Moenkopi – Eldorado 500 kV line with 7% unit margin on the Navajo units (additional 171 MW output). Also, with 7% unit margin on the Palo Verde units (additional 374 MW) the system retained angular stability after loss of either the Palo Verde – Devers 500 kV line or the Hassayampa – North Gila 500 kV line.

10. All pre and post-project cases met all applicable reliability criteria, including thermal, transient and post transient voltage (reactive margin and voltage deviation) criteria.

Detailed results can be found in Appendix B and C.

6.C. High Inertia EOR/SCIT Study

6.C.1. Study Assumptions and Methodology to stress EOR and SCIT

The following two cases were developed to perform the high inertia, simultaneous EOR/SCIT study:

1) Pre-project case (Mohave offline).
2) Post-Project, the 505 MW increase in EOR and SCIT scheduled to SCE and SDG&E pr. an 85/15 split (Mohave offline).

70 % compensation was modeled on the Mohave – Lugo 500 kV line in this scenario.

The following steps were taken to establish the stability limit in the pre-project benchmark study cases:

1) Flow on the Hassayampa – North Gila and the Palo Verde – Devers 500 kV lines (PV West) was maximized. Due to the pre-project ratings on the series capacitors on these two lines the flow could not exceed about 2850 MW (limited by the N-1 rating on Hassayampa – North Gila 500 kV line for loss of Palo Verde – Devers 500 kV line). The current scheduling limit on Palo Verde West is 2,823 MW.
2) 1,060 MW of the 1,660 MW of generation recently completed in Mexico near Imperial Valley Substation was modeled as online.

3) The SCIT paths were increased by removing generating units in SCE's coastal areas and San Diego, replacing internal generation with imports from outside of the boundary of SCIT. As can be seen in the table below, four of the five SCIT paths were maximized in both the pre and post-project scenario.

SCIT Path	Path Rating	Pre-Project case	Post-Project case
Path 26 (Midway – Vincent)	3,400 MW	3,400 MW	3,403 MW
Path 65 (Pacific DC Intertie)	3,100 MW	3,104 MW	3,104 MW
Path 27 Intermountain Power Project DC line	1,920 MW	1,925 MW	1,925 MW
North of Lugo[2]	1,200 MW[3]	1,463 MW	1,463 MW
Path 46 West of River	10,118 MW	6,832 MW	7,339 MW
Total SCIT flow[4]		**16,303 MW**	**16,809 MW**

4) All available resources in Southern Nevada were used to stress the West of the River flow. However, WOR did only reach a moderate level due to the Mohave units being offline and the presence of peak load conditions in Southern Nevada.
5) The phase shifters in the Four Corners area (TOT2A and TOT2B) were utilized to stress the EOR system in the pre and post-project cases.
6) The number of Hassayampa units online was kept at a minimum. Previous Palo Verde Transmission System (PVTS) studies have shown the inertia/reactive support from the Hassayampa/Palo Verde units to impact the EOR/SCIT stability limit. It should be noted that high Palo Verde East flow adds stress to the system. High generation output from the units online at Hassayampa was therefore modeled. (A separate sensitivity study was performed with maximum Palo Verde East flow to assess the impact on the EOR/SCIT stability limit).

6.C.2. Study Conclusions EOR/SCIT Simultaneous Study with High Inertia

Based on the results of the study the following conclusions can be made:

1. The SCIT/EOR operating point in the pre-project case satisfied the 1996 SCIT nomogram (no margin). The SCIT/EOR operating points in the pre and post-project cases are plotted in Appendix D.

2. The EOR and SCIT flows were limited by the thermal rating on the series capacitors on the Palo Verde – Devers and Hassayampa – North Gila – Imperial

[2] Not a WECC rated path
[3] Flow North of Lugo not limited to 1,200 MW
[4] Flow measured in receiving end

Valley 500 kV lines (the N-1 rating on Hassayampa – North Gila 500 kV in particular). This limited the total flow west of Palo Verde to about 2,850 MW in the pre-project case.

3. Generation re-dispatch was used to mitigate potential criteria violations in the pre-project case. All of these are considered to be "downstream" facilities from EOR:

   a) Loss of Imperial Valley – Miguel 500 kV line limited the import into San Diego. A potential voltage collapse limited the flow on the Imperial Valley – Miguel 500 kV line and required a certain amount of online generation within the SCE area. Also the San Luis Rey – San Onofre 230 kV line (South of SONGS) was loaded at 100% of its N-1 rating in the post-project case. Most of the internal generation in San Diego was therefore dispatched to mitigate for the Imperial Valley – Miguel 500 kV outage.
   b) Voltage deviation higher than 5% for loss of the PDCI (3,100 MW) limited the import into LADWP control area. Internal DWP generation was used to mitigate this in the pre-project case.
   c) Emergency overloading on Antelope – Vincent 230 kV line for loss of the PDCI (3,100 MW) required SCE generation from the Big Creek units to be dispatched. (The short term emergency rating was used to mitigate this in the post-project case).
   d) Post-transient voltage deviations in the Montrose/Hesperus 345 kV system limited the flow on TOT2A and TOT2B for loss of PDCI (3,100 MW). Some of the TOT phase shifters were also at or close to their angular limit.

4. No transient voltage dip criteria violations or undamped oscillations were found in either the pre or post-project cases even without the additional voltage support as outlined in the Plan of Service.

5. Voltage support at Devers was needed in the post-project case to prevent a voltage collapse after loss of Imperial Valley – Miguel 500 kV line. The additional voltage support devices at Valley and Devers Substations were found to be adequate to mitigate any post-transient voltage concerns for this outage in the analysis performed.

6. All machines in the WECC interconnection remained in synchronism and were well damped. All disturbances met the NERC/WECC transient stability criteria in both the pre and post-project case. Transient stability plots of the most limiting outage, a four cycle, three phase fault on the Hassayampa 500 kV bus with subsequent loss of the Hassayampa – North Gila 500 kV line can be found in Appendix D. Additional transient stability plots are available upon request.

7. The system retained angular stability after loss of either the Navajo – Crystal 500 kV line or the Moenkopi – Eldorado 500 kV line with 7% unit margin on the Navajo units (additional 171 MW output). Also, with 7% unit margin on the Palo

Verde units (additional 374 MW), the system retained angular stability after loss of either the Palo Verde – Devers 500 kV line or the Hassayampa – North Gila 500 kV line.

8. Both pre and post-project cases met all applicable reliability criteria, including thermal, transient and post transient voltage (reactive margin and voltage deviation) criteria

Detailed results can be found in Appendix D.

7. SENSITIVITY STUDIES

7.A EOR/SCIT Simultaneous Study with maximum EOR flow

Objective: To study the simultaneous interaction between SCIT and the increased flow on East-of-River. The study would assess the impact on transient stability performance and quantify the need for dynamic voltage support at Devers Substation. In the study, EOR should be modeled at its maximum pre-project (7,550 MW) and post-project(8,055 MW).

Study Methodology: An already developed SCIT/EOR case was used as a starting point. The pre-project case was a low SCIT inertia case with Mohave offline; the case is documented in Appendix B. EOR was increased by 314 MW, from 7,236 MW to 7,550 MW in the pre-project sensitivity scenario, primarily by utilization of the phase shifters located in the Four Corners area (TOT2A and TOT2B). Some of the SCIT paths were adjusted to ensure that the pre-project sensitivity case met all applicable reliability criteria. Total SCIT flow and SCIT inertia were kept at the same level as in the starting case in order to assess the impact from the increased EOR flow.

It should be noted that only the flow on the two northern EOR lines, the Moenkopi – Eldorado and Navajo – Crystal 500 kV lines picked up the additional 314 MW on the EOR interface in the pre-project case. The flow on the Palo Verde – Devers and Hassayampa – North Gila 500 kV lines ("PV West") was already at it's maximum in the starting case and could therefore not be increased any further.

The post-project sensitivity case was developed the same way as the post-project "base case" (from Appendix B). The additional EOR increase of 505 MW was scheduled to SCE and SDG&E based on a 85/15 split.

The following table summarizes important flows/parameters between the low inertia starting case ("Base Case") and the requested sensitivity:

	"Base Case"		Sensitivity with EOR @ max	
	Pre (MW)	Post (MW)	Pre (MW)	Post (MW)
EOR	7236	7742	7550	8055
SCIT	14,920	15,428	14,912	15,416
SCIT Inertia	75,900	75,900	76,800	76,800
Palo Verde West	2914	3245	2923	3240
Palo Verde East	1811	2005	1617	1856
WOR	7916	8431	7614	8135
PDCI	3104	3104	2002	2002
IPPDC	1925	1925	1754	1754
P-26	1295	1288	2439	2424
N. of Lugo	1098	1098	1307	1307
# of Hass. Units online	5 units	9 units	5 units	9 units

A powerflow diagram of the pre and post-project sensitivity cases is provided in Appendix E. Also transient stability plots of the most significant outage, a four cycle, three phase fault on the Hassayampa 500 kV bus with subsequent loss of the Hassayampa – North Gila 500 kV line is included in Appendix E.

Study Results: The increase in EOR flow in the sensitivity case did not increase the need for dynamic voltage support. In fact, the need for voltage support decreased from 160 MVAR in the "base case" scenario to 0 MVAR in the sensitivity case. This was attributed in large by the decrease in WOR and Palo Verde East as can be seen in the table above.

Study Conclusion: The additional flow modeled on the two northern EOR lines does not contribute to the need for dynamic voltage support to mitigate the transient voltage dip at Devers after a 3 phase fault on the Hassayampa 500 kV bus with the subsequent loss of the Hassayampa – North Gila 500 kV line.

7.B EOR/Palo Verde Transmission System (PVTS)

Objective: Study the simultaneous interaction between the increased flow on EOR and the Palo Verde Transmission System (PVTS). EOR will be modeled as high as possible, with the phase shifters at Perkins and Liberty bypassed to reflect a realistic operating scenario. The proposed 505 increase in EOR should added to the two southern EOR lines only. With the project in service, the PV West flow needs to be at 3,328 MW (2823 MW + 505 MW). At the same time, maximum Palo Verde East flow should be modeled. Maximum Palo Verde East is reached when the flow on Jojoba – Kyrene 500 kV line is at 2,000 A. Only a post-project scenario is required. The impact on transient stability performance including the need for dynamic voltage support at Devers Substation for an outage of the Hassayampa – North Gila 500 kV line should be investigated. SCIT flow and SCIT inertia do not need to be monitored.

Study Methodology:

The non-simultaneous 8,055 MW case without Mohave was selected as a starting case. The modifications needed in order to meet the study objective as described above were applied to the study case. This included updated values for all of the generating units including plant load connected to the Palo Verde/Hassayampa hub. The thermal rating (1,630 A) on the series capacitor at Navajo on the Navajo – Crystal 500 kV line was found to be the limiting element on the northern EOR system. With the total flow on the two southern EOR lines limited to 3,328 MW, the EOR flow reached 7,640 MW in the study case. The PV East flow was at 6,285 MW with all the units connected to the Palo Verde/Hassayampa switchyard modeled as online. The flow on Jojoba – Kyrene 500 kV line reached 1,963 A.

Study Results: The study case did not require any SVC at Devers 500 kV substation to meet the study criteria. The highest voltage dip on any load bus was found to be at 21.3% at the High Desert 115 kV bus. No voltage dips greater than 20% with a duration of 20 cycles or more were found without the SVC in place. Powerflow diagrams can be found in Appendix F together with transient stability plots of the 3 phase fault on Hassayampa 500 kV bus with subsequent loss of Hassayampa – North Gila 500 kV line.

Study Conclusion: No new dynamic voltage support is required in the scenario studied. The presence of the Mountainview generation project (1,000 MW) and the enhanced modeling of the Palo Verde – Devers 500 kV line in the study case may have reduced the voltage dip concern in the Devers area as compared to previous studies.

7.C EOR/Valley Voltage

Objective: Study the simultaneous interaction between the increased flow on EOR and the potential for voltage collapse at SCE's Valley Substation. Recent studies have shown the potential for voltage collapse at Valley Substation during conditions with peak load after an outage of the Serrano – Valley 500 kV line. With the Serrano – Valley 500 kV line out of service the entire load at Valley will be served from Devers over the Devers – Valley 500 kV line.

Study Methodology:

The 2006 Heavy Summer Case with a 1 in 10 year heat wave load forecast from SCE's 2004 Expansion Plan Studies was used as starting case. The case modeled a total of 1,346 MW of load on the Valley 115 kV system with 47 MVAR or reactive load. Existing reactive support includes 140 MVAR of shunt capacitors. The case was modified to include maximum South of Lugo flow (5,600 MW). The following contingencies were applied to the case:

N-1 loss of Serrano – Valley 500 kV line
N-1 of Devers – Valley 500 kV line
N-1 of Palo Verde – Devers 500 kV line
N-1 of Hassayampa – North Gila 500 kV line

N-2 of Lugo – Mira Loma No. 2 and 3 500 kV lines
N-2 of Mira Loma – Serrano No. 1 and 2 500 kV lines
G-2 of two San Onofre units

SCIT and EOR were increased by 505 MW in the post-project case. The Plan of Service including the 300 MVAR of shunt capacitors on the Valley 500 kV bus, two 100 MVAR SVC's on the Valley 115 kV bus and the 400 MVAR SVC at Devers 500 kV Substation were modeled. The same contingencies were applied to the post-project case.

Study Results: The pre-project case did not converge after the simulated loss of Serrano – Valley 500 kV line. All of the other contingencies listed above solved including the loss of two San Onofre units. With the project in service and the 505 MW increase in both EOR and SCIT all of the contingencies applied to the post-project case solved. This was attributed to the additional voltage support included as part of the Project. Powerflow diagrams can be found in Appendix G.

Study Conclusion: The Project reduces the likelihood of voltage collapse at Valley after loss of the Serrano – Valley 500 kV line. The shunt capacitors on the Valley 500 kV side were added to boost the voltage on the 500 kV system during conditions with heavy load and help prevent a sudden voltage collapse after loss of the Serrano – Valley 500 kV line. The primary purpose of the two SVC's added on the Valley 115 kV side is to prevent air-conditioner load from stalling for the same outage by keeping the 115 kV voltage at an acceptable level. All three SVC's, including the 400 MVAR SVC at the Devers 500 kV Substation help mitigate the transient voltage dip after loss of Hassayampa – North Gila 500 kV line.

7.D EOR/G-2 of SONGS

Objective: Study the simultaneous interaction between the increased flow on EOR and the impact from a double unit outage of San Onofre Nuclear Generating Station (SONGS). Assess whether or not SCIT can be increased by 505 MW after the Project is placed in service.

Study Methodology:
The already developed SCIT/EOR low inertia case with Mohave off was used as a starting point.

Due to a very high SCIT flow in the starting case it could not sustain the loss of both SONGS units. (The case did conform with the no-margin SCIT nomogram developed in 1996 but not with the current SCIT operating nomogram that limits the SCIT flow based on a double unit outage of the two San Onofre units). SCIT was therefore reduced by increasing the generation output from units already online in the coastal areas of SCE. The increased generation from SCE was scheduled to PG&E's system across path 26. EOR and the other four SCIT paths were kept at the same level. After SCIT was reduced

to 14,273 MW in the pre-project case it converged for the loss of both SONGS units. The SCIT inertia was kept constant and the flow on Palo Verde West was close to it's maximum around 2900 MW. (This case was named the Pre-project case). The EOR/SCIT operating point in the Pre-project case was checked against the current operating nomogram to verify that the operating point is above the horizontal limit (ignoring the 500 MW margin applied to the current operating nomogram) An additional reduction of 50 MW from Redondo Beach (SCE) caused the pre-project case to not converge. This ensured that the pre-project case was really stressed to its post transient limit. SCE's Centralized Grid Capacitor Control (CGCC) algorithm was used in the post-transient studies. Also transient stability studies were performed to ensure that the pre-project case was stable and met all transient stability criteria.

EOR and SCIT were increased by 505 MW in the post-project case. The 505 MW was scheduled from Hassayampa to SCE (Ormond Beach and Alamitos) and SDG&E (Encina) based on a 85/15 split. Key flows/parameters are listed below:

	Pre (MW)	Post (MW)
EOR	7231	7740
SCIT	14,273	14,778
SCIT Inertia	75,900 MWS	75,900 MWS
Palo Verde West	2886	3202
Palo Verde East	1838	2072
WOR	7922	8435
PDCI	3104	3104
IPPDC	1925	1925
P-26	640	635
N. of Lugo	1098	1098
# of Hass. Units online	5 units	9 units

Also the new voltage support devices as outlined in the Plan of Service (POS) were included:

1) 2 x 150 MVAR shunt capacitors at Valley 500 kV bus
2) 2 x 100 MVAR SVC's at Valley 115 kV bus
3) 400 MVAR SVC at Devers 500 kV bus

Study Results: The post-project case solved after the loss of both San Onofre units. Powerflow diagrams can be found in Appendix H. Transient stability studies performed demonstrated that the post-project case met all transient stability criteria as well.

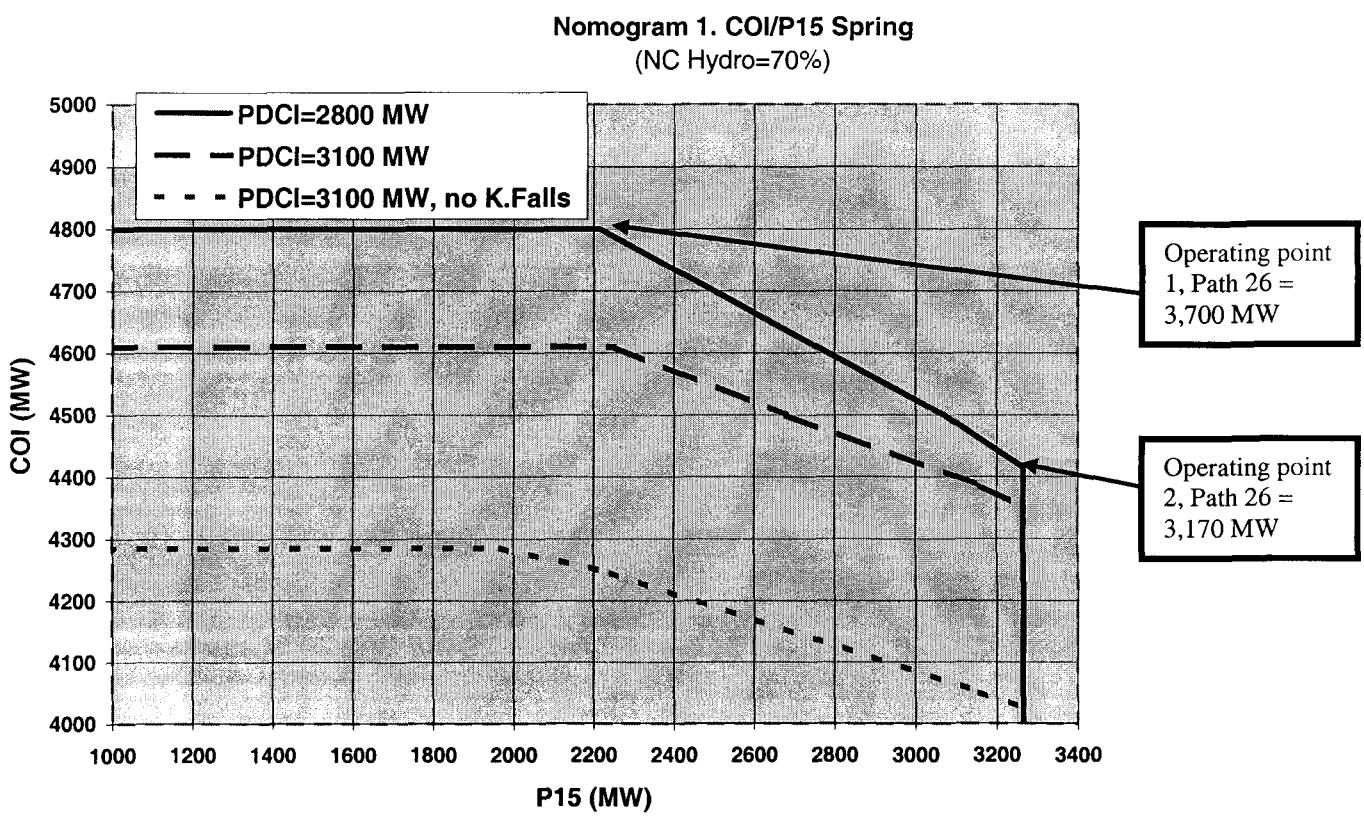
Study Conclusion: The SCIT limit can be increased by 505 MW with the project in service.

7.E EOR/COI/P-26-P15

Objective: Study the simultaneous interaction between the increased flow on EOR under conditions with maximum COI, Path 26 (Midway – Vincent) and Path 15. COI, PDCI and Path 15 should be modeled at their maximum allowable level (according to the developed nomogram). Palo Verde West should be stressed to its maximum flow limit in the pre-project scenario. The post-project case will have the proposed 505 MW increase on EOR flowing on the two 500 kV lines west of Palo Verde to simulate maximum stress on the system. Two operating points based on the existing nomogram (see below) for Path 15, COI, PDCI and Northern California Hydro will be tested with maximum flow on Path 26 and Palo Verde West. The proposed 300 MW increase in the rating on Path 26 (total of 3,700 MW) will be modeled since it has received WECC Phase 2 status.

Study Methodology:

The base case used to perform the 3,400 MW WECC path rating study for Path 26 was used as a starting case. This represented a 2005 Heavy Spring Case with 3,400 MW on Path 26 and maximum Path 15 flow. The case was updated to reflect 2006 conditions. The desired flows on the various interfaces as depicted in the nomogram below were modeled. Two operating points were tested.



Operating Point 1:

To simulate Operating Point 1 (as shown on the nomogram), the flow on Path 26 was increased by 300 MW to 3,700 MW. Generation in the Midway area was utilized and scheduled into SCE to increase the Path 26 flow by the desired amount. The flow on Path 15, PDCI, COI and the level of Northern California Hydro were kept at the level as shown in the nomogram above. In addition, the flow on Palo Verde West (Palo Verde – Devers and Hassayampa – North Gila 500 kV lines) was increased until the thermal limit on the existing series capacitors was reached. Palo Verde West reached 2,848 MW when the series capacitor on the Hassayampa – North Gila 500 kV line was loaded at 100% of its N-1 rating for loss of the Palo Verde – Devers 500 kV line. Mohave was modeled as offline with the series compensation on Mohave – Lugo 500 kV line modeled at 70%. The phase shifters on both the Perkins – Mead 500 kV and Liberty – Peacock 345 kV lines were bypassed to simulate actual operation. A total of 1,333 MW of generation was tripped after the simultaneous loss of the Midway – Vincent No. 1 & 2 500 kV lines to avoid overloading the Midway – Vincent No. 3 500 kV line above it's short term emergency rating of 3,500 A. The following units[5], all located in the Midway area, were tripped for this double line outage:

La Paloma	4 x 230 MW	Total 920 MW
Sunset	1 x 75 MW	Total 75 MW
Texaco Sunrise	2 x 169 MW	Total 338 MW
		Total 1,333 MW

Generation connected to the Hassayampa 500 kV switchyard was increased in the post-project case with the power scheduled to SCE and SDG&E. The flow on Palo Verde West was increased by 505 MW to 3,341 MW. Flows in the pre and post-project cases on various interfaces are listed in the table below:

	Pre (MW)	Post (MW)
COI	4,800	4,800
PDCI	2,804	2,804
Path 15	-2,198	-2,202
IPPDC	1,854	1,854
SCIT	14,145	14,674
WOR	5,987	6,690
EOR	5,429	6,074
P-26	3,701	3,699
North of Lugo	103	-67
Palo Verde West	2,848	3,352

[5] A final determination of amount and location of generation needed to be tripped will be determined in the WECC Path Rating studies for Path 26

Operating Point 2:

To simulate Operating Point 2 (as shown on the nomogram), the same methodology as for Operating Point 1 was used. However, to achieve 3,250 MW on Path 15, all of the generation connected to Midway Substation had to be turned off (one of the two Diablo Canyon Nuclear units was still at maximum load). Generation in Northern California (PG&E) replaced the generation connected to Midway. Also the flow on Path 26 was reduced since no generation was available to be tripped for the double line outage of the Midway – Vincent No.1&2 500 kV lines. With the flow on Path 26 reduced to slightly less than 3,200 MW, the Midway – Vincent No. 3 500 kV line was loaded at 3,475 A or 99.3% of its short term emergency rating of 3,500 A for the outage of Midway – Vincent No. 1 & 2 500 kV lines. PDCI, COI and Northern California Hydro were kept at the same level as shown in the nomogram above. The flow on Palo Verde West was increased until the thermal limit on the existing series capacitors was reached, similar to what was done with the case simulating Operating Point 1.

Generation connected to the Hassayampa 500 kV switchyard was increased in the post-project case with the power scheduled to SCE and SDG&E. The flow on Palo Verde West was increased by 505 MW. Flows in the pre and post-project cases on various interfaces are listed in the table below:

	Pre (MW)	Post (MW)
COI	4,408	4,411
PDCI	2,804	2,804
Path 15	-3,252	-3,252
IPPDC	1,854	1,854
SCIT	13,656	14,208
WOR	6,028	6,752
EOR	5,466	6,138
P-26	3,169	3,170
North of Lugo	103	-67
Palo Verde West	2,837	3,342

Thermal powerflow analysis including N-0, N-1 and N-2 were conducted in both the pre and post-project scenario for Operating Point 1 & 2. Also post-transient voltage deviation and transient stability analysis were performed.

Study Results: No thermal overloads were found in any of the pre and post-project cases. Also, all buses had a voltage deviation less than 5% for single contingencies and 10% for double contingencies. No transient stability violations were identified in either the pre or post-project scenarios. Detailed results including powerflow plots of pre and post-project cases can be found in Appendix I.1 for the Operating Point 1 cases and in Appendix I.2 for Operating Point 2 cases.

Study Conclusion: No adverse impact was identified under conditions with maximum Palo Verde West flow and maximum North to South flow on PDCI, COI, Path 15 and Path 26.

7.F EOR/MWD pumps offline

Objective: Study the simultaneous interaction between the increased flow from EOR during conditions with no MWD pumps online. MWD indicated that there will be times during the year when all the pumps are offline at their five substations with pumps (Julian Hinds, Iron Mountain, Eagle Mountain, Gene and Intake). The primary concern is the potential for thermal overload.

Study Methodology:

Two cases were analyzed; EOR/SCIT High inertia case (without Mohave) and EOR/SCIT Low inertia case (with Mohave online). The case with high inertia has EOR modeled at 6741 MW and SCIT at 16,300 MW. The post-project case has a 505 MW increase in both EOR and SCIT (see Appendix D for documentation). The low inertia case has EOR modeled at 7102 MW and SCIT at 15,170 MW in the pre-project scenario with a 505 MW increase in the post-project case (see Appendix C).

The table below summarizes the amount of pump load modeled in these cases. The pumps were turned off to assess the impacts on the thermal loadings in the MWD system. To stress the system, generation from Alamitos was reduced by the same amount as the pump load.

	Pump load (MW), Low Inertia	**Pump load (MW), High Inertia**
Julian Hinds	55.8	74.4
Eagle Mountain	55.8	74.4
Iron Mountain	25.6	25.6
Gene	40.2	53.6
Intake	60.3	53.6
Total	237.7	281.6

The following contingencies were applied to each pre and post-project cases:

N-1 of Palo Verde – Devers 500 kV line
N-1 of Lugo – Mohave 500 kV line
N-1 of Hassayampa – North Gila 500 kV line
N-1 of Blythe – Eagle Mountain 161 kV line
N-1 of Blythe – Niland 161 kV line
N-1 of Mead – Camino No. 1 or 2 230 kV line

N-1 of Parker – Gene 230 kV line

N-1 of Iron Mountain – Camino 230 kV line

N-1 of Iron Mountain – Eagle Mountain 230 kV line

N-1 of Julian Hinds – Eagle Mountain 230 kV line

N-1 of Julian Hinds – Mirage 230 kV line

N-1 of Devers –Coachella Valley 230 kV line

N-1 of Ramon – Mirage 230 kV line

G-1 of one San Onofre unit

Study Results: No normal overload or any contingency overloads were found in the scenarios with the MWD pumps offline. The cases with a 505 MW increase in EOR and SCIT had little impact on the thermal loadings of the MWD transmission lines. For example, the flow on the Eagle Mountain to Julian Hinds decreased by about 7 MW (from 212 to 205 MW) in the scenario with high SCIT inertia. None of the contingencies applied to the cases with high inertia caused any of the MWD lines to load above 90% of their normal rating. The most significant outage was the outage of Palo Verde – Devers 500 kV line which caused the flow on Eagle Mountain – Julian Hinds 230 kV line to increase by 10 MW to 302 MW in the high inertia post-project case. None of the two MWD's remedial action schemes were triggered.[6]

In the low inertia case, the flow on Eagle Mountain – Julian Hinds decreased by 7 MW with the project in service. However, the contingency flow after an outage of the Palo Verde – Devers 500 kV line increased by 8 MW, from 317 MW to 325 MW due to higher flow on the two Palo Verde West lines in the post-project scenario. (The normal rating of the Eagle Mountain to Julian Hinds 230 kV line is 358.5 MW with an N-1 rating of 394.4 MW.) No other contingencies caused any of the MWD lines to load above 90% of their normal rating.

As expected, no post transient voltage deviations were found in any of the scenarios.

Study Conclusion:[7] The 505 MW increase in EOR and SCIT has little impact on the MWD transmission system between Mead and Julian Hinds Substations. The most significant outage is the outage of the Palo Verde – Devers 500 kV line.

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[6] 1) If the line loading on the Iron Mountain – Eagle Mountain 230 kV line exceeds 250 MVA, an overloading scheme will trip the Eagle Mountain – Julian Hinds 230 kV line. 2) An overpower/undervoltage protection scheme will be triggered when a flow greater than 65 MW is measured from Julian Hinds to Mirage 230 kV line and the voltage is 90 percent or lower at the Julian Hinds 6.9 kV bus. These two conditions would initiate the tripping of the Julian Hinds – Mirage 230 kV line.

[7] On November 10, 2004 SCE informed WATS that the Mirage – Julian Hinds 230 kV line has been de-rated from 896 A normal and 1029 A emergency rating to 599 A (normal and emergency). Loss of Palo Verde – Devers 500 kV line loads the Mirage – Julian Hinds 230 kV line above 599 A in both the pre and post project scenario.. Given the large magnitude of the overload in the pre-project scenarios (up to 141%) and the limited impact from the EOR upgrade (about 6%), SCE has stated that this will be resolved outside the WECC path rating process.

ATTACHMENT C

SOUTHERN CALIFORNIA EDISON COMPANY
2005-2014
TEN-YEAR PLAN

Devers-Palo Verde No. 2 Project
WECC Comprehensive Progress Report

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

Dana M. Cabbell
Manager, Regional Planning
Transmission & Interconnection Planning

April 21, 2004

PLANNING COORDINATION COMMITTEE
OPERATIONS COMMITTEE
TECHNICAL STUDIES SUBCOMMITTEE

Subject: Devers–Palo Verde No.2 Project (DPV2)/Path 49 Rating Comprehensive Progress Report

The Southern California Edison Co. (SCE) proposes to increase the Accepted Rating of the East of the River Path (WECC Path 49) in accordance with the WECC "Procedures for Regional Planning Project Review and Rating Transmission Facilities." Today, the non-simultaneous rating of Path 49 is 7,550 MW. There is a near-term project proposal, the Path 49 Series Capacitor Upgrade Project (Upgrade Project), to upgrade equipment to increase the Path 49 rating. Originally, the Upgrade Project proposed an increase of 760 MW. However, recent studies have indicated an increase of 505 MW, resulting in a Path 49 rating of 8,055 MW. Owing to new and upgraded transmission facilities associated with the plan of service for the DPV2 Project, the Path 49 non-simultaneous rating is expected to increase by 1,200 MW. This would be an incremental increase from the Upgrade Project's current proposed new rating of 8,055 MW to 9,255 MW.

Attached is the subject WECC Comprehensive Progress Report (Report) summarizing the study assumptions, methodology and results. SCE has conducted power flow, dynamic stability, and post-transient studies to demonstrate that the plan of service meets the WECC Criteria at the proposed new rating. With the submission of this report, SCE requests that the DPV2 Project be granted Phase 2 status. In accordance with the WECC Rating Process, SCE would like to solicit comments on the Report and also solicit interest in forming a Project Review Group. The purpose of the Project Review Group will be to address any comments received and to complete any additional analyses necessary to obtain Phase 3 status and a new WECC Accepted Rating of 9,255 MW for Path 49.

Comments on this Report and responses from parties interested in participating in the Project Review Group should be sent to Steven Mavis at (626) 302–8175 or steven.mavis@sce.com by June 21, 2004.

Sincerely,

[original signed]

Dana Cabbell, Manager
Regional Transmission Planning

Cc: Chifong Thomas (TSS Chair)
A. Perez – CAISO
J. Miller – CAISO

SOUTHERN CALIFORNIA
EDISON
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DEVERS – PALO VERDE NO. 2 PROJECT

COMPREHENSIVE PROGRESS REPORT

APRIL 20, 2004

INTRODUCTION

Southern California Edison (SCE) is proposing to build a 500 kV transmission line project from the Palo Verde area, near Phoenix, Arizona, to SCE's Devers substation, near Palm Springs, California. The Project is named Devers-Palo Verde No. 2 (DPV2). DPV2 is expected to increase the rating of WECC Path 49, or Arizona-California East-of-River (EOR) path, by 1,200 MW. This 1,200 MW increase is based on the proposed new Path 49 rating of 8,055 MW resulting from the Path 49 Upgrade Project, giving a post-DPV2 Path 49 rating of 9,255 MW.

On October 10, 2003, SCE submitted a notification letter to the Planning Coordination Committee (PCC) and the Technical Studies Subcommittee (TSS) initiating Phase 1 of the WECC Rating Process for the DPV2 Project. Regional review of the DPV2 Project is being performed through the DPV2 Regional Planning Review Group, formed in November of 2003. The DPV2 Regional Planning Compliance Report will be submitted to the Regional Planning Policy Committee (RPPC) upon completion of the Review Group's final review. This Comprehensive Progress Report (Report) provides the analysis used to define the Plan-of-Service for the DPV2 project. The purpose of this Report is to provide documentation of the technical studies performed by SCE demonstrating that the DPV2 Project complies with the WECC Reliability Criteria at the proposed new Path 49 rating of 9,255 MW.

PROJECT DESCRIPTION

The Plan of Service (POS) for DPV2 is planned to include of the following major facilities and procedure:

Devers - Harquahala 500 kV Line

A new 230 mile-500 kV line between Harquahala Generating Company's Harquahala Switchyard in Arizona to SCE's Devers 500 kV Substation near Palm Springs, California will be constructed. The line will include 2B-2156 ACSR conductor and with 50% series compensation that matches the compensation equipment on the No.1 Palo Verde-Devers 500 kV line. The proposed route between Devers and Harquahala parallels the entire length of SCE's existing Palo Verde - Devers (DPV1) 500 kV transmission line. 102 miles of the route are in Arizona and 128 miles are in California.

Harquahala-Hassayampa 500 kV Line

SCE intends to acquire the Harquahala switchyard and the Harquahala-Hassayampa 500 kV transmission line from Harquahala Generating Company (HGC) under an existing agreement.

Devers – San Bernardino 230 kV lines #1 and #2

The Devers – San Bernardino 230 kV lines #1 and #2 will be rebuilt and reconductored. The original single-circuit 230 kV tower lines will be removed and replaced with new double-circuit 230 kV tower structures, strung with bundled 1033 ACSR conductor. The conductor on the existing double circuit 230 kV towers will also be replaced with bundled 1033 ACSR conductor.

Devers – Vista 230 kV lines #1 and #2

The Devers – Vista 230 kV lines #1 and #2 will be rebuilt and reconductored. The original single-circuit 230 kV tower lines will be removed and replaced with new double-circuit 230 kV tower structures, strung with bundled 1033 ACSR conductor. The conductor on the existing double circuit 230 kV towers will also be replaced with bundled 1033 ACSR conductor.

Static VAR Compensators (SVC)

Install one 388 MVAr SVC at Valley 500 kV substation and one 388 MVAr SVC at Devers 500 kV substation.

Special Protection System (SPS)

A Special Protection System (SPS) will be designed to drop approximately 900 MW of generation in the Palo Verde area and approximately 900 MW of load in SCE. The scope of the SPS will be further defined and evaluated during the WECC Rating Process. In parallel, SCE intends to work with the CAISO, Arizona utilities, and generator owners to develop a workable generator dropping scheme to satisfy this SPS requirement.

Diagrams

The geographic and one-line diagrams of the DPV2 project are shown in Figures 1 and 2, respectively, on the following pages.

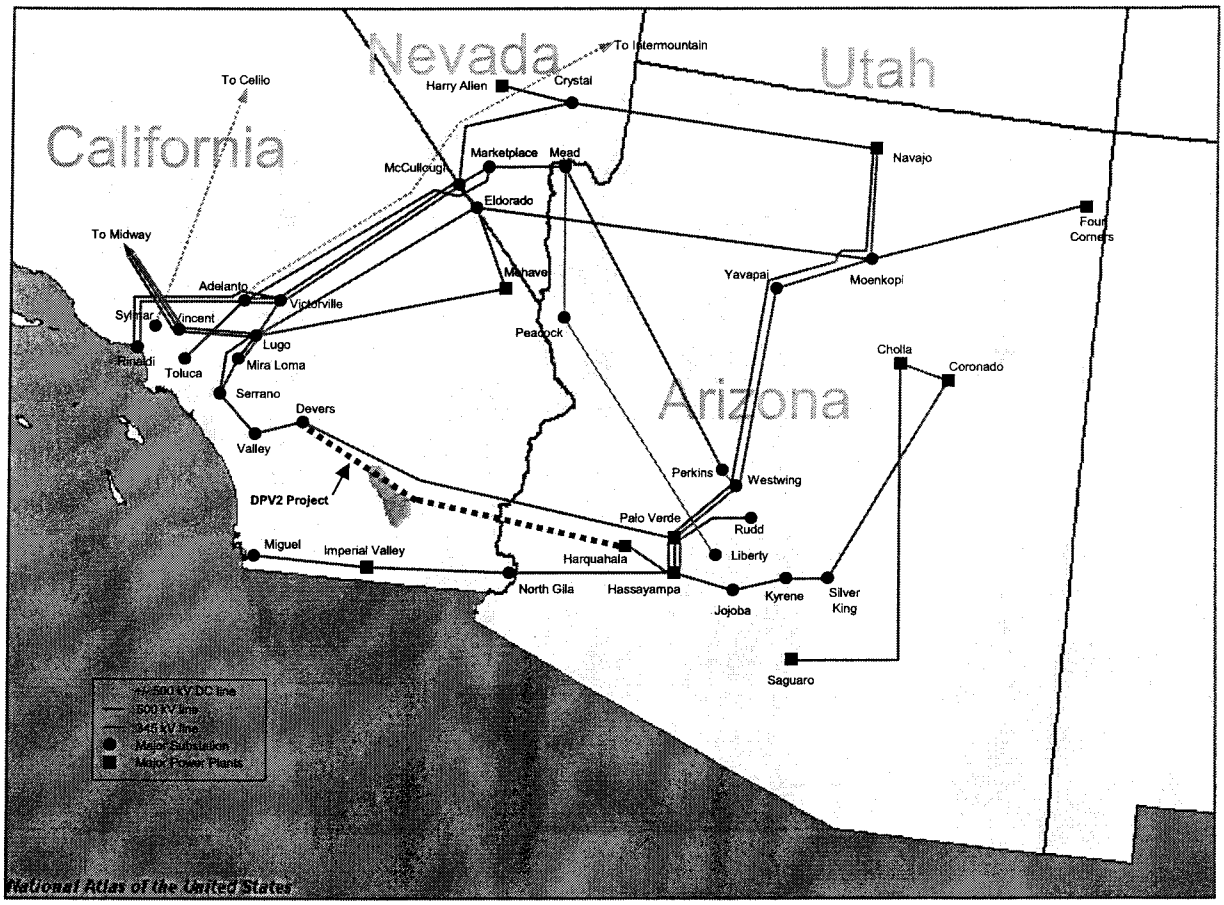

Figure 1

Geographic Diagram

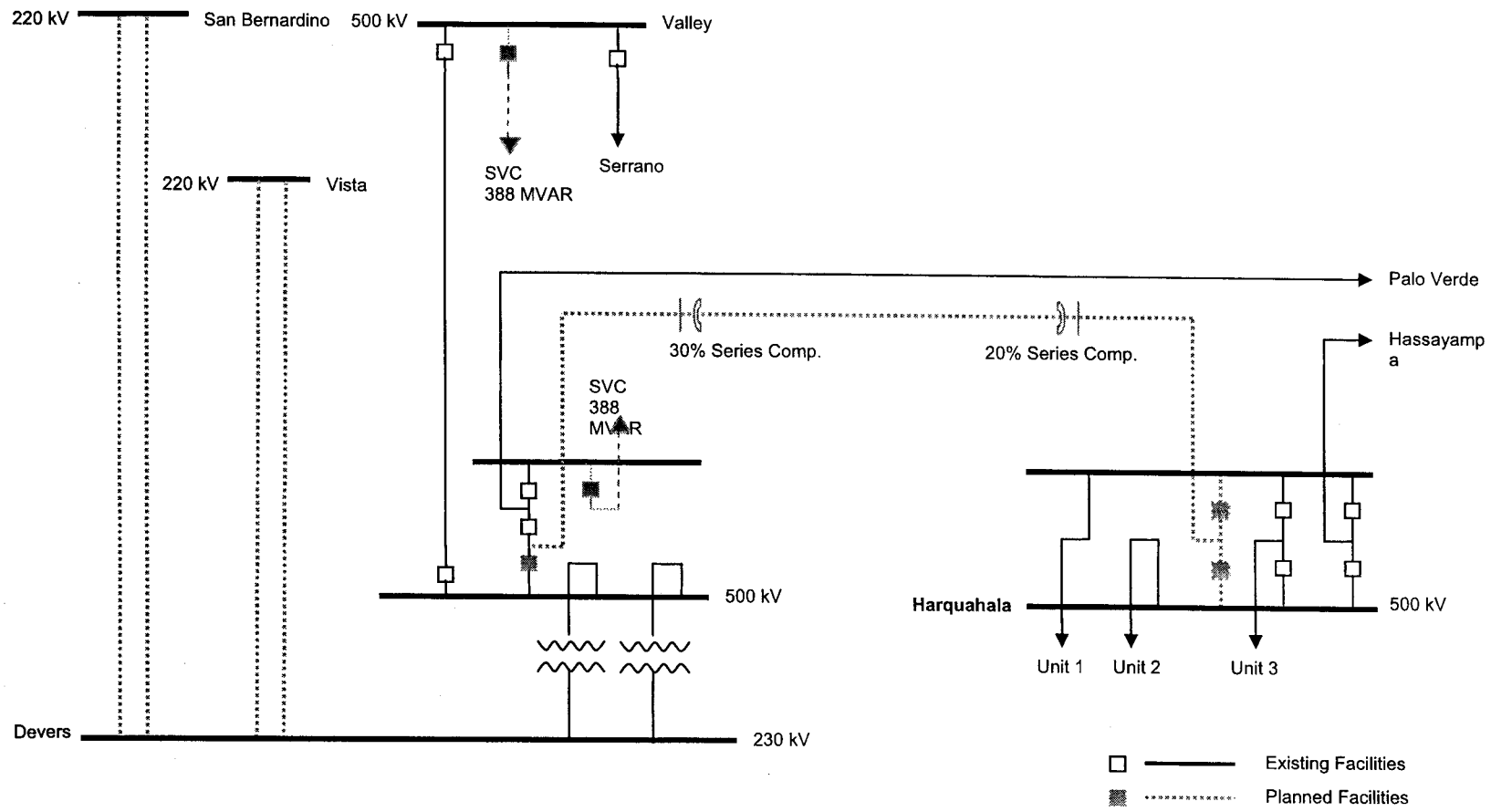

Figure 2

One Line Diagram

PLANNED OPERATING DATE

The expected operating date for the DPV2 project is the summer of 2009.

PROJECT STATUS

The DPV2 project is proceeding as planned. SCE initiated the regional planning process through the distribution of a letter to the Planning Coordinating Committee (PCC) and the Technical Studies Subcommittee (TSS), dated October 10, 2003. With this initial Regional Planning Announcement, Phase I of the WECC Rating Process also began. A Regional Planning Review Group meeting was held on November 12, 2003 to gather input from the Review Group participants of their project needs and plans in the Colorado River area.

Currently, the project is progressing through regional and local reliability assessments. The technical study is under review by the California ISO (CAISO). This Report is being provided to all stakeholder forums in the Desert Southwest region in addition to the WECC for review and comments.

PROJECT MILESTONE SCHEDULE

Activity	Planned Completion Date
Technical Assessments	07/2004
Regional Reliability & Rating Assessments	05/2005
Regulatory Approvals	03/2006
Engineering & Construction	06/2009
Testing & Operations	2009

PROJECT CAPACITY

Owing to the close proximity of the DPV2 project facilities to the existing Palo Verde – Devers 500 kV line, the Path 49 definition and rating would have to be revised to include the DPV2 line. Accordingly, the rating of the DPV2 project will be determined by the increase in the non-simultaneous rating of Path 49 as a result of the construction of the DPV2 project. The DPV2 project plans to receive a WECC approved "Accepted Rating."

Today, the non-simultaneous rating of Path 49 is 7,550 MW. There is a near-term project proposal, the Path 49 Series Capacitor Upgrade Project, which plans to increase the rating from 7,550 MW to 8,055 MW. The Path 49 Series Capacitor Upgrade Project rating study is being performed by SDG&E. This near-term project proposal has a planned operating date of the summer of 2006. The proposed 8,055 MW rating is used as the basis for establishing the proposed increase of 1,200 MW due to the DPV2 project construction. The resulting 9,255 MW rating for Path 49 is the non-simultaneous rating expected to be achieved.

During the WECC Phase 2 review process, additional case evaluations will be needed to demonstrate the simultaneous flow impact of the project. Although the simultaneous flow conditions could change the requirements for the dynamic voltage support equipment (SVC)

currently specified in the Plan-of-Service for DPV2, it is anticipated that the equipment presented in this report will be sufficient to meet the system performance requirements.

STUDY CONDITIONS

The DPV2 project has a planned rating of 1,200 MW, which will be achieved by increasing the non-simultaneous rating of the Path 49 from the proposed rating of 8,055 MW to 9,255 MW. It is assumed that the 8,055 MW is achieved after the Path 49 series capacitor upgrades and other system reinforcements being proposed by the EOR Participants through the Path 49 Rating Studies. To ensure NERC/WECC Planning Standards are met while achieving this increment of 1,200 MW, power system studies were performed using WECC base cases and all applicable reliability criteria. Two base cases, 2008 Heavy Autumn pre- and post-DPV2 cases were used to perform this study. EOR was stressed to its maximum non-simultaneous rating during the Heavy Autumn condition only. The non-simultaneous base case used for this report was the recently approved Western Arizona Transmission System (WATS) Study Group Heavy Autumn base case developed for the Path 49 Series Capacitor Upgrade Project rating study. The WATS study group is used to develop agreement on flow conditions for path rating studies in the southwest region.

1. Base Case Description

The base case representing 2008 Heavy Autumn (2008 HA) was started from the current WATS-approved Path 49 Series Capacitor Upgrade Project study case that represents 2005 heavy autumn conditions. Area information including load and generation in SCE, Arizona, LADWP, IID, and SDG&E was projected to 2008 HA system conditions. The pre-project HA case has an EOR flow of 8,055 MW. The Project (i.e. Harquahala –Devers 500 kV) line and the schedules were added to the pre-project case to develop post-project cases. In the post-project case EOR is 9,255 MW during HA based on SCE/LADWP/SDG&E schedule shares of 55%/30%/15%:

Case 1: 2008 HA pre-project case
Case 2: 2008 HA post-project case

Generation and new transmission line project assumptions are discussed below:

2. Generation Assumptions

a. Intergen Ocotillo units, proposed to be connected at SCE's Devers 230 kV Substation, are assumed to be off-line.

b. Mountainview units, proposed to be connected at SCE's San Bernardino 230 kV Substation, are assumed to be on-line. A sensitivity case was developed to evaluate the Mountainview units off-line. The results indicated that the Mountainview units, on or off, do not alter the scope of the Plan-of-Service for DPV2.

c. Mountain Vista units 3 and 4, connected at SCE's Etiwanda 230 kV Substation are assumed to be retired.

d. Arizona generation totaling approximately 6,300 MW in and around Hassayampa and Harquahala switchyards is assumed to be on-line. The details of the assumed new generation in Arizona are as follows:

Harquahala	6 units	1,170 MW
Arlington Valley	5 units	600 MW
Mesquite	6 units	1,250 MW
Red Hawk	6 units	1,000 MW
Panda Power	12 units	2,080 MW

e. New generation of approximately 4,400 MW is assumed to be on-line in southern Nevada area.

Mirant	3 units	596 MW
Duke	6 units	1,330 MW
Calpine	4 units	990 MW
LVCOGEN	6 units	280 MW
Bighorn	4 units	660 MW
Slwhk Gen	3 units	540 MW

f. New generation of 50 MW at the San Diego-Mexico border is assumed to be on-line, as modeled in the Path 49 Series Capacitor Upgrade Study. Other units are modeled off-line.

g. Both SONGS Units are on-line.

h. Both Mohave Units are off-line.

i. Blythe Generation Project I, with a capacity of 520 MW, is assumed to be on-line.

j. Palo Verde nuclear units No. 1 and No. 2 are modeled at the increased capacity of 1,472 MW on each unit. Palo Verde unit #3 is at 1352 MW.

3. New Transmission Line Project Assumptions

a. Path 49 Series Capacitor Upgrade Project: It is assumed that these upgrades are in service in the pre-project condition. The upgrades consist of the following:

- Total of five series capacitor upgrades on the Navajo-Crystal, Palo Verde-Devers and Hassayampa-North Gila- Imperial Valley 500 kV lines.
- A new 500/230 kV transformer is modeled at Devers Substation.
- A new 450 MVA 230 kV degree phase shifting transformer is modeled between SDG&E's IV Substation and IID's El Centro Substation.

b. Centennial Transmission Project is assumed to be in service. The project consists of three new 500 kV lines and associated facilities necessary to deliver 3,000 MW of new generation interconnected at the Harry Allen Substation to the southern Nevada area.

c. Series compensation on the Lugo – Mohave 500 kV line was modeled at 70% with the Mohave units off-line.

4. WECC Major Path Flow/Path Rating Assumptions

The transmission paths listed below are the major paths into California. The pre-project non-simultaneous rating of each path also is listed. However, actual path transfer capabilities fluctuate with changes in load and generation conditions and because of interactions with other paths.

Therefore, path flows may be limited such that they do not exceed known operating constraints that are in effect for the conditions that are being studied.

	Transfer Path	Path Rating (MW)
Path 49	EOR	8055
Path 46	WOR	10118
Path 26	M-V	3400(N-S)/3000(S-N)
Path 27	IPPDC	1920
Path 65	PDCI	3100
	N/Lugo	1200(N-S)
Path 66	COI	4800(N-S)/3675(S-N)
Path 45	CFE-SDG&E	800
	SCIT	14500

The Lugo-Mohave 500 kV line is part of the northern WOR system which consists of nine high voltage transmission lines. With the shut-down of Mohave generation, the proposed path rating increase of 505 MW by the Series Capacitor Upgrade Project necessitated the re-balance of power flow among the WOR lines. Consequently, the series compensation on the Lugo – Mohave 500 kV line was increased to 70%.

WECC major path flow summary is included in the Table – A1, Appendix A.

STUDY METHODOLOGY

- The power flow base cases(s) and dynamic stability data including the new WECC approved governor model were developed in General Electric PSLF 13.1 format.
- For all areas outside California, the network topology and loads reflect information provided to WECC by each respective area.
- The study complied with the CAISO and WECC/NERC planning standards.

1. Power Flow Analysis (study criteria and contingency list)

Study Criteria:

a. Power flow studies were conducted for single and double contingencies. Under normal conditions, bus voltages must be maintained between 0.95 p.u. and 1.05 p.u., unless specific minimum operating voltage requirements exist. All line and transformer loading must be below normal continuous ratings.

b. The net VAR flow interchange with each interconnected utility shall be within limits established by the transmission owners. SCE guidelines for VAR flow interchange with adjacent utilities would be ideally kept at a fixed, constant value.

	Intertie	Var flow	
1	McCullough-LADWP	0± 200	at Eldorado
2	Victorville-LADWP	0±200	at Lugo
3	Eldorado-APS	0 ±100	at Eldorado
4	Palo Verde-SRP	0 ±100	At Palo Verde
5	Midway-PG&E	0 ±100	at Midway
6	Sylmar-LADWP	0± 20	at Sylmar
7	Velasco-LADWP	0± 20	at Laguna Bell
8	Coachella-IID	0± 20	at Mirage
9	Mirage -IID	0± 20	at Mirage
10	Inyo-LADWP	0± 20	at Inyo
11	Silver Peak-SPP	0± 20	at Control
12	Mead-WALC	0± 20	at Eldorado
13	Parker-WALC	0± 20	at Parker
14	Goodrich-PASADENA	0± 20	at Goodrich
15	Blythe-WALC	0± 20	at Eagle Mt.
16	San Onofre-SDG&E	0± 20	At SONGS

c. Study Criteria during Contingency Conditions

- No transmission element will be loaded above its emergency rating as specified in the transmission register for CAISO and power flow case for the reminder of WECC.
- Equipment emergency voltage limits (high or low) will not be exceeded.
- Bus voltage deviations from the base case voltage shall not exceed established planning limits. (These limits may vary throughout the system).
- No loss of load for single contingencies.

The following Table 1 provides a list of contingencies that were simulated in this study.

Table 1: List of Contingencies for Load Flow

1.	N-1 of Hassayampa-N. Gila 500 kV Line
2.	N-1 of Palo Verde-Devers 500 kV Line
3.	N-1 of Moenkopi-Eldorado 500 kV Line
4.	N-1 of Navajo-Crystal 500 kV Line
5.	N-1 of Liberty-Peacock 345 kV Line
6.	N-1 of Harquahala-Devers 500 kV Line
7.	N-1 of Devers-Valley 500 kV Line
8.	N-2 of PV-Devers and Devers-Harquahala 500 kV Lines

2. Transient Stability Analysis (study criteria and contingency list)

Transient stability studies were performed to assess the impact on the dynamic performance of the heavily stressed EOR lines under the projected 2008 system conditions under various contingencies. A pre-project benchmark base case was established to represent the EOR stability limit. The study determined the most critical fault condition that would limit the EOR non-simultaneous transfer capability.

Study Criteria:

a. All machines in the system shall remain in synchronism as demonstrated by their relative rotor angles.

b. System stability is evaluated based on the damping of the relative rotor angles and the damping of the voltage magnitude swings.

c. The transient voltage dip should be maintained above 0.80 p.u. at Adelanto and Sylmar.

d. Other transient voltage dips must meet the following WECC Reliability Criteria:

Performance Level	Disturbance	Transient Voltage Dip Criteria
B	N-1	Max Duration of V Dip 25%-20 Cycles
C	N-2	Max Duration of V Dip 30%-40 Cycles
D	N-3	Not Specified

The following Table 2 provides a list of contingencies that were simulated for transient stability with a Path 49 flow of 9,255 MW.

Table 2: List of Contingencies for Transient Stability

1. PDCI Bi-Pole
2. Navajo-Crystal 500 kV Line
3. Moenkopi-Eldorado 500 kV Line
4. Eldorado-Lugo 500 kV Line
5. Palo Verde-Devers 500 kV Line
6. Devers-Harquahala 500 kV Line
7. Devers-Valley 500 kV Line
8. IPPDC Bi-Pole
9. McCullough-Victorville 500 kV No. 1 and 2 Lines
10. Lugo-Mira Loma 500 kV Nos. 2 and 3 Lines
11. Devers-Coachella and Mirage-Ramon 230 kV Lines

In accordance with regional practices, the EOR flow margin of 7% was added to the pre-fault load flow case used in the following list of contingencies in Table 3 that were simulated for transient stability.

Table 3: List of Contingencies for Transient Stability

12. Hassayampa-North Gila 500 kV Line
13. Hassayampa-North Gila 500 kV Line (w/o Mountainview Generation)
14. Palo Verde-Devers and Devers-Harquahala 500 kV Lines

3. Post-Transient Studies (study criteria and contingency list)

Study Assumptions:

a. All loads will be modeled as constant MVA during the first few minutes following an outage or disturbance.

b. All voltages at distribution substations will be restored to normal values by the transformer tap changers and other voltage control devices.

c. Generator MVAR limits will be modeled as a single value for each generator since the reactive power capability curve will not be modeled in the power flow program.

d. There will be no manual operator intervention to increase the generator MVAR output.

e. Remedial actions such as generator dropping, load shedding and blocking of automatic generation control (AGC) will not be considered.

f. Shunt capacitors (132 MVAR) at Adelanto and Marketplace will be used if the post-transient voltage deviation exceeds 5% at those buses. Although modeled as shunt capacitors the actual devices are automatically controlled SVCs.

g. Other Assumptions
   - Area Interchange: Disabled
   - Governor Blocking: Per WECC Modeling & Validation Work Group recommendations - Diablo, Palo Verde, and San Onofre
   - DC Line Transformer Tap Automatic Adjustment: Enabled
   - Generator Voltage Control set to local except for San Onofre, Palo Verde, and selected Northwest generation
   - Phase Shifter Control: Disabled
   - Switched Shunt Devices: Disabled - except in Sierra Pacific Power's system.

Study Criteria:

The post- transient voltage deviations should meet the following WECC Reliability Criteria:

Performance Level	Disturbance	Post Transient Voltage Deviations
B	N-1	5% *
C	N-2	10%
D	N-3	Cascading Not Permitted

* SCE buses allowed to deviate 7%

The following Table 3 provides a list of contingencies that were simulated for Post-Transient transient voltage stability in this study.

Table 3: List of Contingencies for Post-transient Voltage Stability

1. N-1 of Hassayampa-North Gila 500 kV Line
2. N-1 of Palo Verde-Devers 500 kV Line
3. N-1 of Moenkopi-Eldorado 500 kV Line
4. N-1 of Navajo-Crystal 500 kV Line
5. N-1 of Eldorado-Lugo 500 kV Line
6. N-2 of Coachella-Devers and Ramon-Mirage 230 kV Lines
7. N-2 of Lugo-Mira Loma 500 kV Lines
8. N-2 of PV-Devers and Devers-Harquahala 500 kV Lines

STUDY RESULTS

1. Power Flow Study Results

The power flow results for the base case are shown in Appendix A. Table A.1 presents major path flows and summary of generation, interchange, load, and losses for SCE, LADWP, SDG&E, IID and Arizona areas for Heavy Autumn and Heavy Summer for pre-project and post-project conditions. Load flow diagrams for the pre- and post-DPV2 cases are shown in Figures A.1 - A.2 contained in Appendix A.

The following is a summary of maximum loadings on series capacitors in various lines during these contingencies:

Monitored Line	Contingency	Line Loading	Normal Rating	Emergency Rating
PV – Devers 500	N-1 of DPV2	2367 amps	2500 amps	3100 amps
Harquhala-Devers 500	N-1 of DPV1	2456 amps	2500 amps	3100 amps
Perkins – Mead 500	N-1 of DPV1	1649 amps	1430 amps	1900 amps
Hassayampa – N. Gila 500	N-1 of DPV2	1881 amps	1800 amps	2400 amps
N.Gila – IV 500	N-1 of DPV2	1766 amps	1800 amps	2400 amps
Navajo – Crystal 500	N-1 of MK-Ed	2506 amps	1900 amps	2750 amps
Moenkopi – Eldorado 500	N-1 of NV-CR	2569 amps	1900 amps	2750 amps

These loadings do not exceed their thermal capability limits based on the emergency ratings.

2. Transient Stability and Post-Transient Study Results

The most critical contingency for transient stability is the loss of the Hassayampa – North Gila 500 kV line, which was also evaluated with the 7% flow margin added on the EOR path (EOR path flow = 9,903 MW). All the contingencies met the WECC/NERC criteria with the proposed Plan-of-Service modeled. Transient stability plots are included in Appendix B.

Post-transient voltage collapse in southern California and Nevada areas could occur for loss of the DPV1 and the Devers-Harquahala 500 kV lines without a generation and load dropping scheme simulated. To meet the WECC/NERC Planning Standards, for this double contingency, a Special Protection Scheme (SPS) is required. The design of the SPS will include the dropping of approximately 900 MW of generation in the Harquahala and the Hassayampa vicinity at 10.2 cycles and approximately 900 MW of load in SCE at 15 cycles, which may need to be adjusted based on SCE protection design standards and feasible

implementation timing. The load at Padua and Villa Park substation were dropped to mitigate the post-transient voltage collapse problem.

No other post-transient criteria violation was identified with the proposed Plan-of-Service simulated.

CONCLUSIONS

1. The proposed Plan-of-Service for the DPV2 Project demonstrates reliable system performance, and meets all applicable planning criteria.
2. The two SVCs, one each at Devers and Valley 500 kV substations, are expected to be needed for increasing the simultaneous transfer capability.
3. To meet WECC/NERC criteria for the loss of Palo Verde-Devers and Devers-Harquahala double-line outage, an SPS is planned. The SPS requires tripping approximately 900 MW of generation at Hassayampa and Harquahala substations in Arizona and load dropping of approximately 900 MW at Padua and Villa Park substations in SCE.

APPENDICES

Appendix A – Power Flow Study - base case information and power flow diagrams

Appendix B – Summary of Transient Stability Study Plots for HA and HS

Appendix A

Power Flow Study Information

Table – A1 Major Path Flow and Area Information Summary

Figure – A1 2008 HA Pre-DPV2 Base Case

Figure – A2 2008 HA Post-Dpv2 Base Case

Table -- A1 Area Information Summary

	Pre-Project 2008 HA (MW)	Post-Project 2008 HA (MW)
SCIT	10716	11909
EOR	**8055**	**9255**
WOR	8280	9591
N of Lugo	587	587
COI	2673	2735
Path 26	-1164	-1086
Path 45	11	11
IPPDC	1853	1853
PDCI	971	971
SCE		
Generation	10492	9785
Interchange	-4999	-5744
Load	15163	15163
Losses	329	366
Arizona		
Generation	19049	20292
Interchange	7652	8889
Load	11099	11099
Losses	298	305
IID		
Generation	893	894
Interchange	507	507
Load	352	352
Losses	34	35
SDG&E		
Generation	1803	1607
Interchange	-1973	-2168
Load	3680	3680
Losses	96	95
LADWP		
Generation	2703	2251
Interchange	-1797	-2264
Load	4266	4266
Losses	233	248

Figure – A1

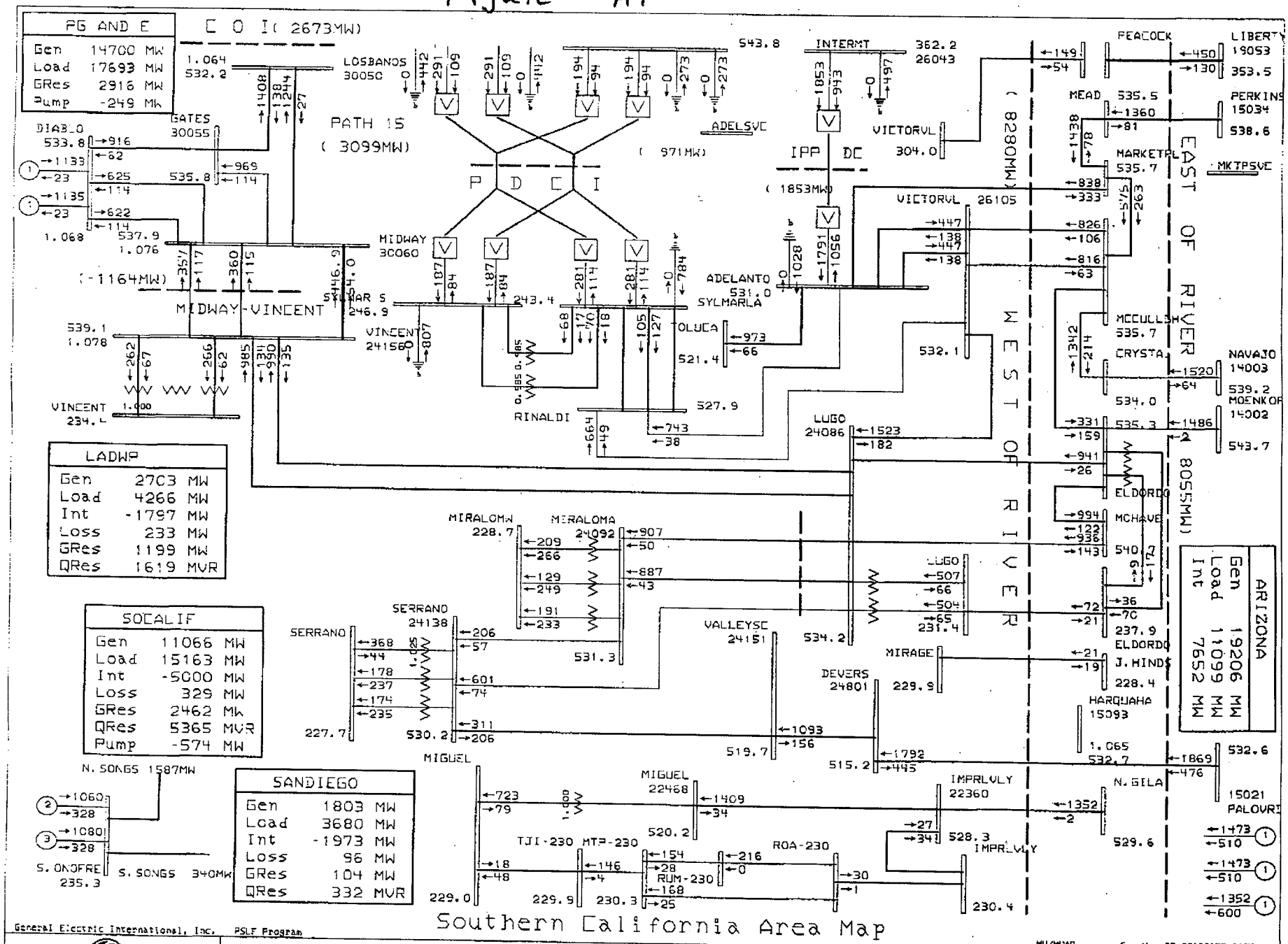
PG AND E
Gen 14700 MW
Load 17693 MW
GRes 2916 MW
Pump -249 MW
C O I (2673MW)
PATH 15
(3099MW)
P D C I
(971MW)
IPP DC
(1853MW)
EAST OF RIVER
WEST OF RIVER
(8280MW)
(8055MW)
(-1164MW)
MIDWAY-VINCENT
LADWP
Gen 2703 MW
Load 4266 MW
Int -1797 MW
Loss 233 MW
GRes 1199 MW
QRes 1619 MVR
SOCALIF
Gen 11066 MW
Load 15163 MW
Int -5000 MW
Loss 329 MW
GRes 2462 MW
QRes 5365 MVR
Pump -574 MW
SANDIEGO
Gen 1803 MW
Load 3680 MW
Int -1973 MW
Loss 96 MW
GRes 104 MW
QRes 332 MVR
ARIZONA
Gen 19206 MW
Load 11099 MW
Int 7652 MW
N. SONGS 1587MW
S. SONGS 340MW
Southern California Area Map
General Electric International, Inc. PSLF Program
8055B:EOR SC UPGRADE OF 8055MW POST PROJECT CASE
WITH MOUNTAIN VIEW, 2008 HA, Pre-DPV2 Case
PV UNIT2 UPGRADE, FEBRUARY 23, 2004
MW/MVAR
Sun Mar 07 08:20:55 2004
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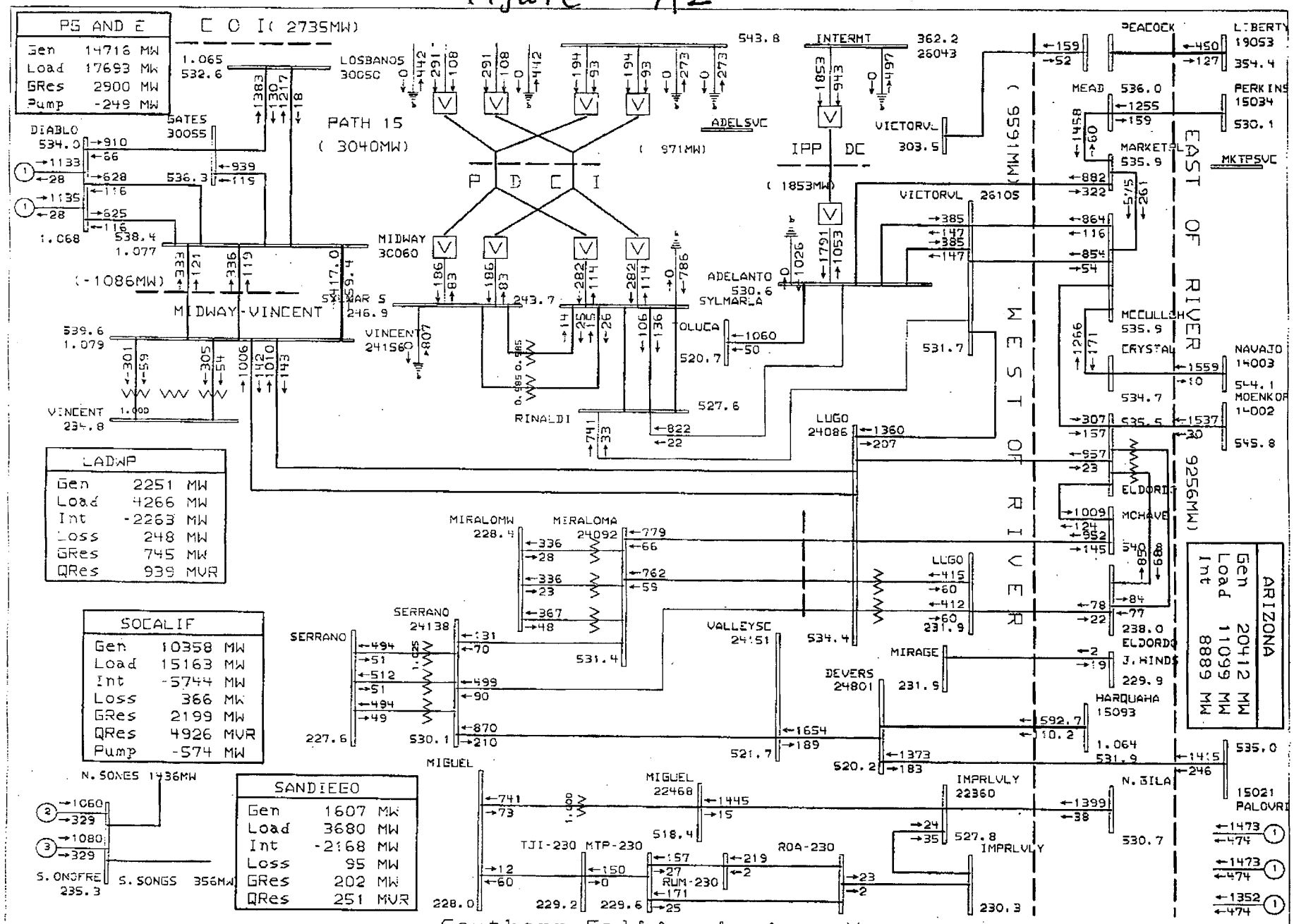
Figure — A2



Southern California Area Map

General Electric International, Inc. PSLF Program

REVISED VERSION OF EOR POST PROJECT CASE
EOR: 9255MW, Increase by 1200 MW with DPV2

PV UNIT2 UPGRADE, FEBRUARY 19, 2004
W/T KOD UPGRADES -- 2B-1033 X 4

MW/MVAR

Fri Mar 12 13:37:25 2004

gedlwork.drw
C:\pslf\Cases\dpv2\OB-1705sw\9
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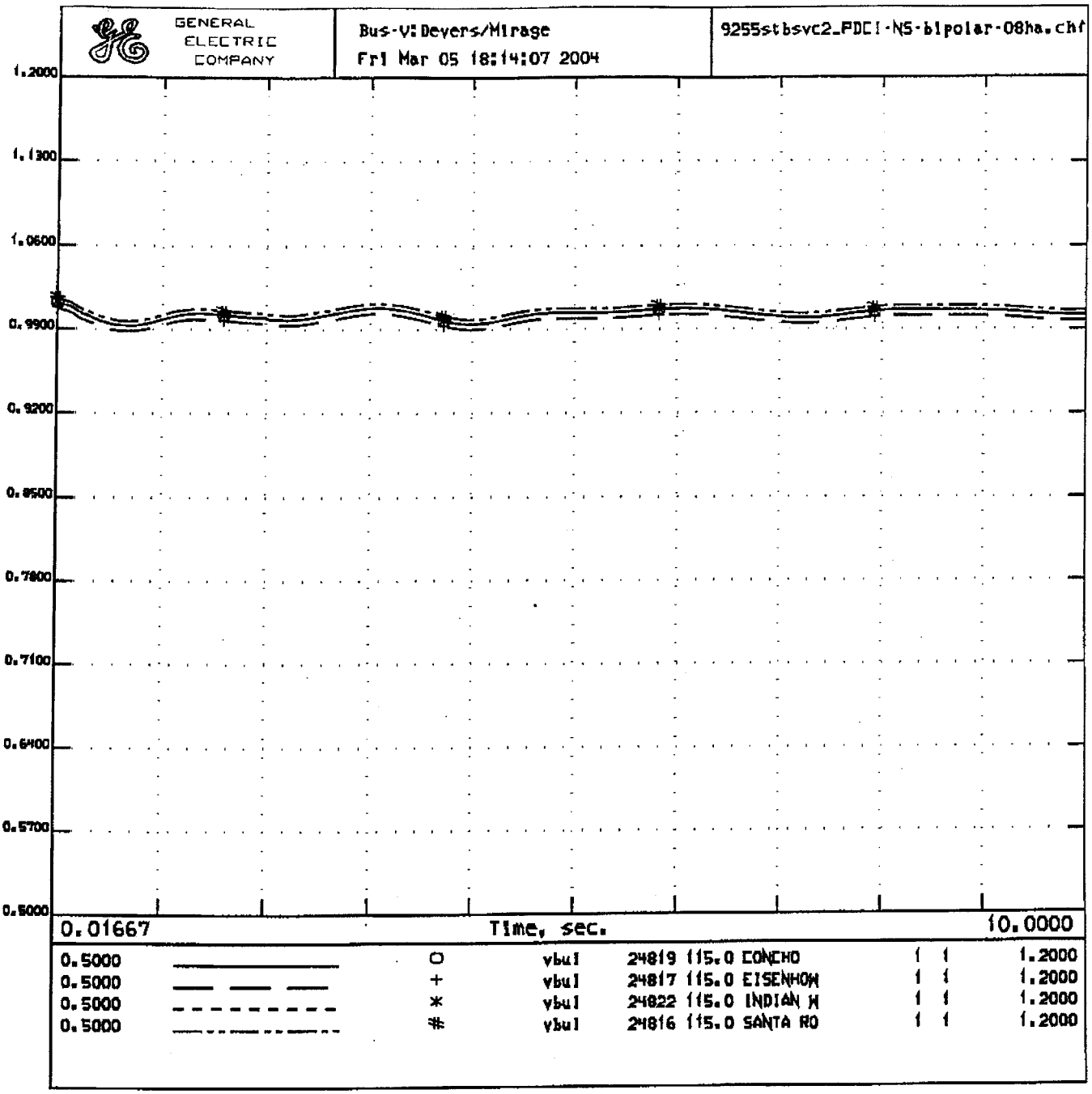
Appendix B

Transient Stability Study Plots

Transient Stability Study Plots - 1

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Bi-polar**
CONTINGENCY:	**N-1**
OUTAGE:	**Pacific DC Intertie**
EOR MARGIN:	**None**
NOTES:	



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Swt file=c:\psif\cases\dpv2\PDCI-NS-bipolar-08ha.swt
Terminal output log is CASE.trm

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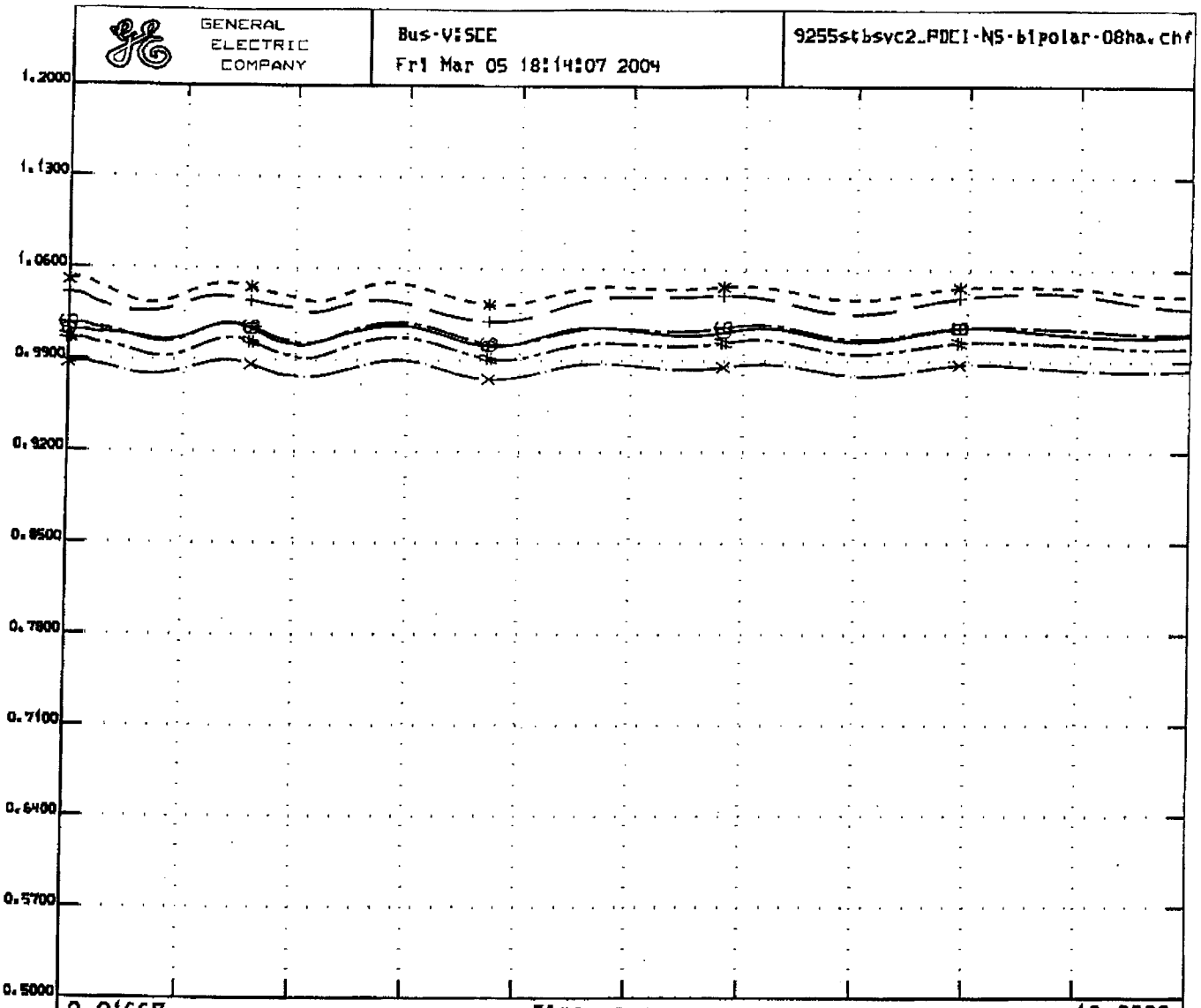
STRESSED EOR BY DECREASING LOADLEVEL ACCORDING TO OSS MANUAL
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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Terminal output log is CASE.trm

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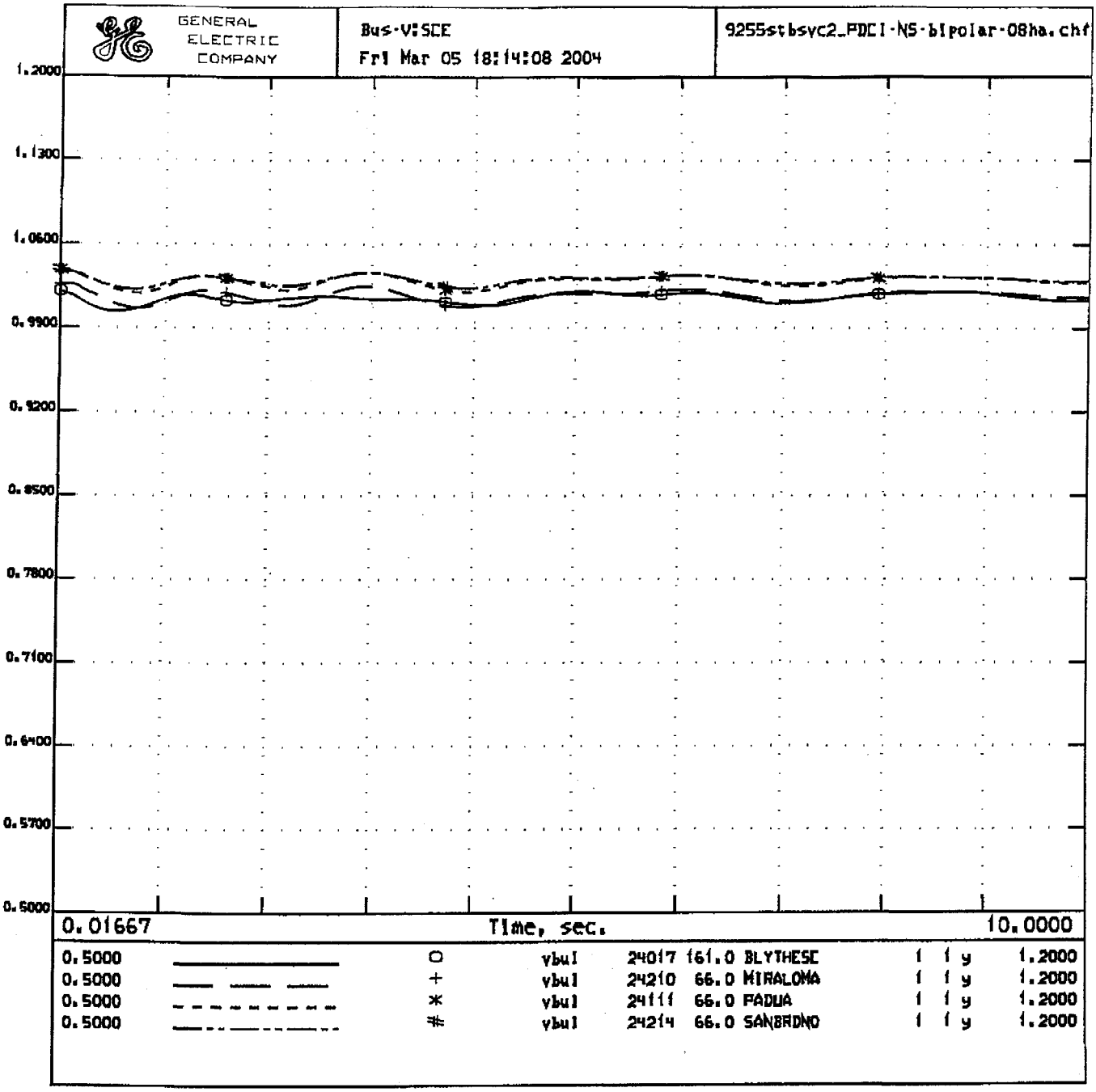
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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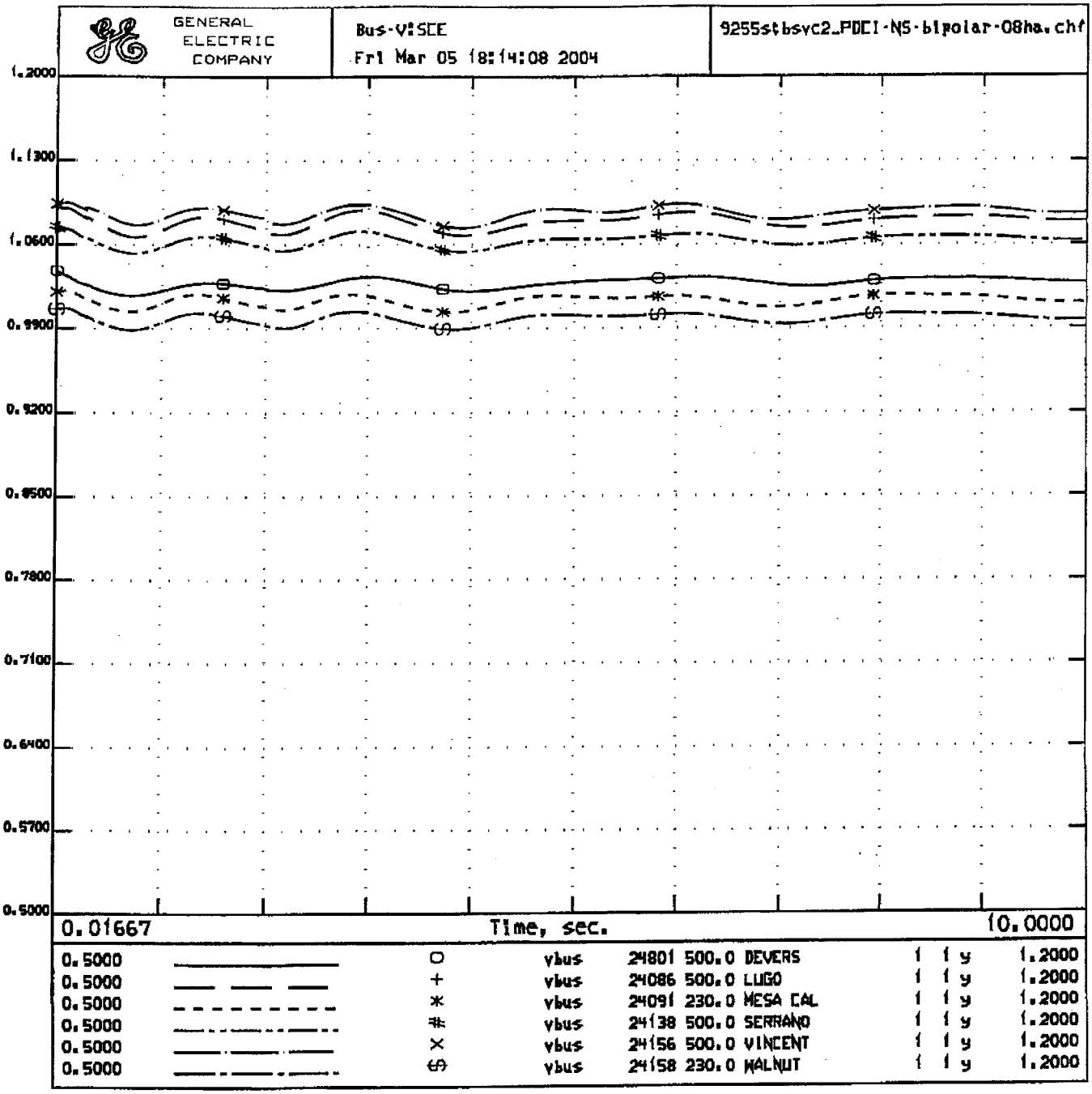

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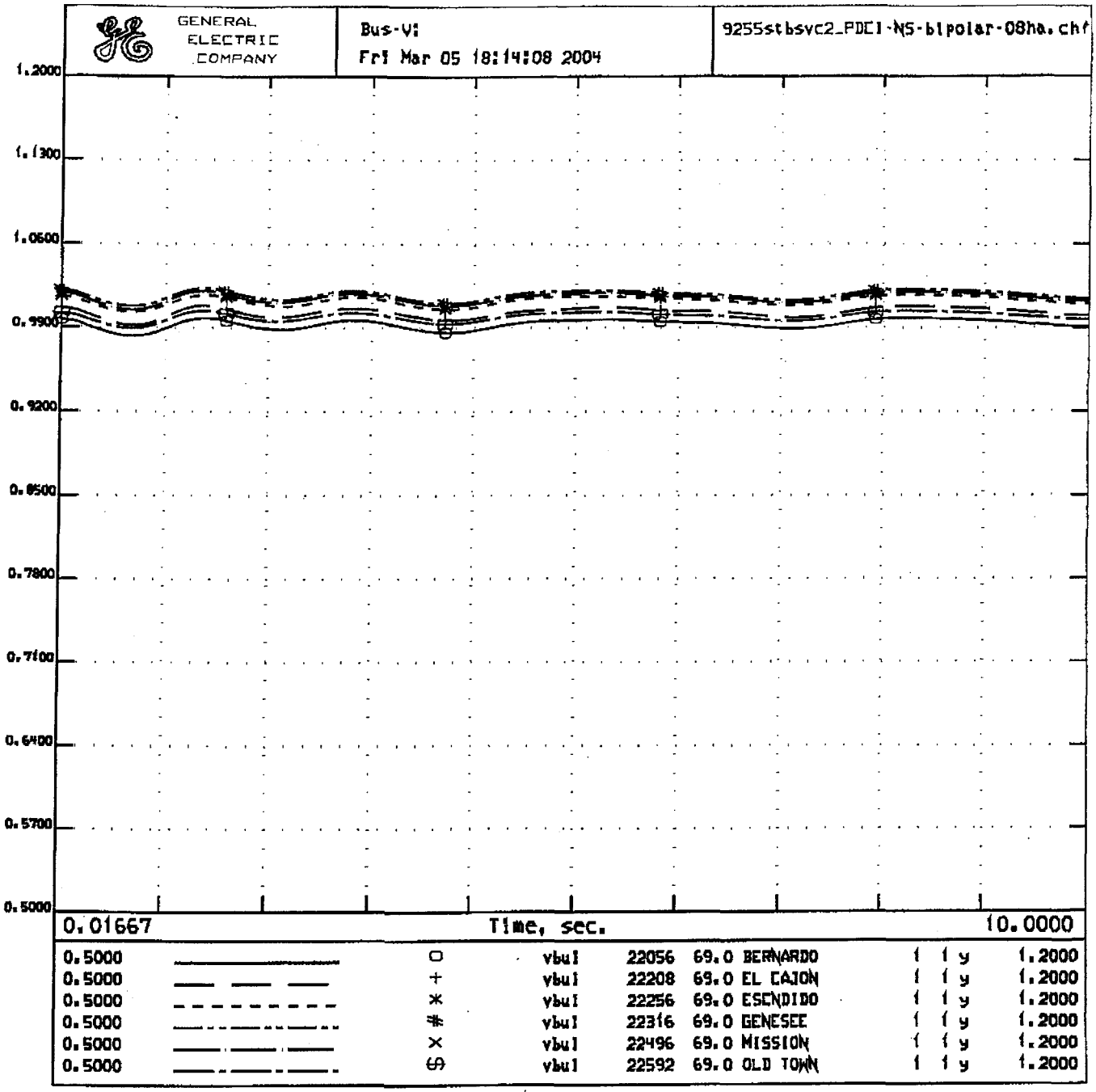

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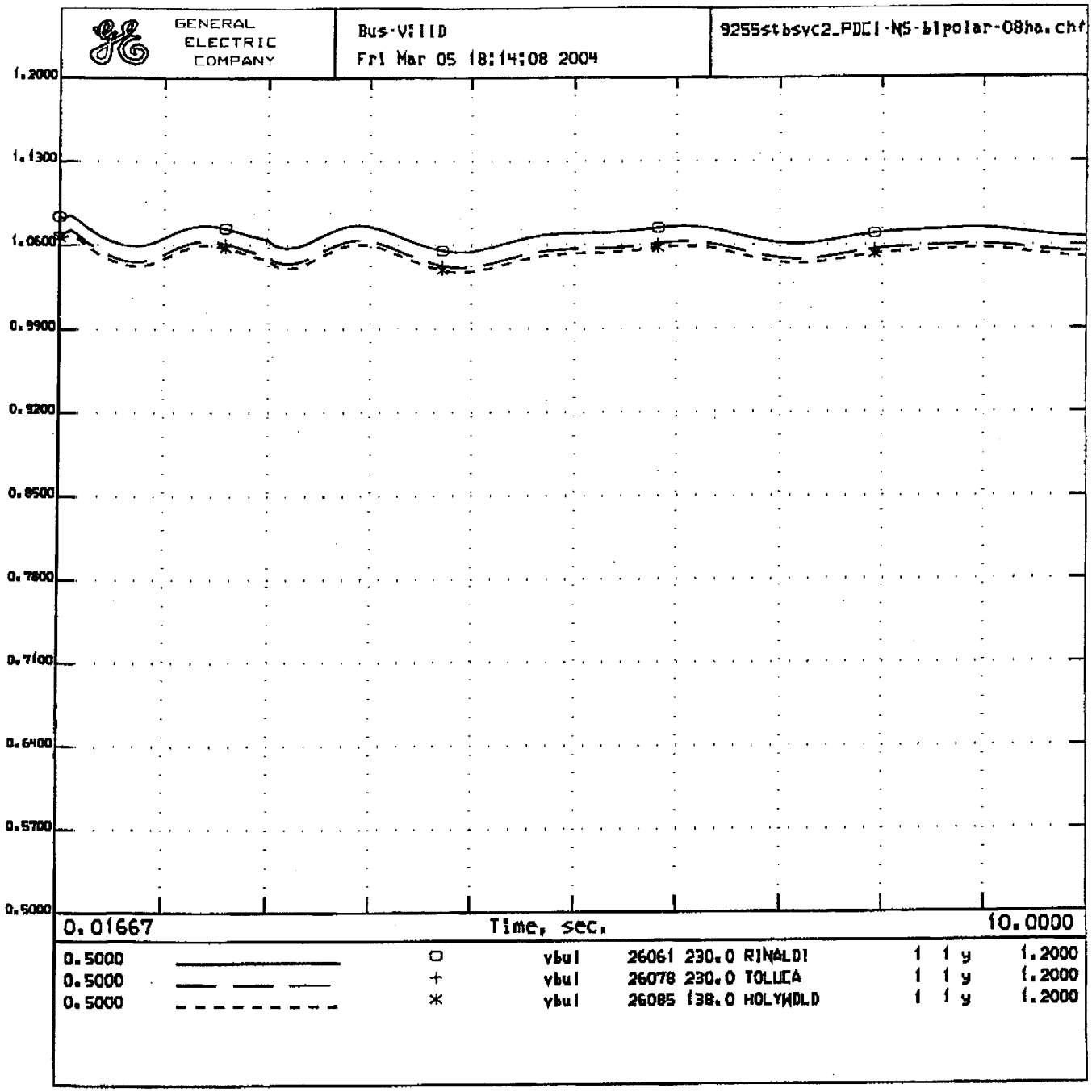

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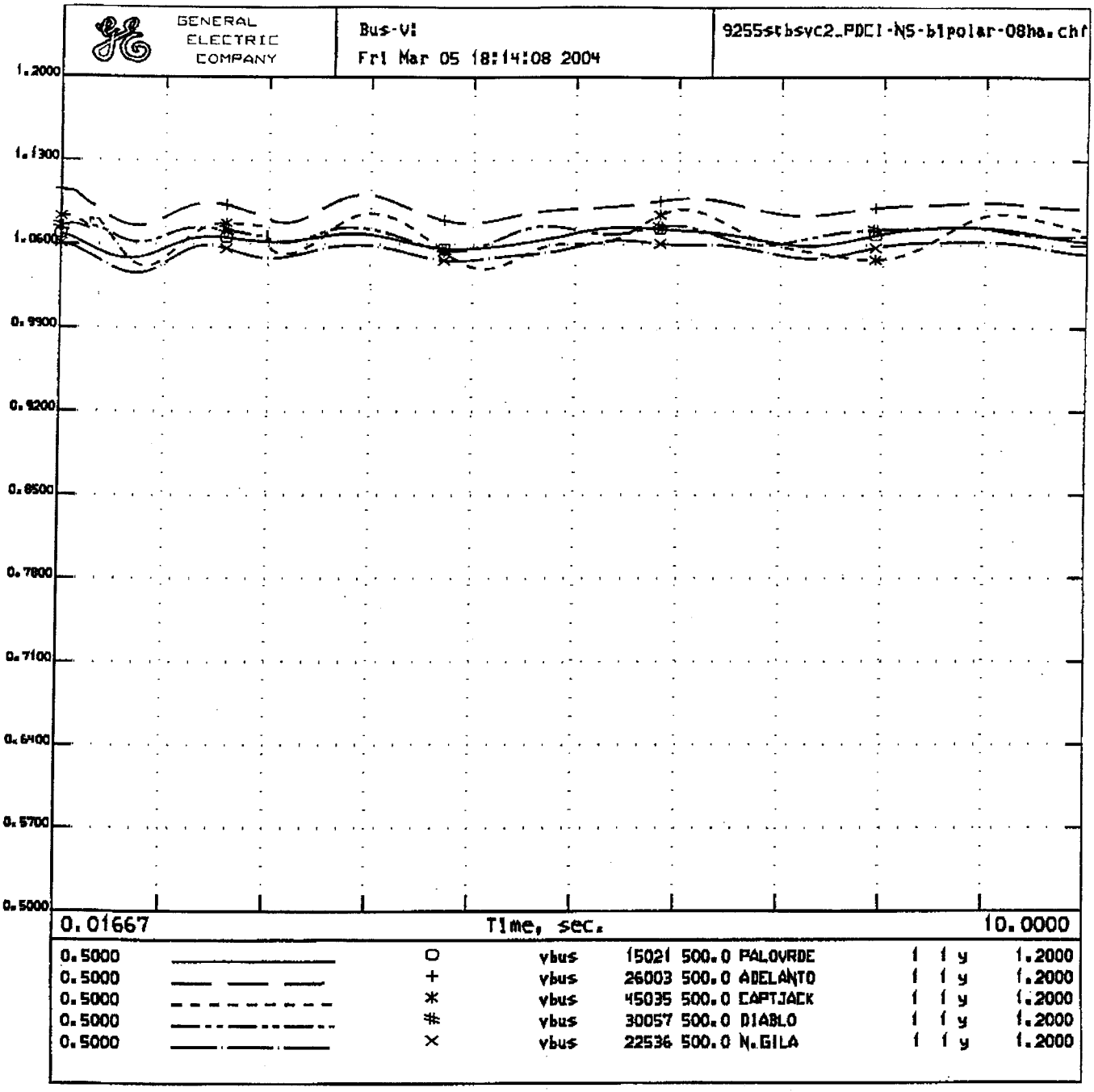
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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AT 55/30/15 RATIO (SCE/DWP/SDG&E)
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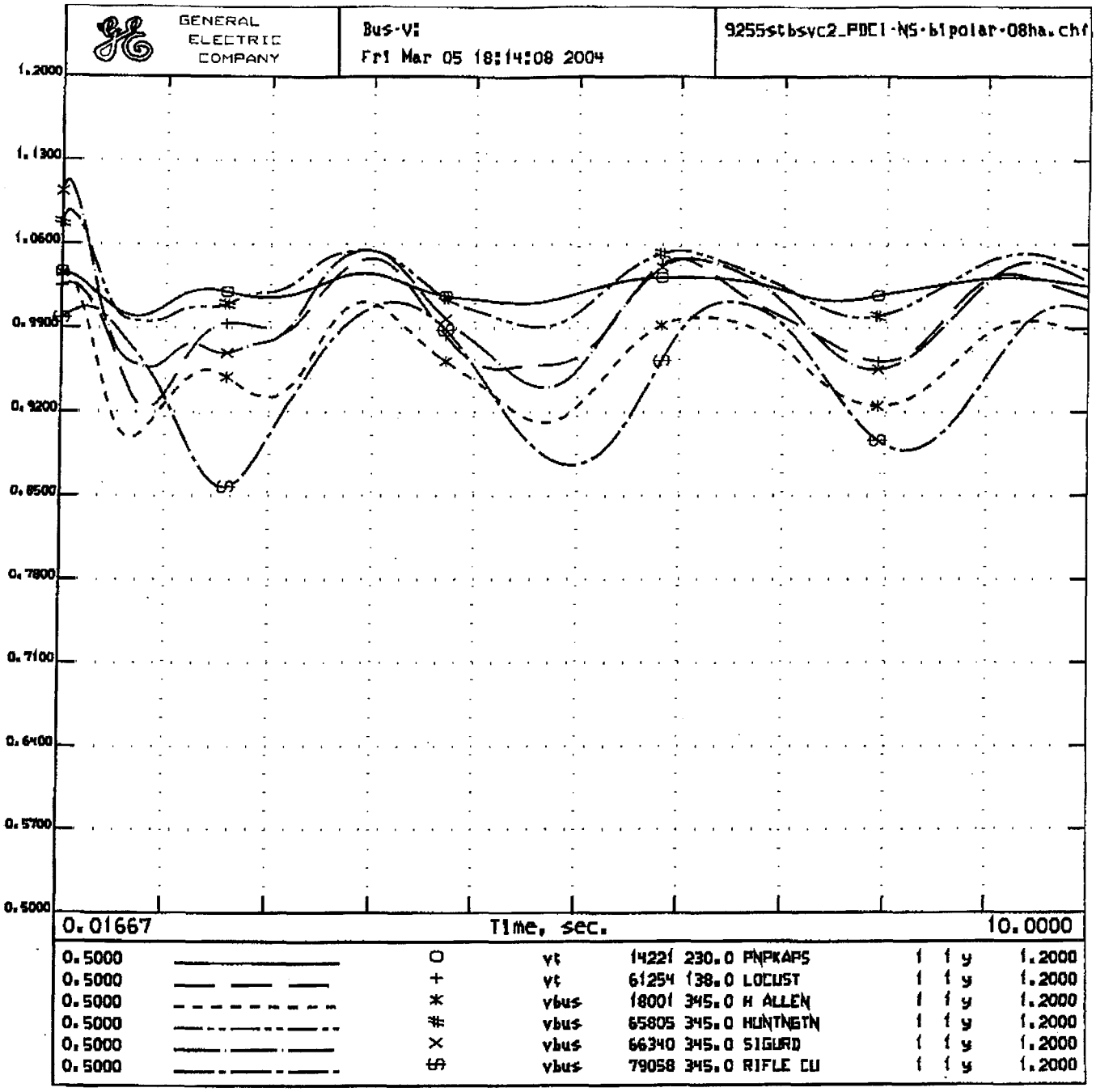

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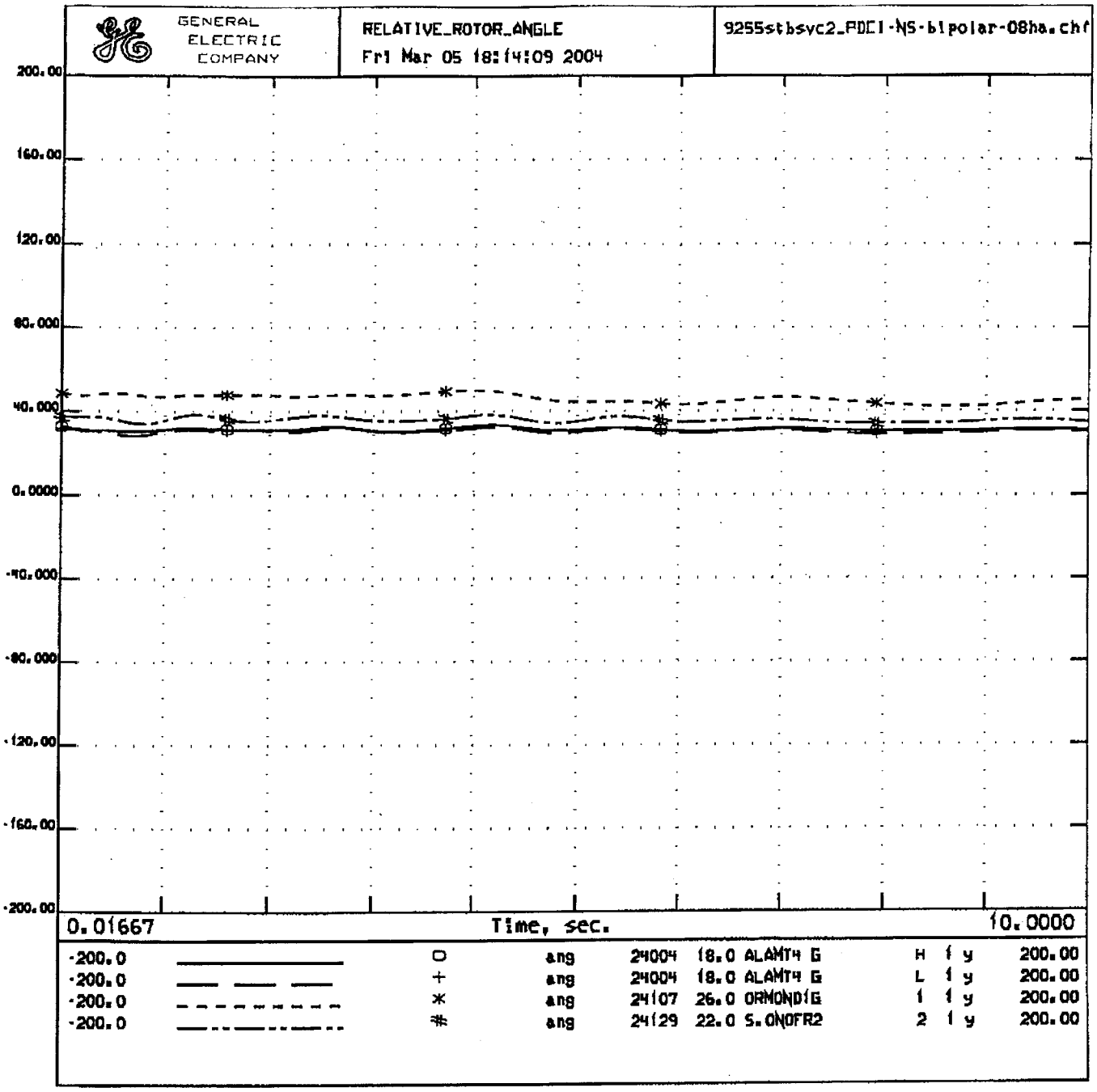
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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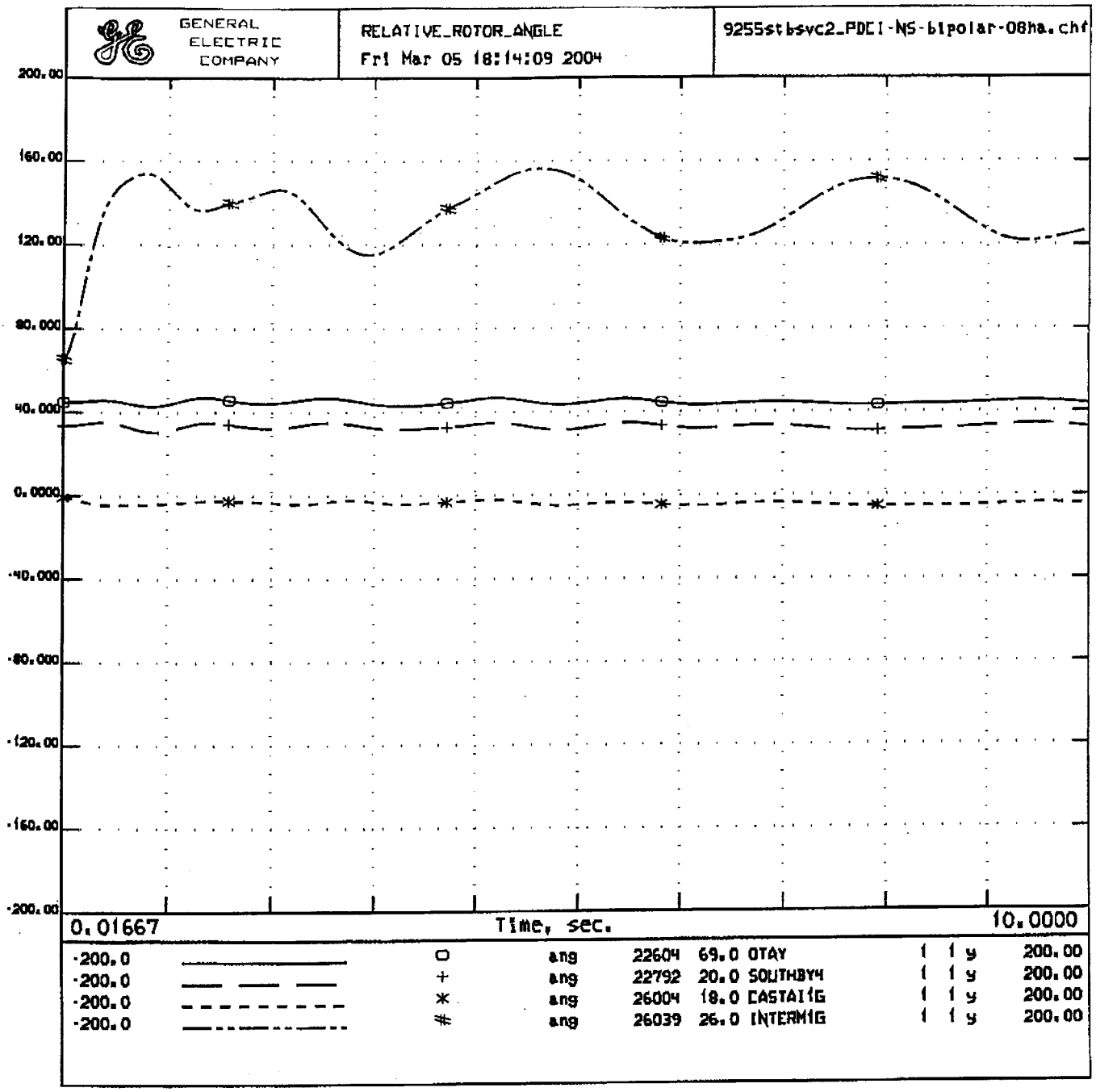

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Terminal output log is CASE.trm

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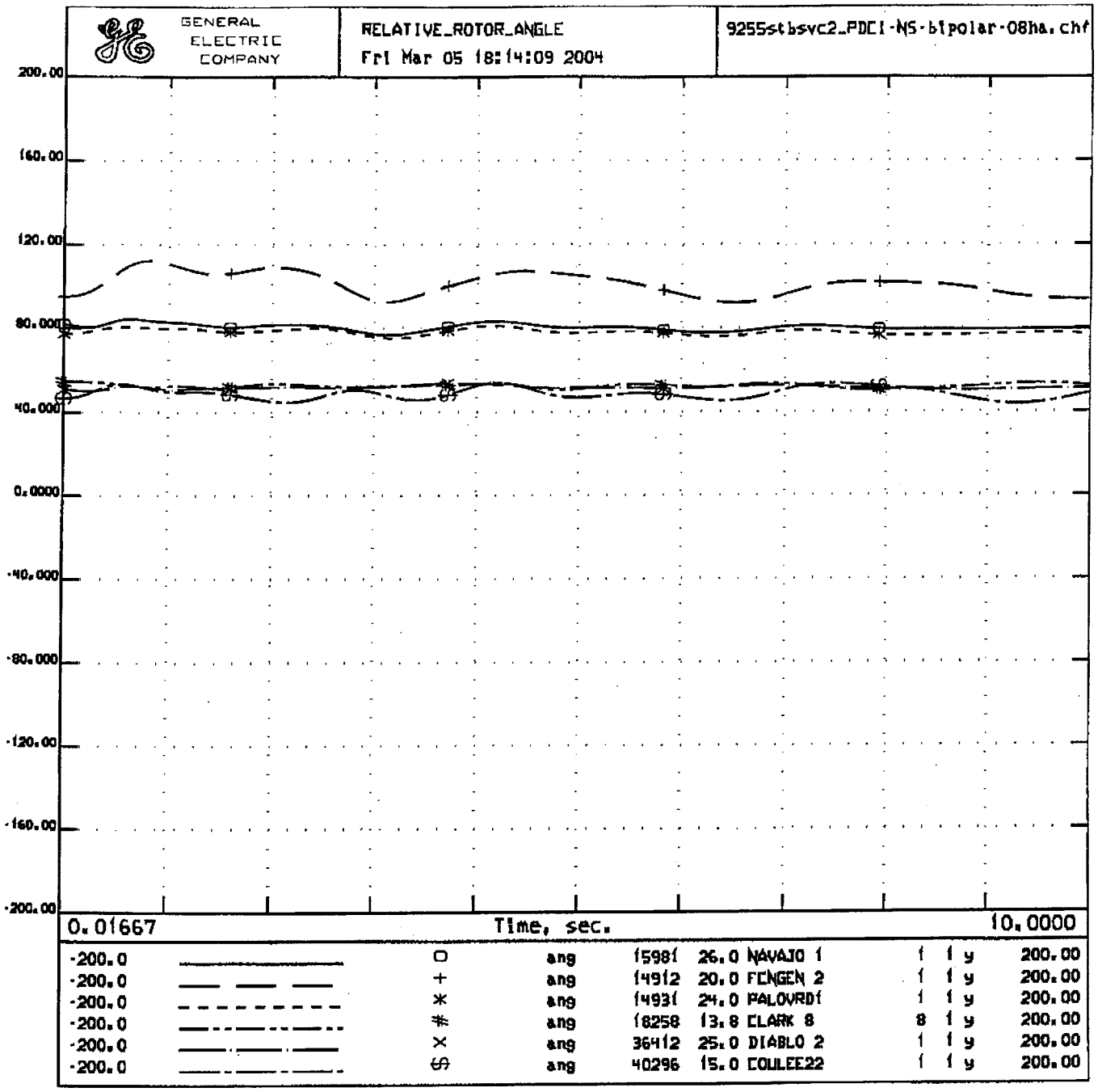

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Terminal output log is CASE.trm

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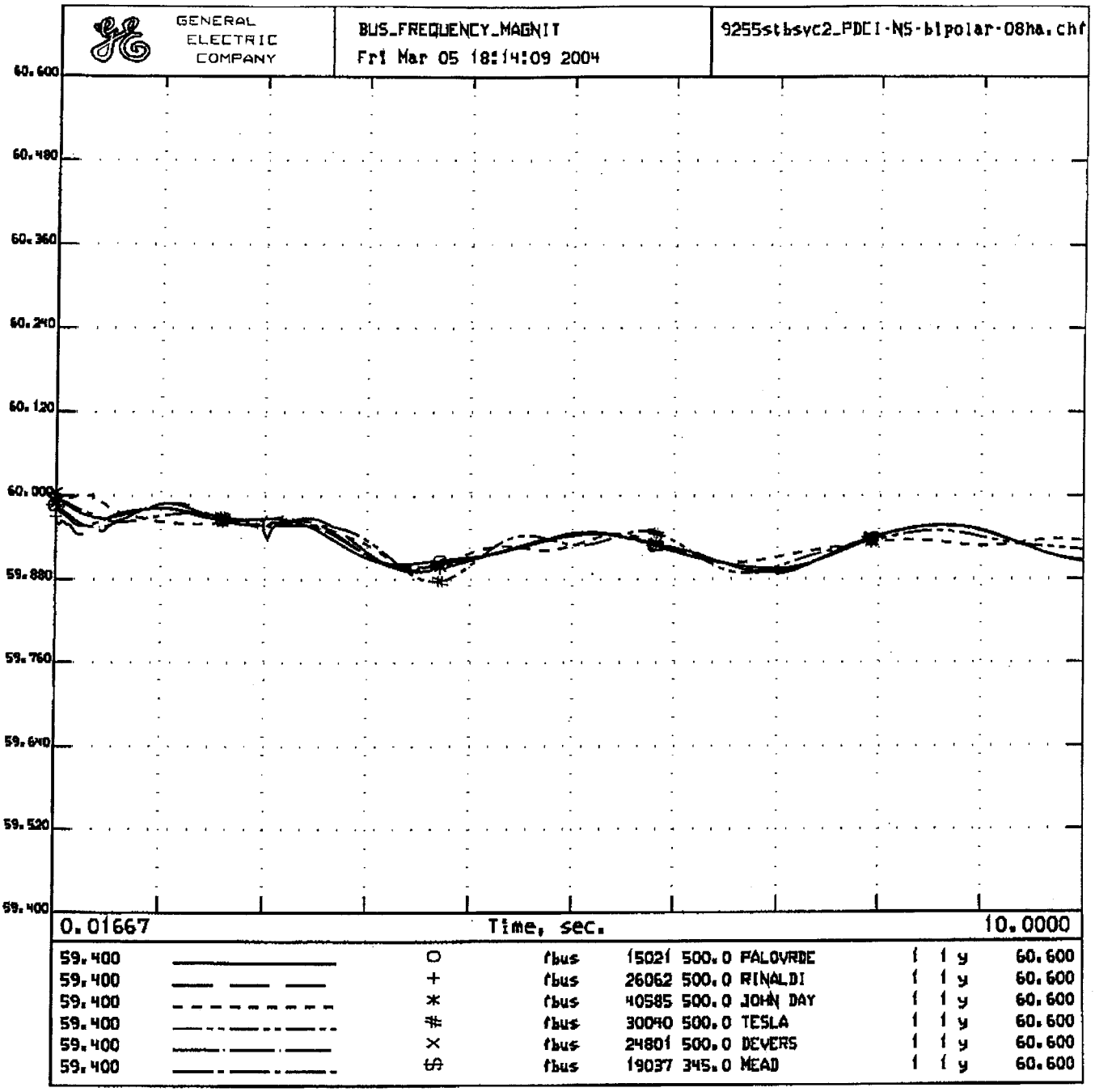

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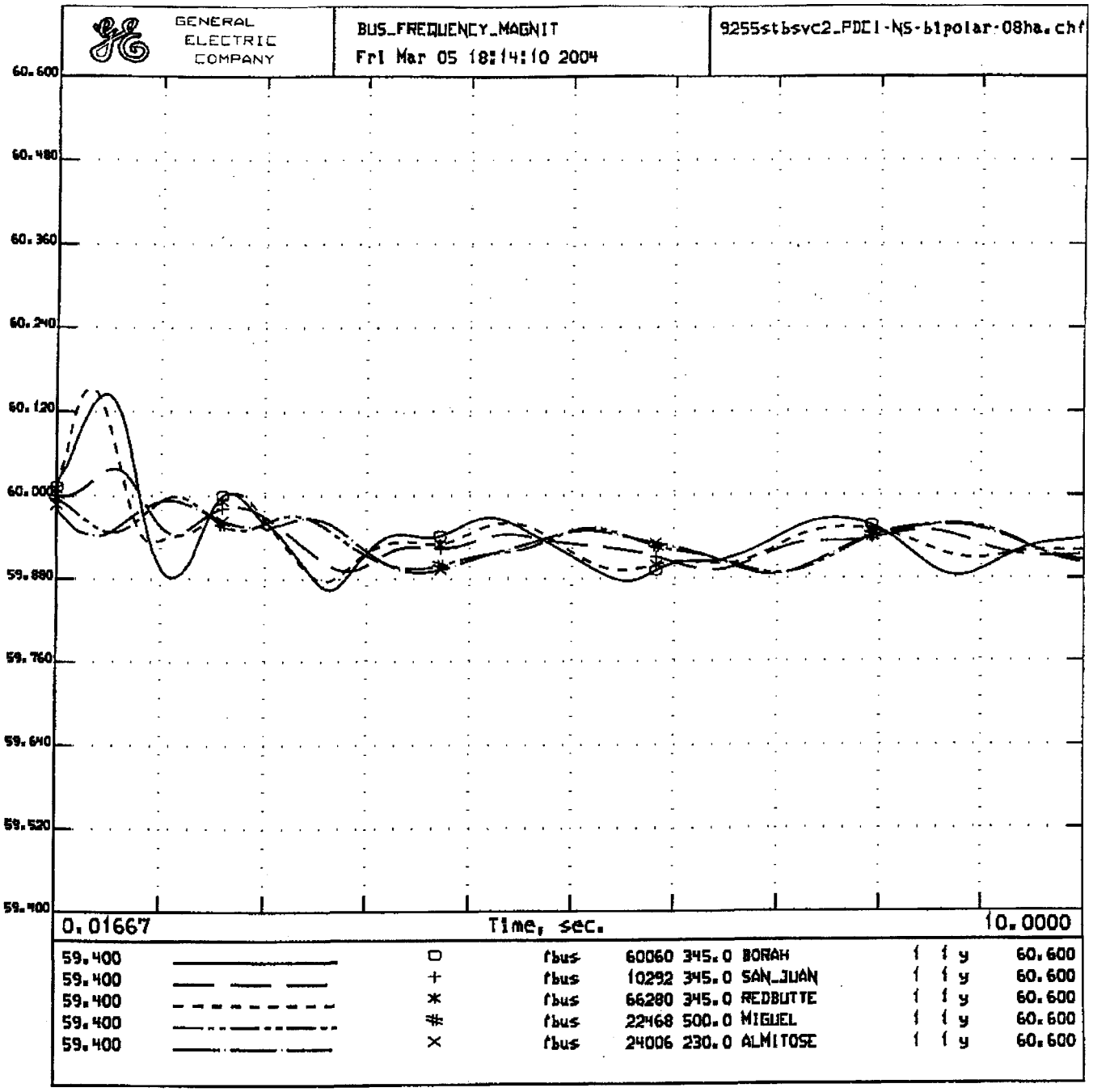

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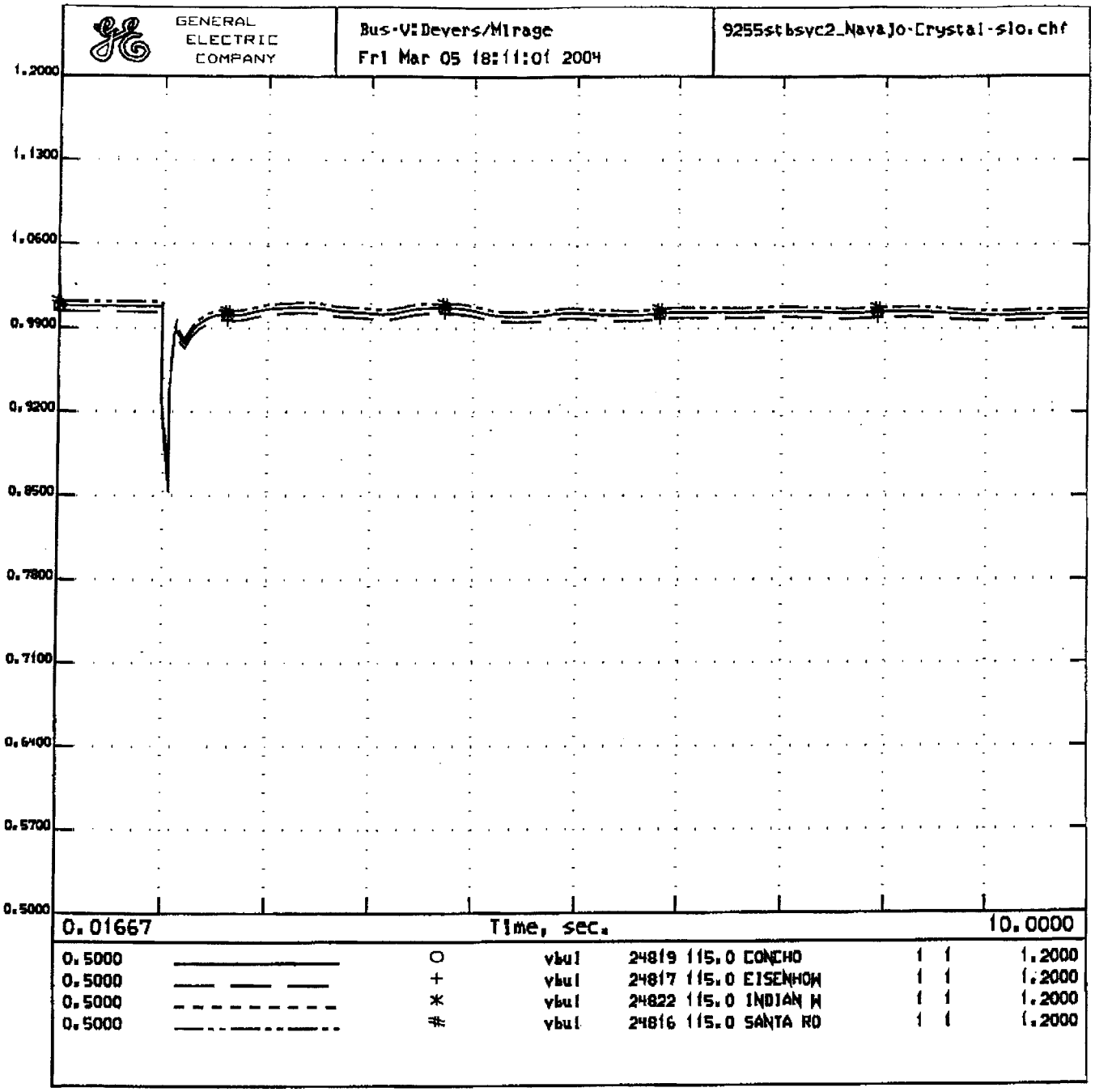
Transient Stability Study Plots - 2

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Navajo-Crystal 500 kV Line**
EOR MARGIN:	**None**
NOTES:	



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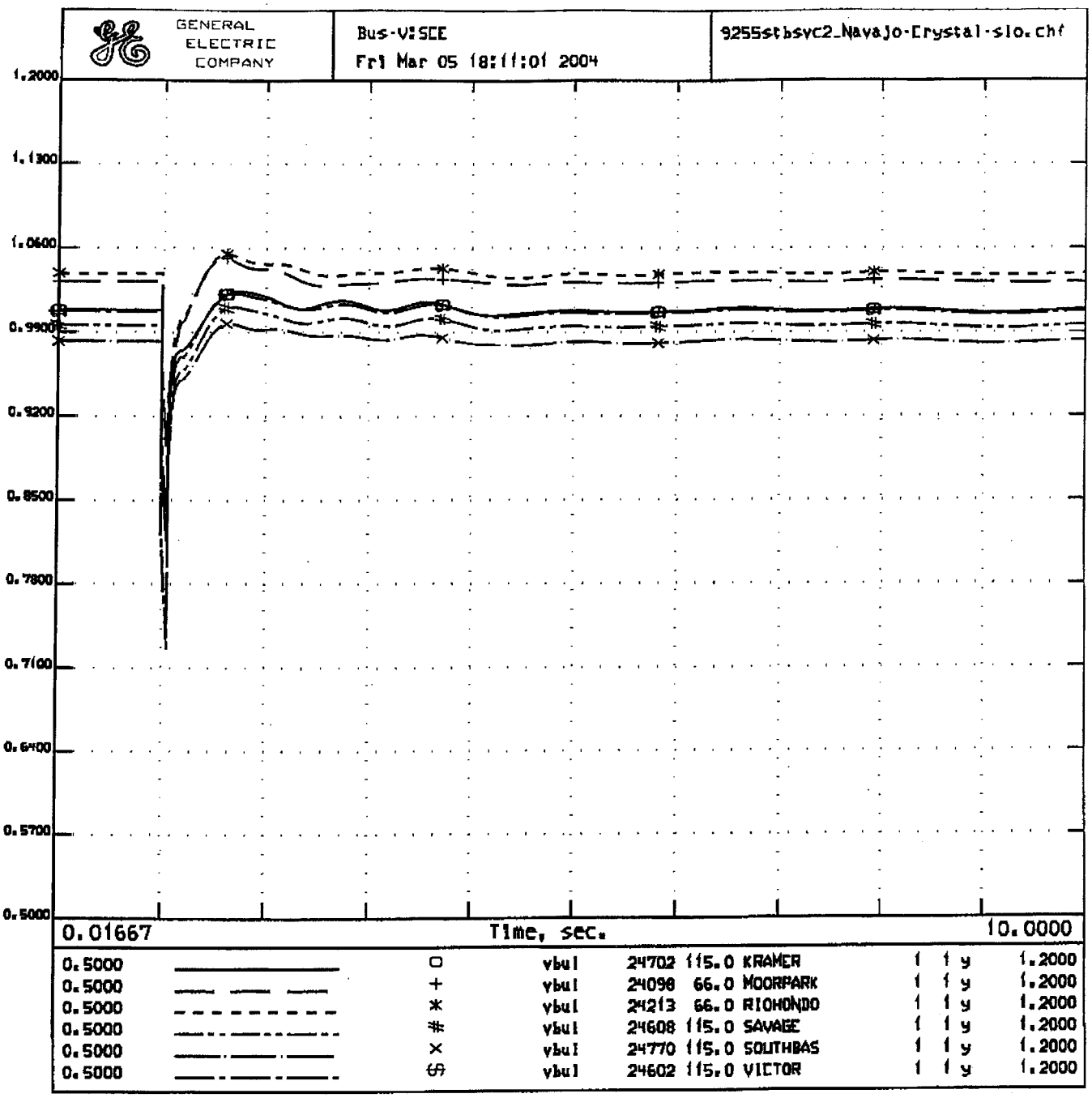

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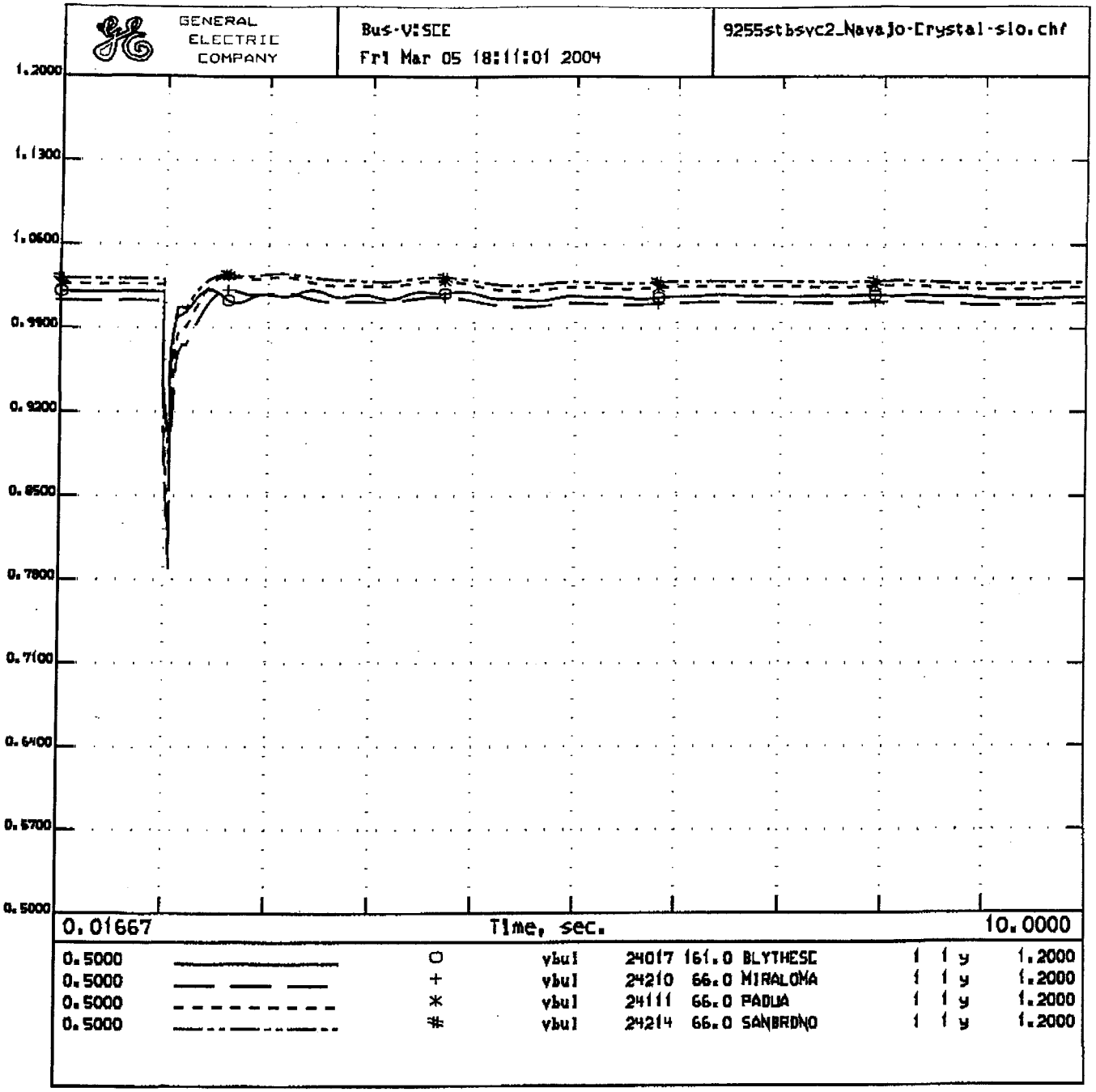

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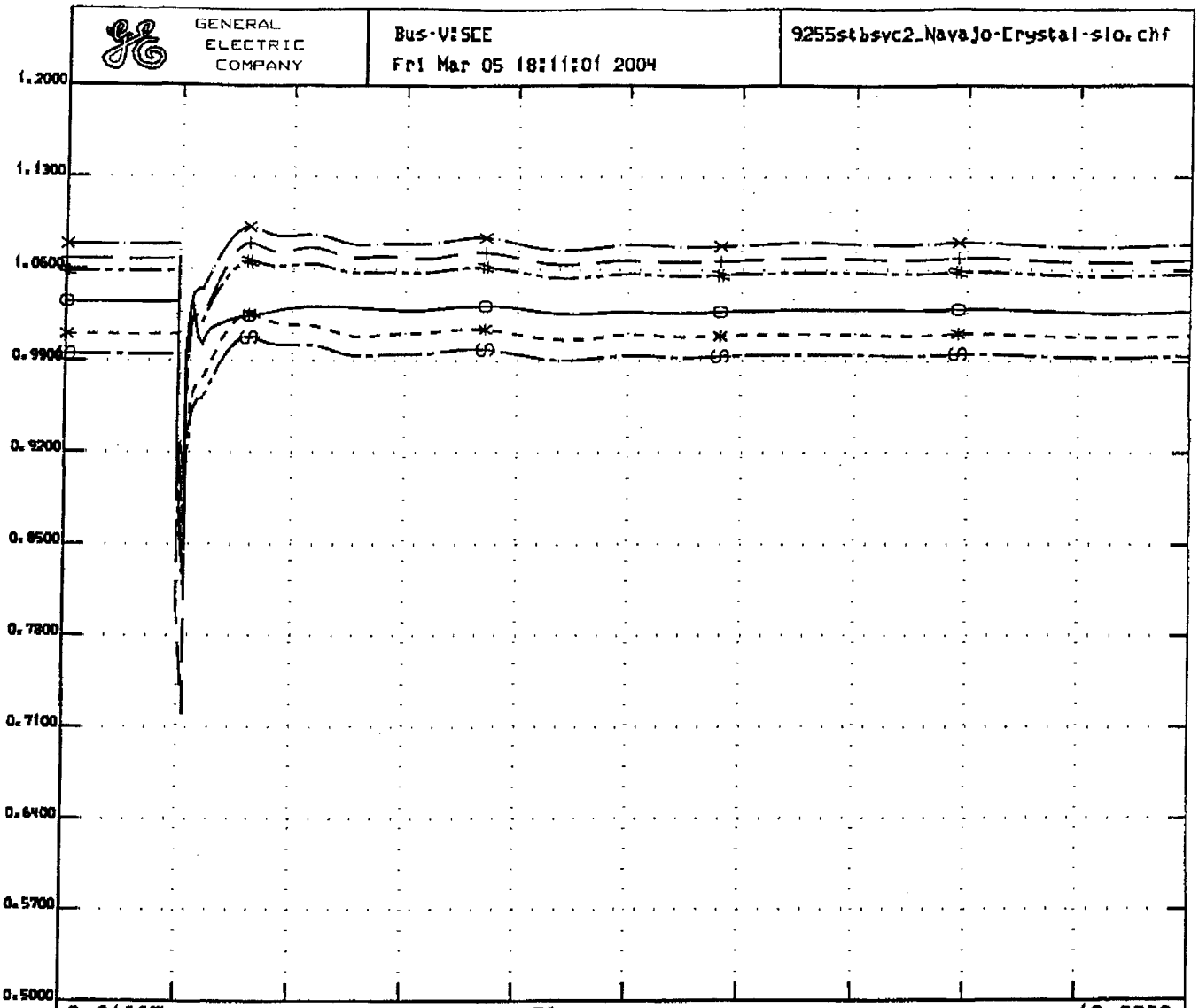

0.5000	———	▭	vbus	24801	500.0	DEVERS	1	1 y	1.2000
0.5000	— — —	+	vbus	24086	500.0	LUGO	1	1 y	1.2000
0.5000	- - - - -	✳	vbus	24091	230.0	MESA CAL	1	1 y	1.2000
0.5000	—·—·—	#	vbus	24138	500.0	SERRANO	1	1 y	1.2000
0.5000	—·—·—	×	vbus	24156	500.0	VINCENT	1	1 y	1.2000
0.5000	—··—··—	⊗	vbus	24158	230.0	WALNUT	1	1 y	1.2000

Case *9255stbsvc2_Navajo-Crystal-slo
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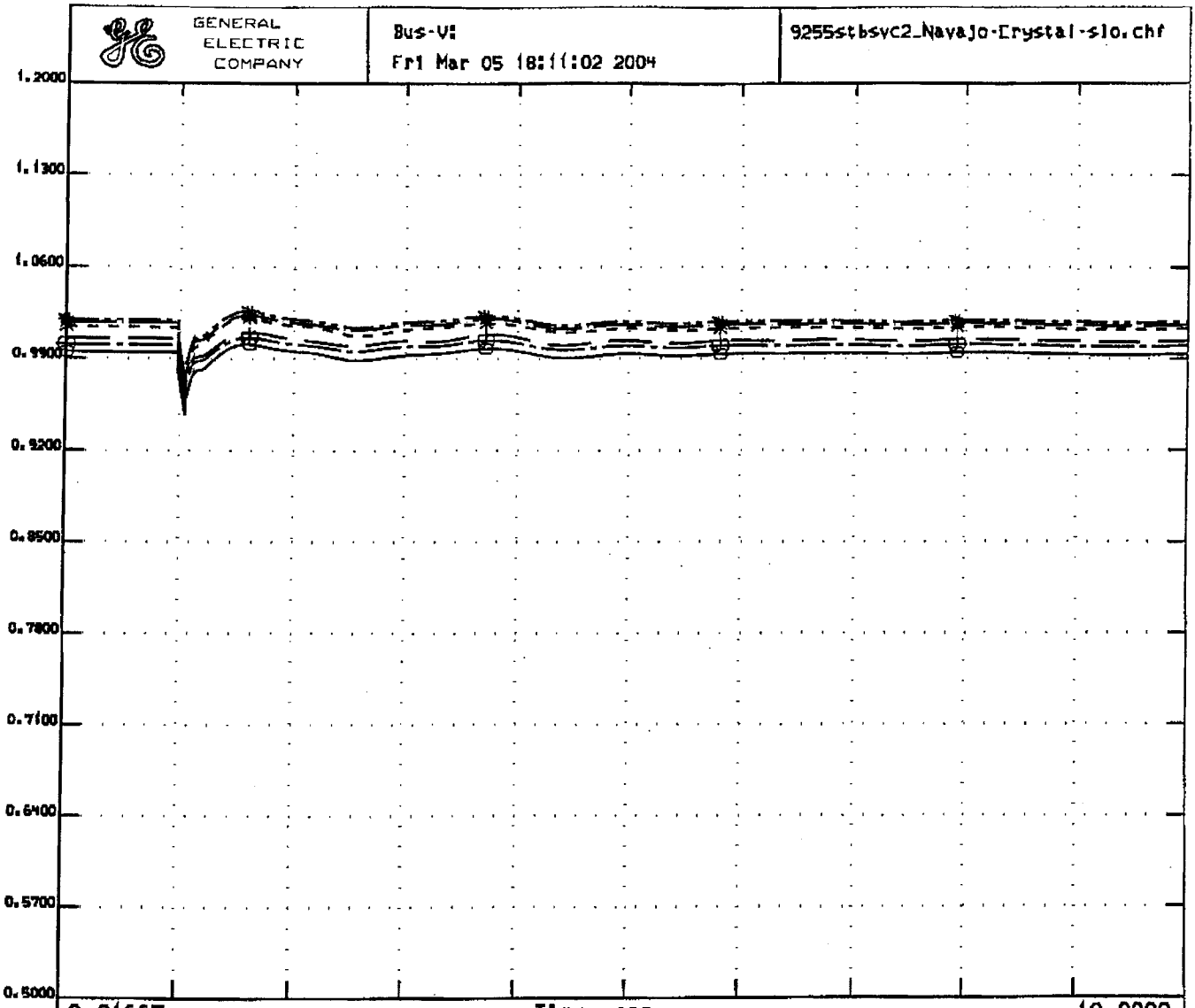

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0.5000		+	vbul	22208	69.0	EL CAJON	1	1 y	1.2000
0.5000		*	vbul	22256	69.0	ESCNDIDO	1	1 y	1.2000
0.5000		#	vbul	22316	69.0	GENESEE	1	1 y	1.2000
0.5000		×	vbul	22496	69.0	MISSION	1	1 y	1.2000
0.5000		⊕	vbul	22592	69.0	OLD TOWN	1	1 y	1.2000

Case *9255stbsvc2_Navajo-Crystal-slo
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Swt file=c:\pslf\cases\dpv2\Navajo-Crystal-slo.swt
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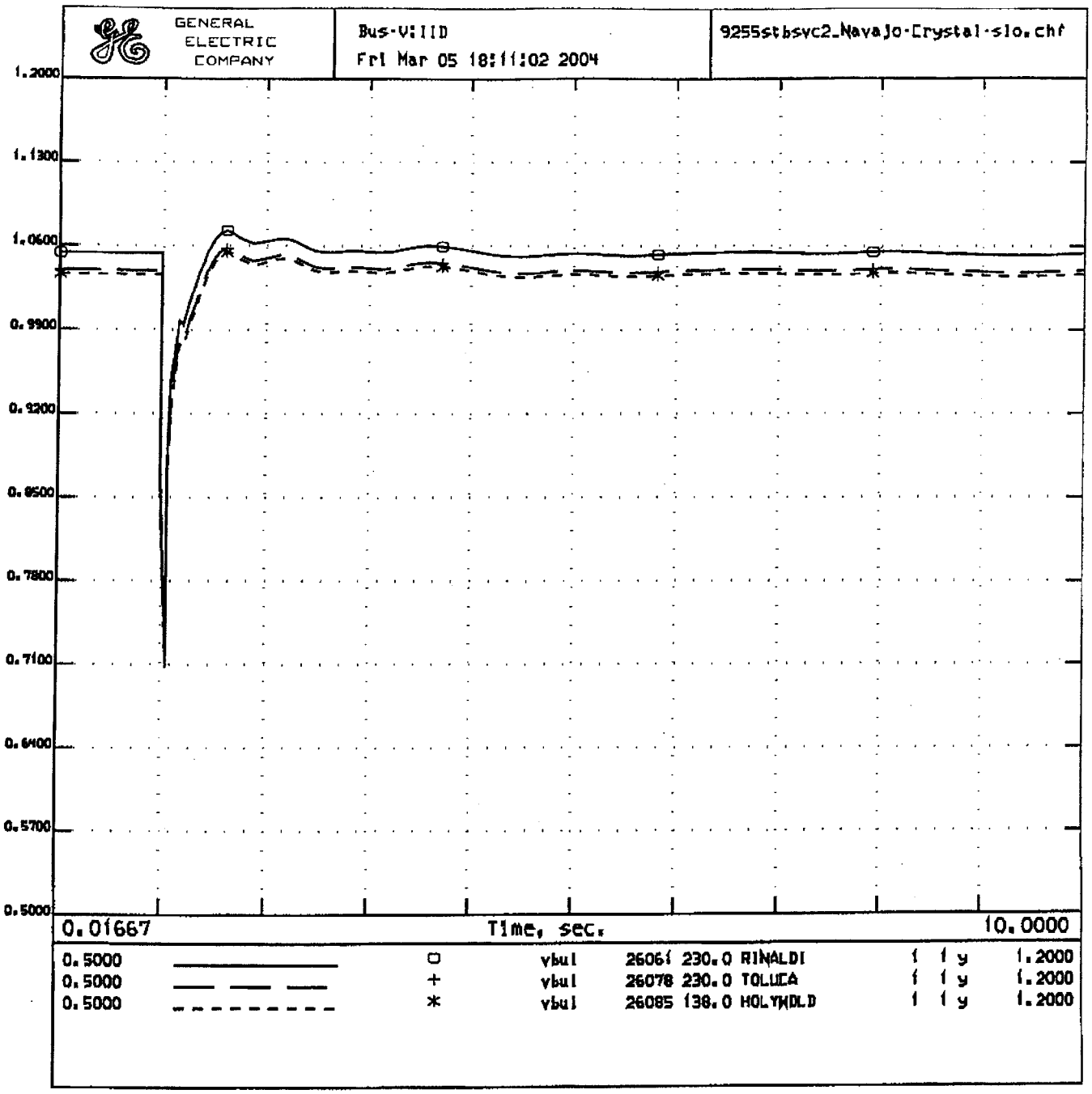

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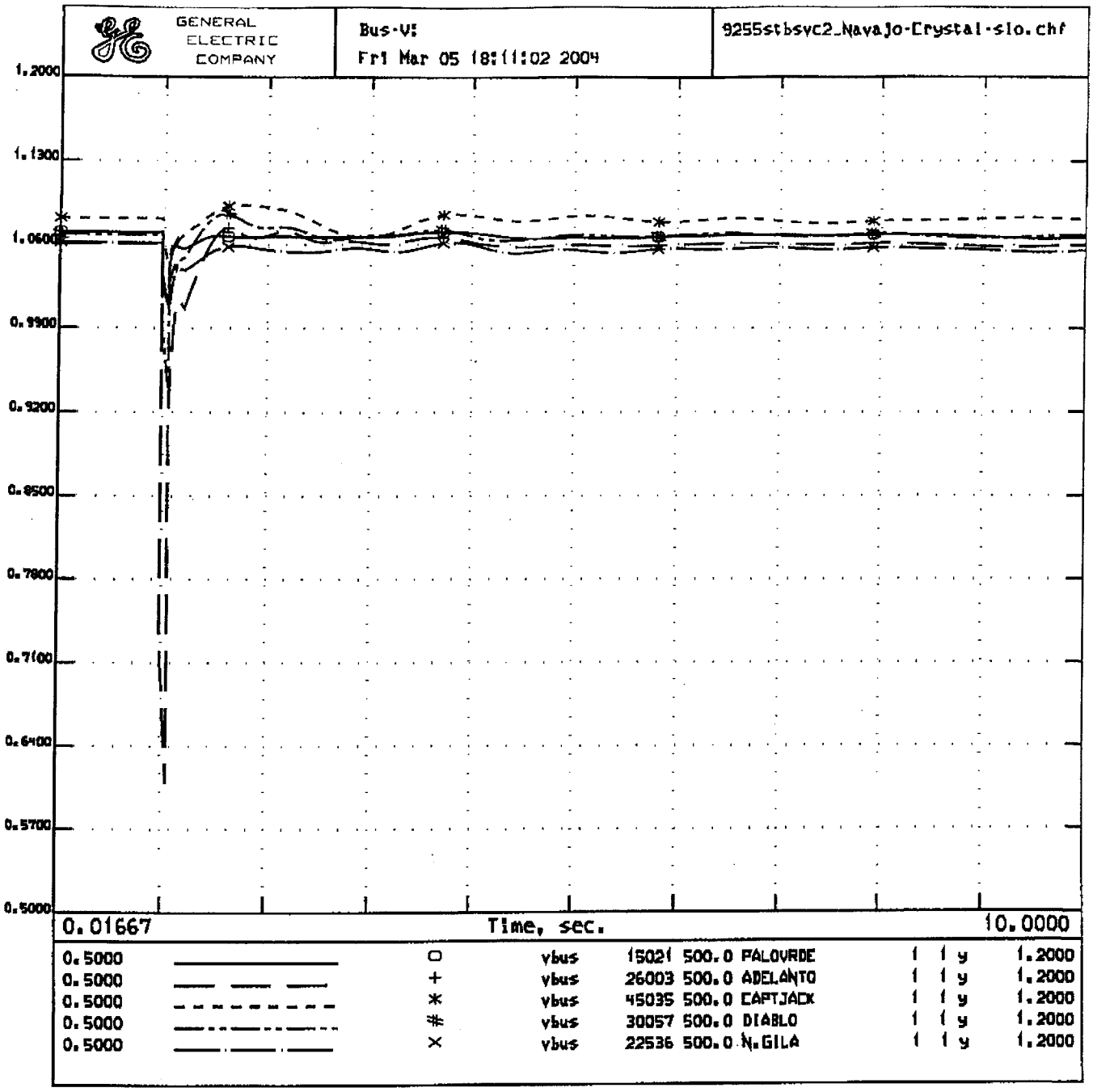

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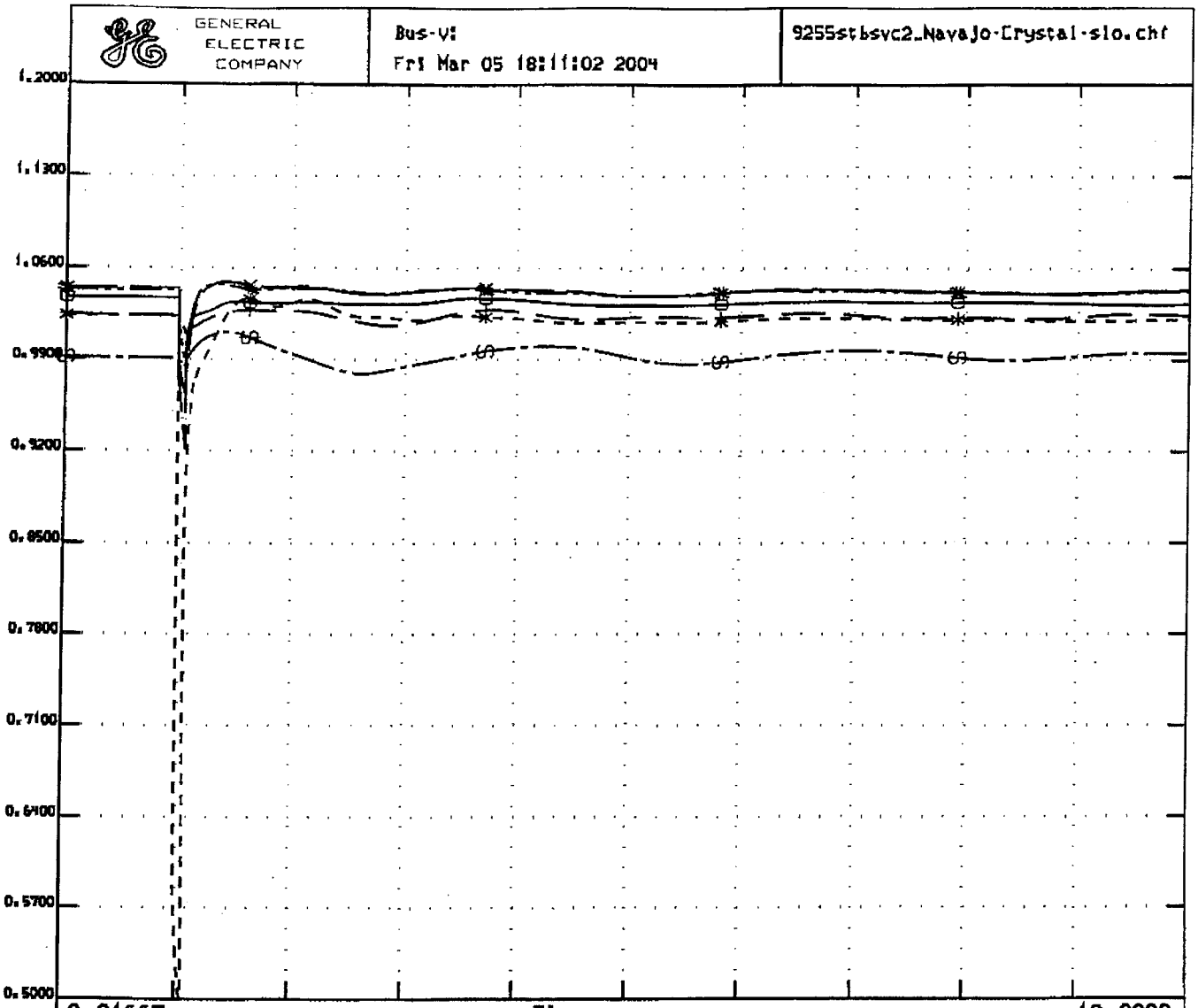

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0.5000	— — —	+	vt	61254 138.0 LOCUST	1	1	y	1.2000
0.5000	- - - - - - - -	*	vbus	18001 345.0 H ALLEN	1	1	y	1.2000
0.5000	—··—··—··	#	vbus	65805 345.0 HUNTNGTN	1	1	y	1.2000
0.5000	—·—·—·—	×	vbus	66340 345.0 SIGURD	1	1	y	1.2000
0.5000	—·—·—·—	⊗	vbus	79058 345.0 RIFLE CU	1	1	y	1.2000

Case =9255stbsvc2_Navajo-Crystal-slo
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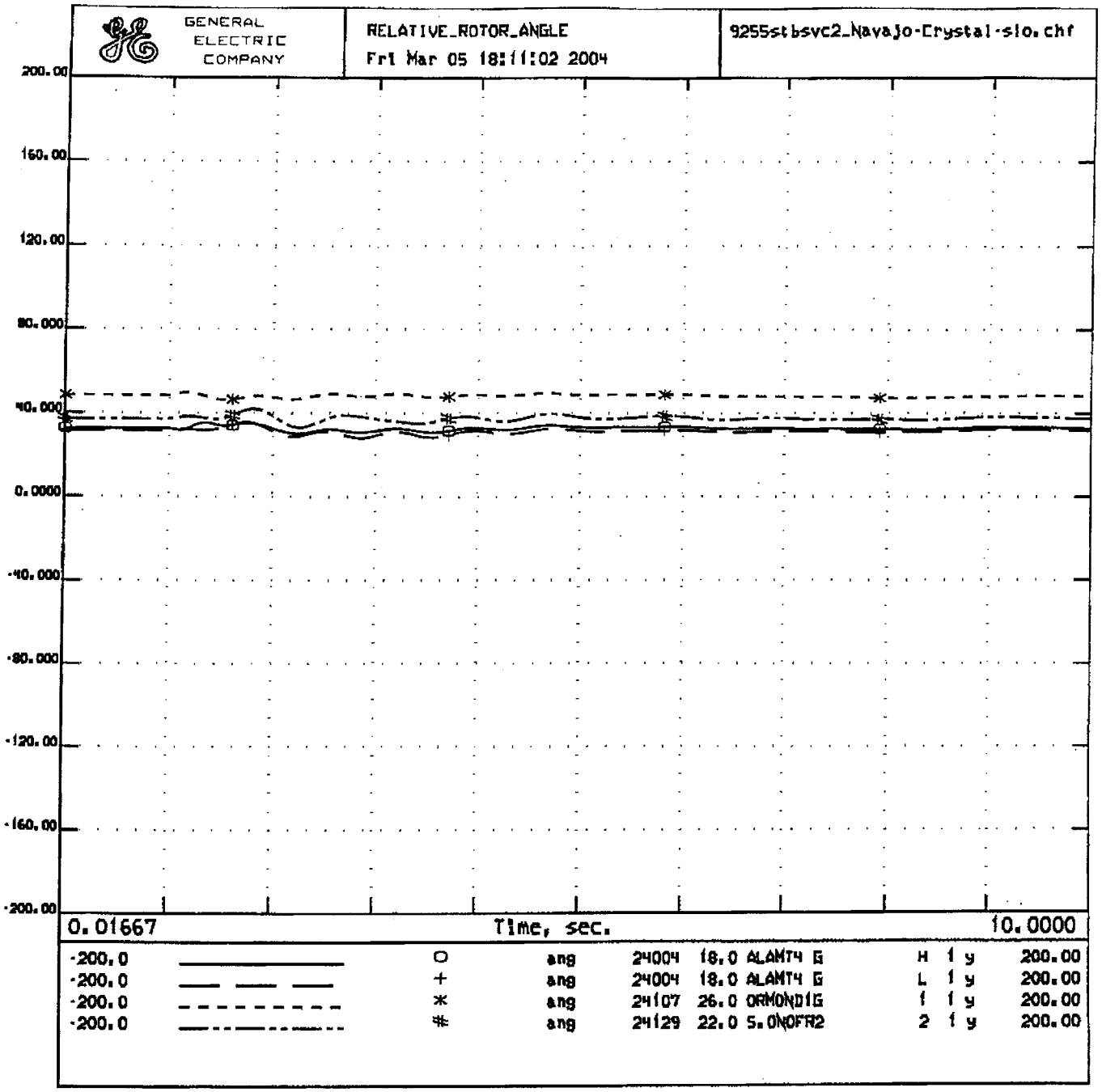

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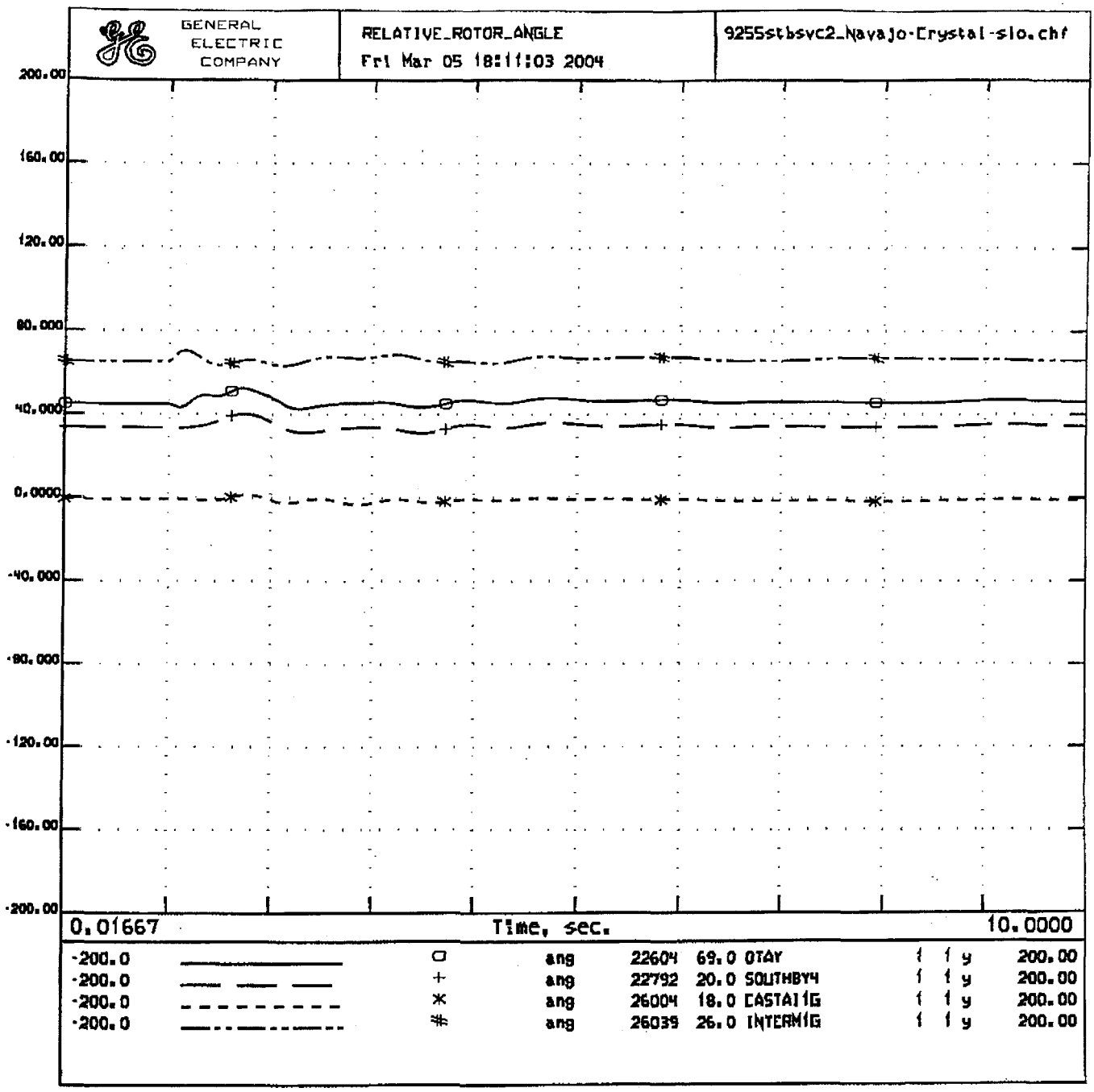

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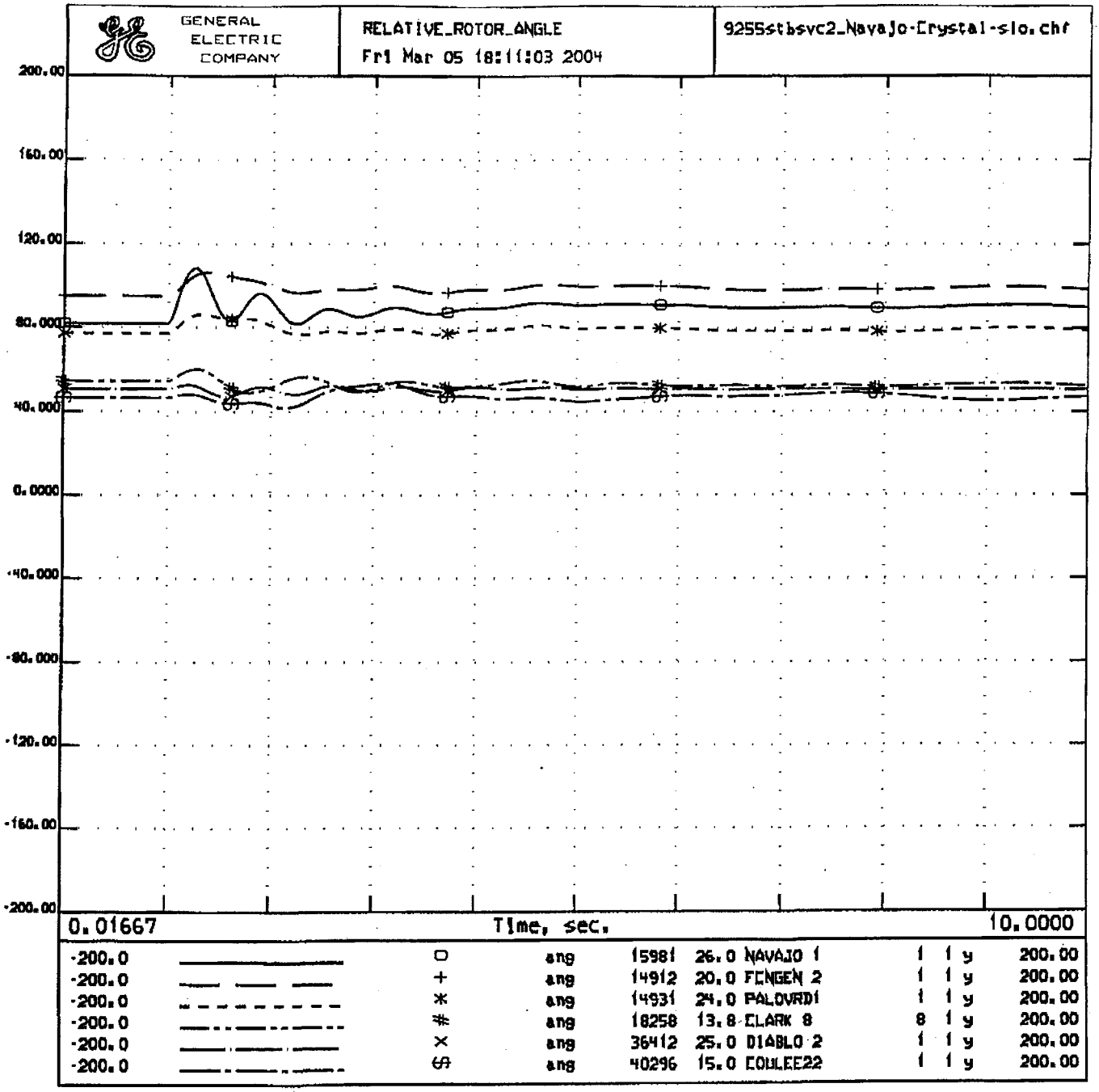

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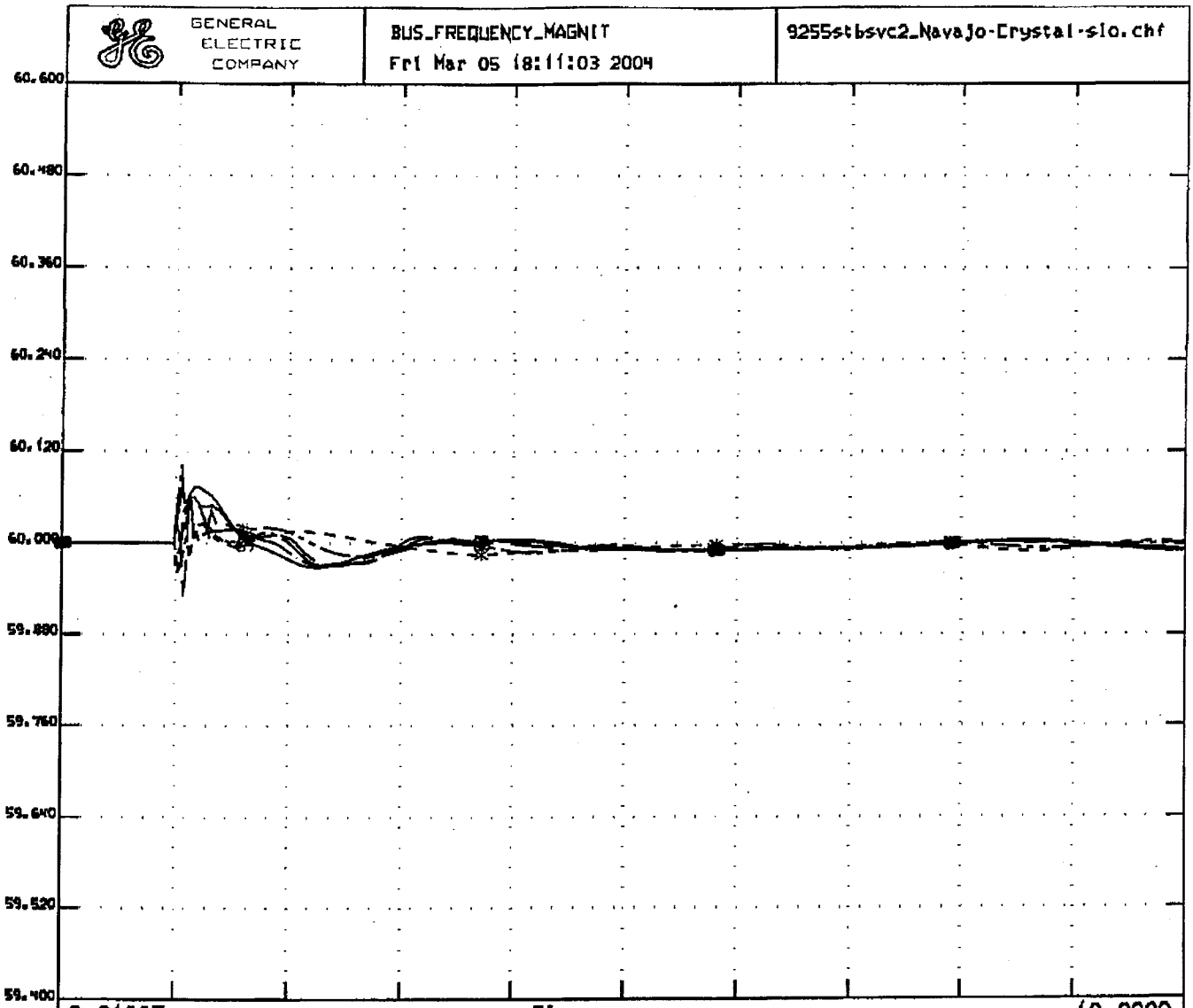

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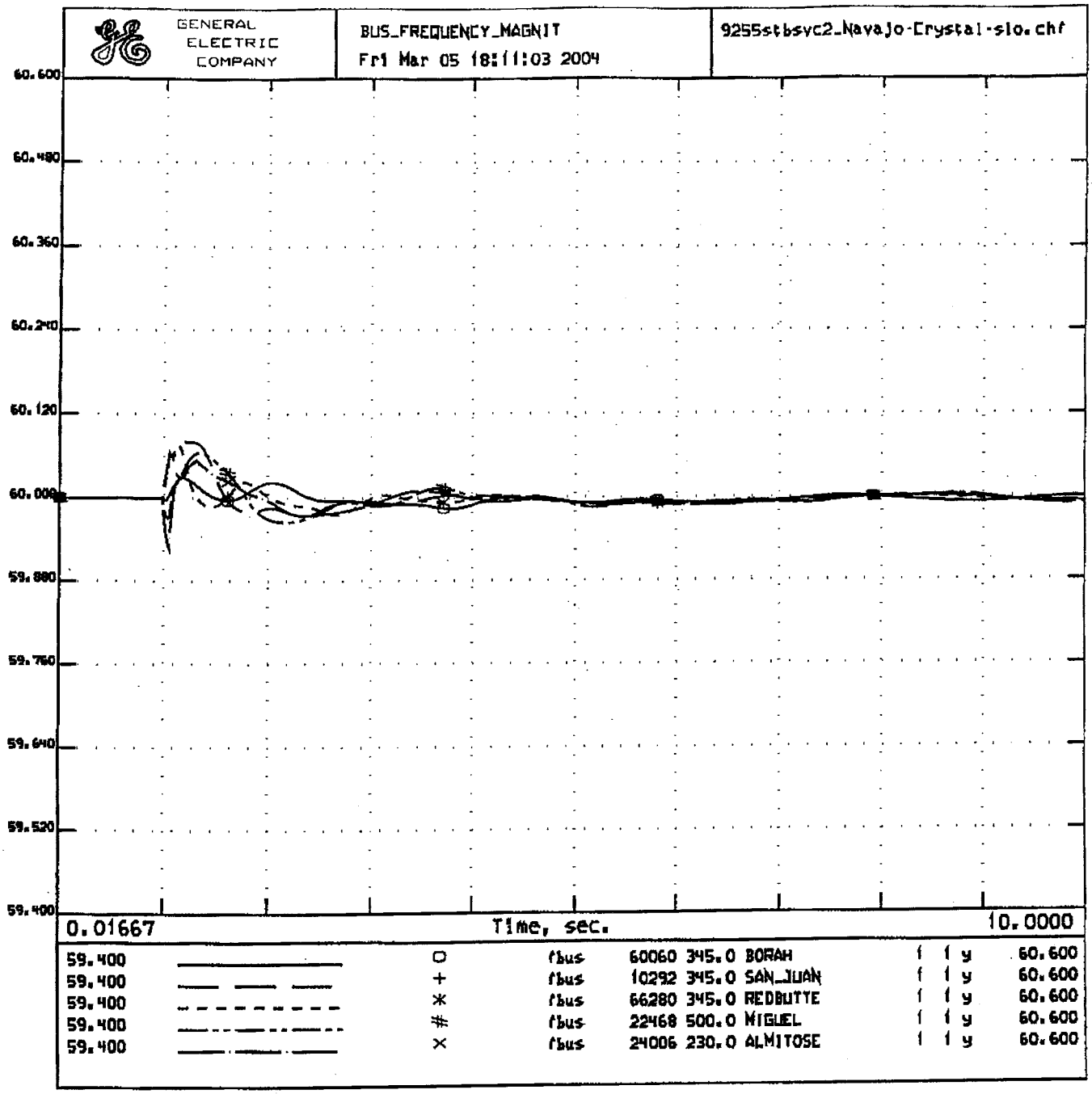

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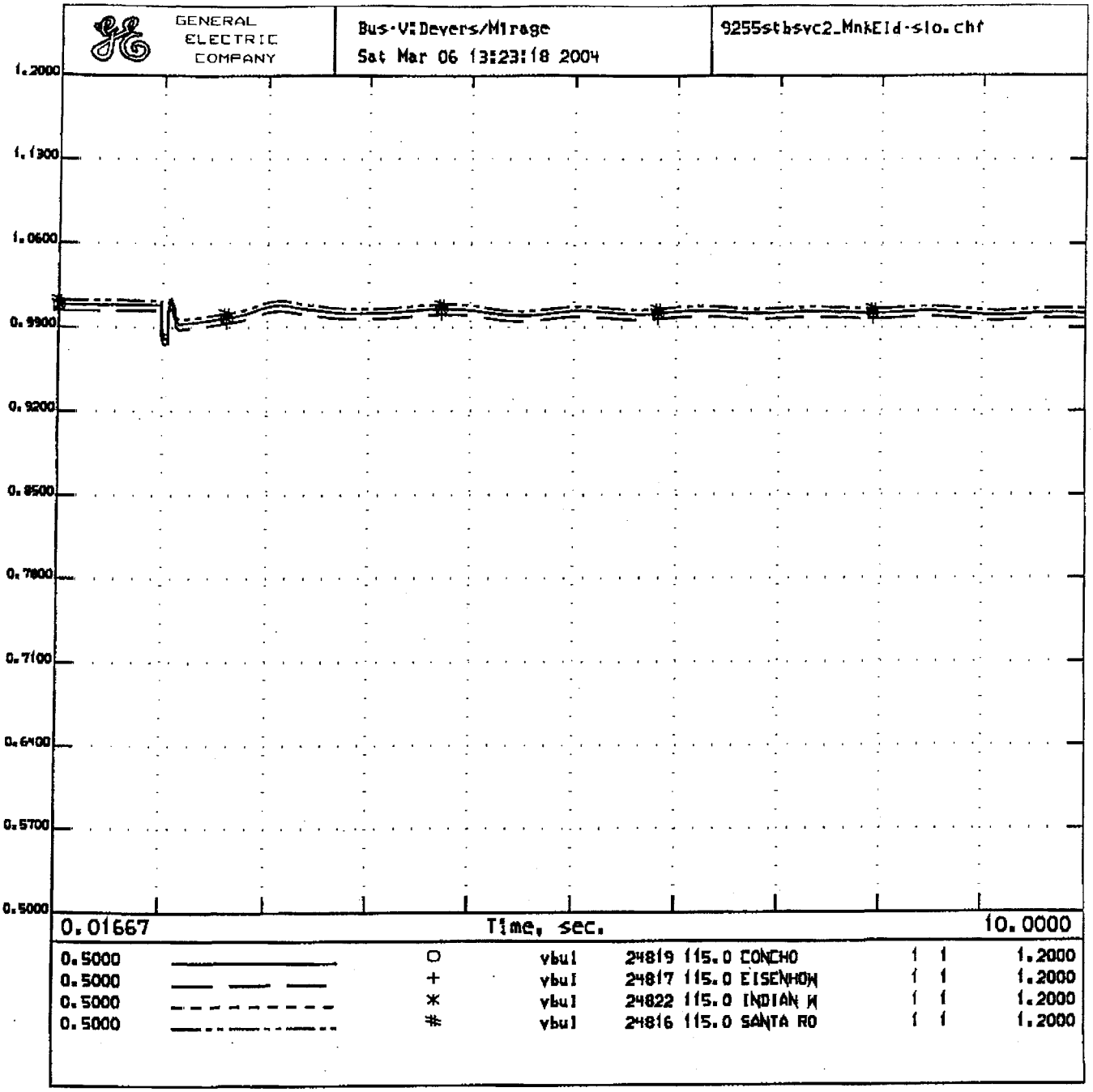

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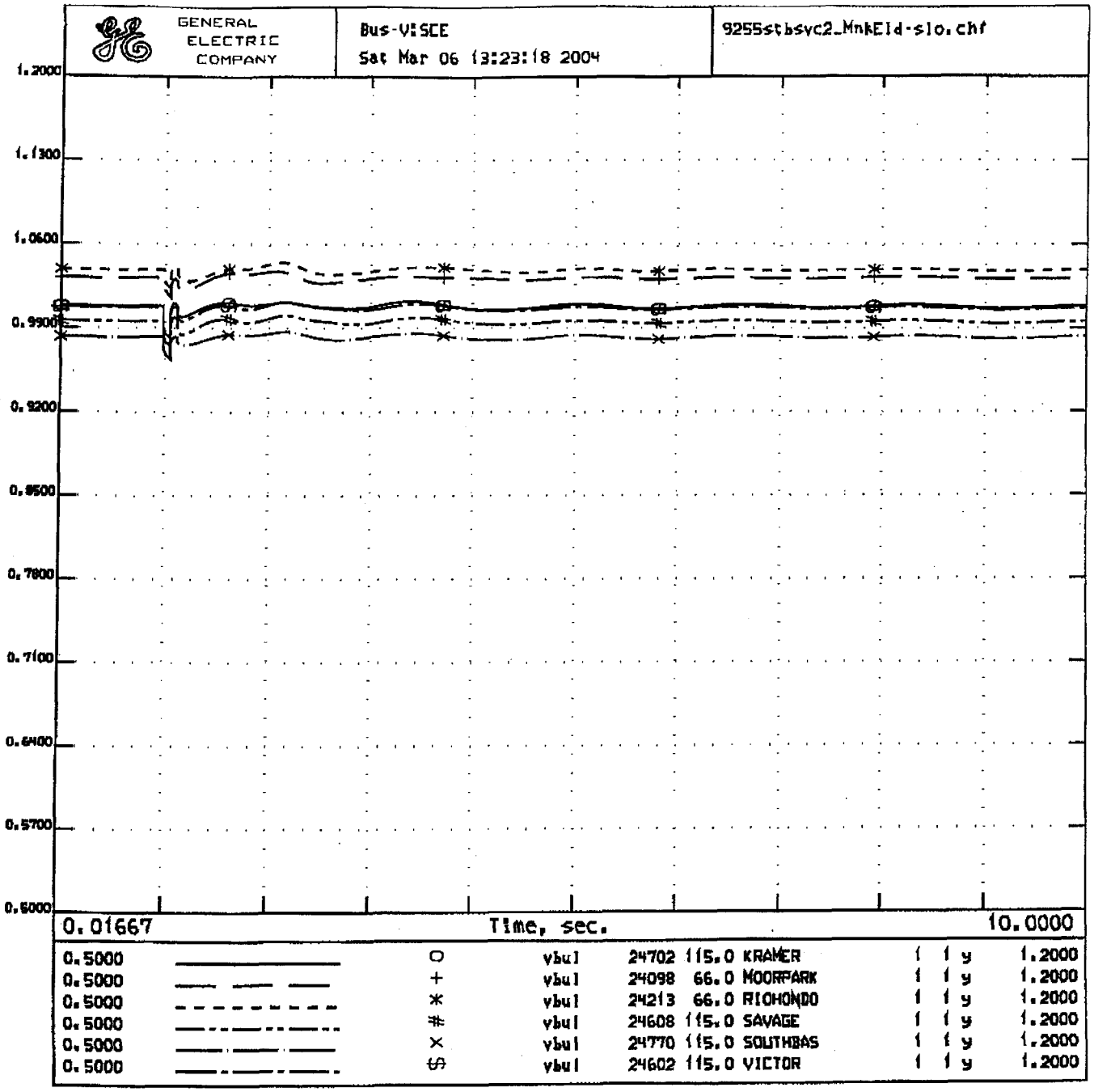

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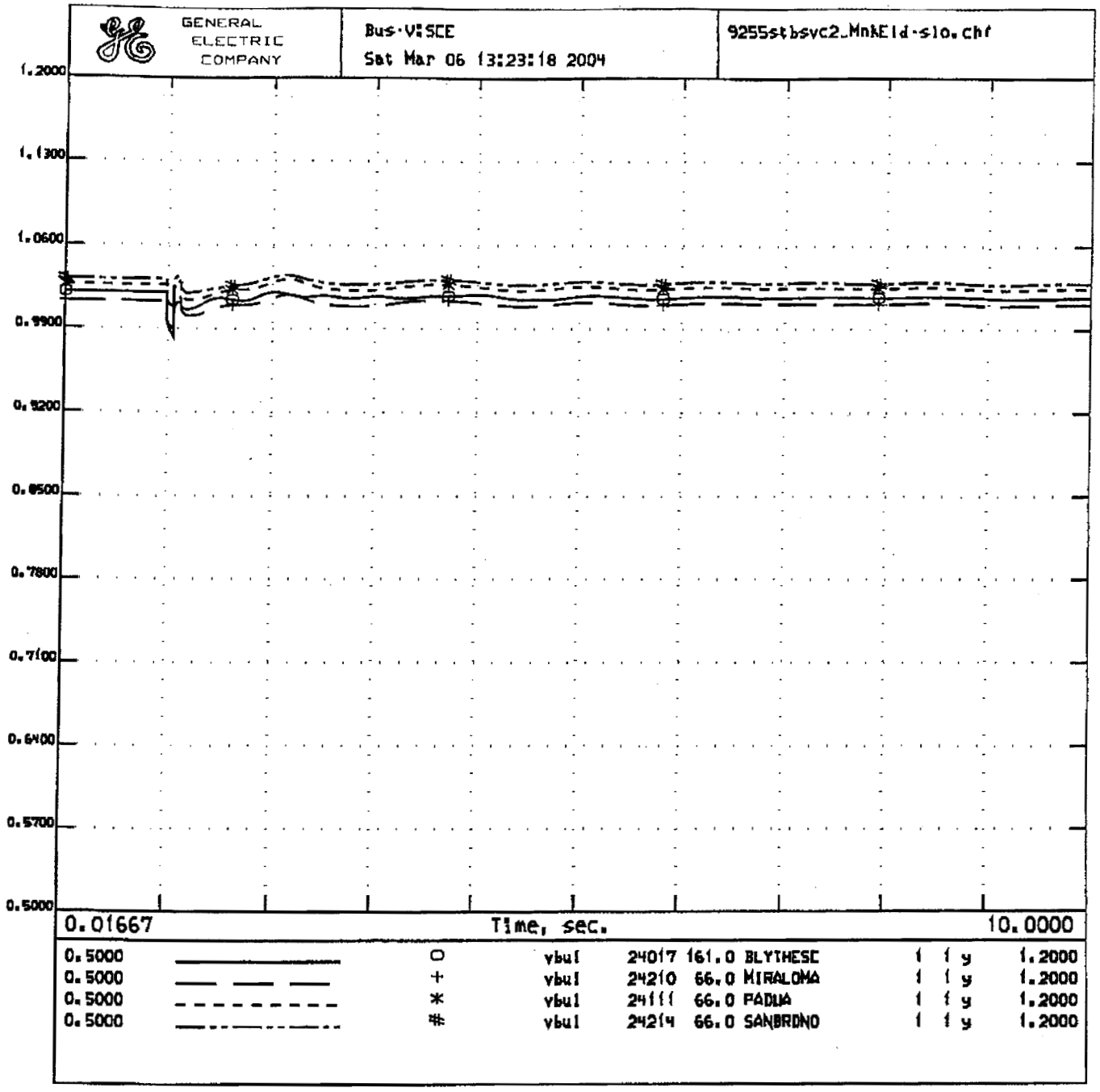

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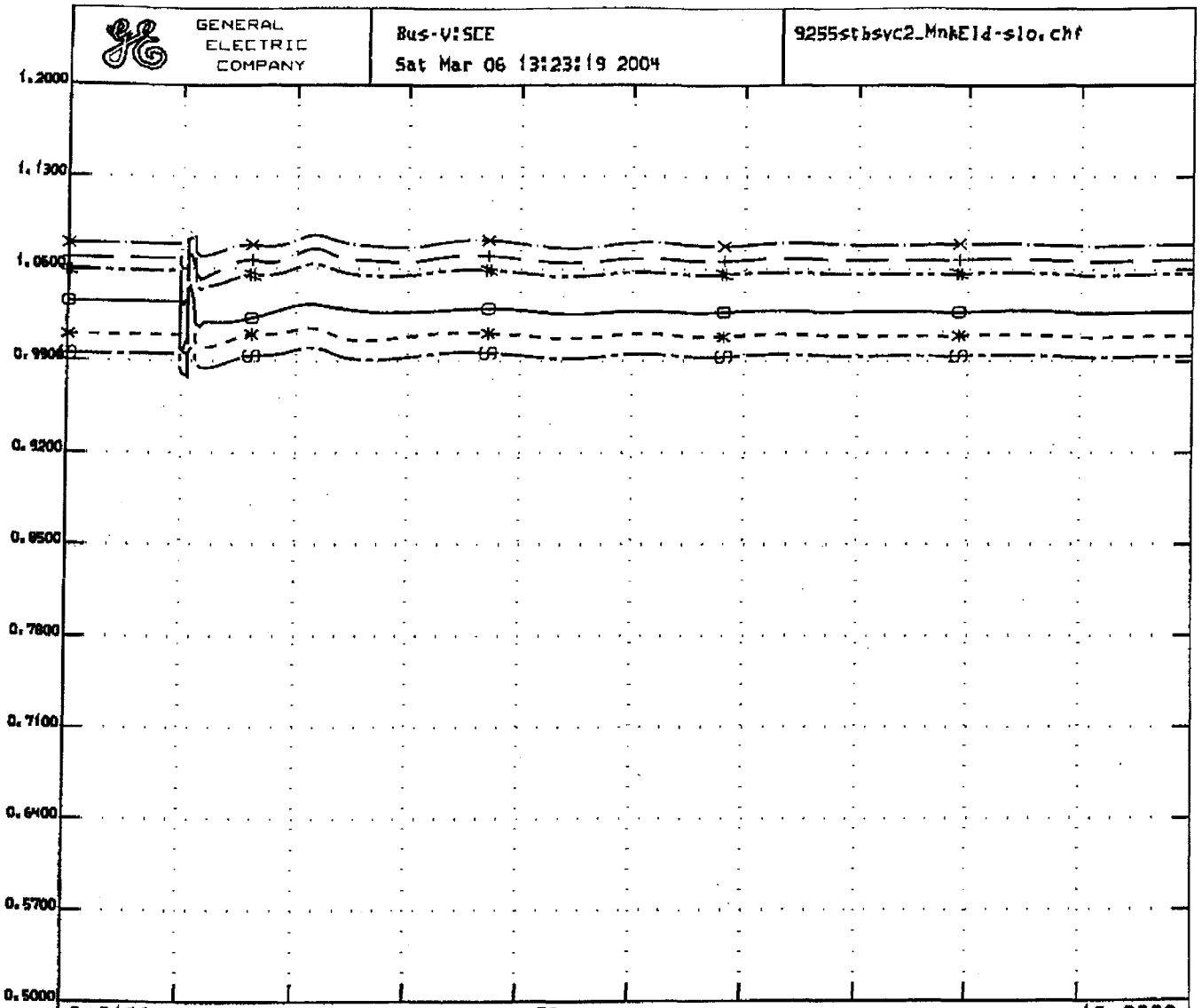

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0.5000	— — —	+	vbus	24086	500.0	LUGO	1	1	y	1.2000
0.5000	- - - - -	*	vbus	24091	230.0	MESA CAL	1	1	y	1.2000
0.5000	—-—-—	#	vbus	24138	500.0	SERRANO	1	1	y	1.2000
0.5000	—·—·—	×	vbus	24156	500.0	VINCENT	1	1	y	1.2000
0.5000	—·-·—	⊕	vbus	24158	230.0	WALNUT	1	1	y	1.2000

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Swt file=c:\psif\cases\dpv2\MnkEld-slo.swt
Terminal output log is CASE.trm

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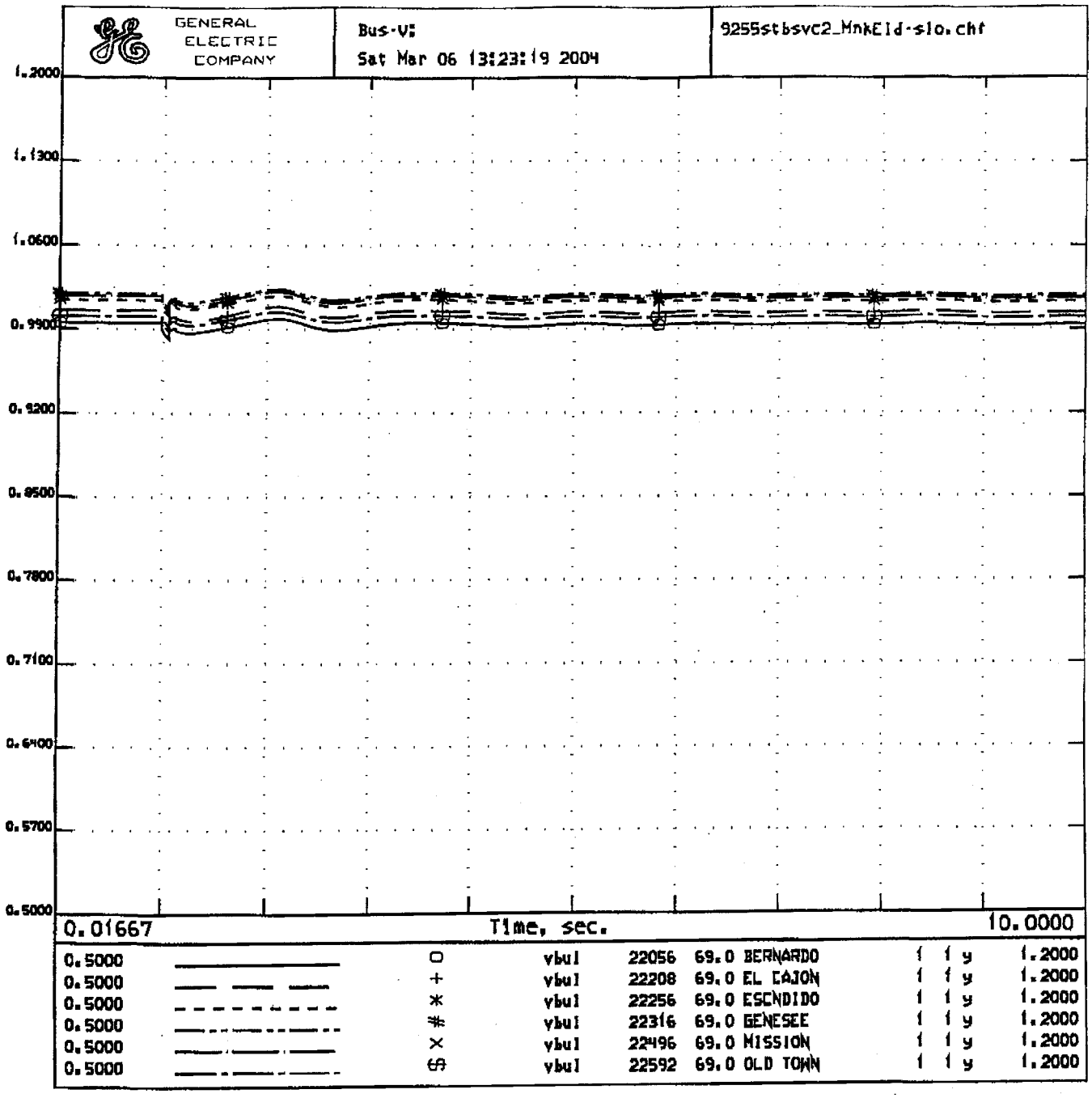
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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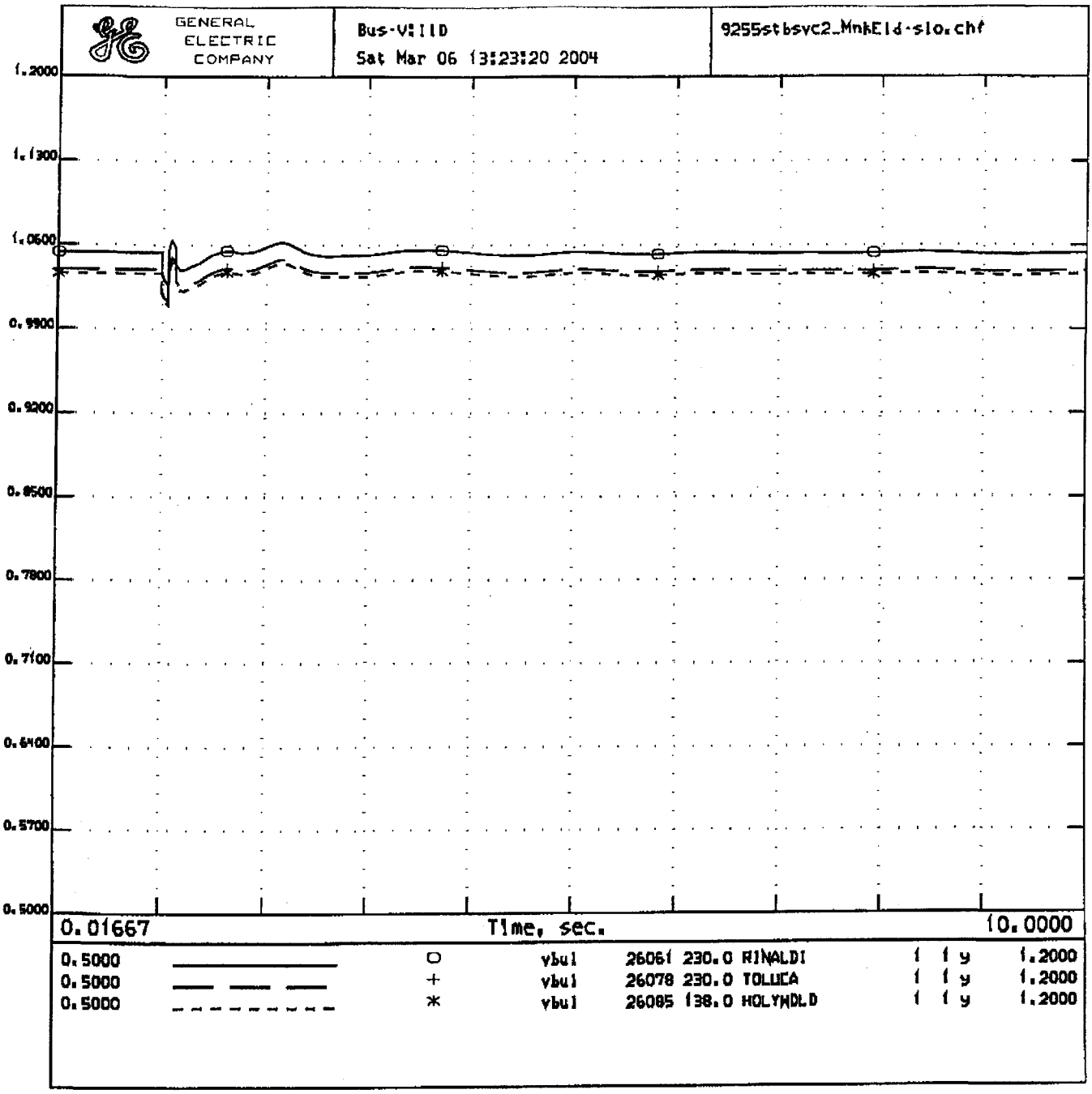

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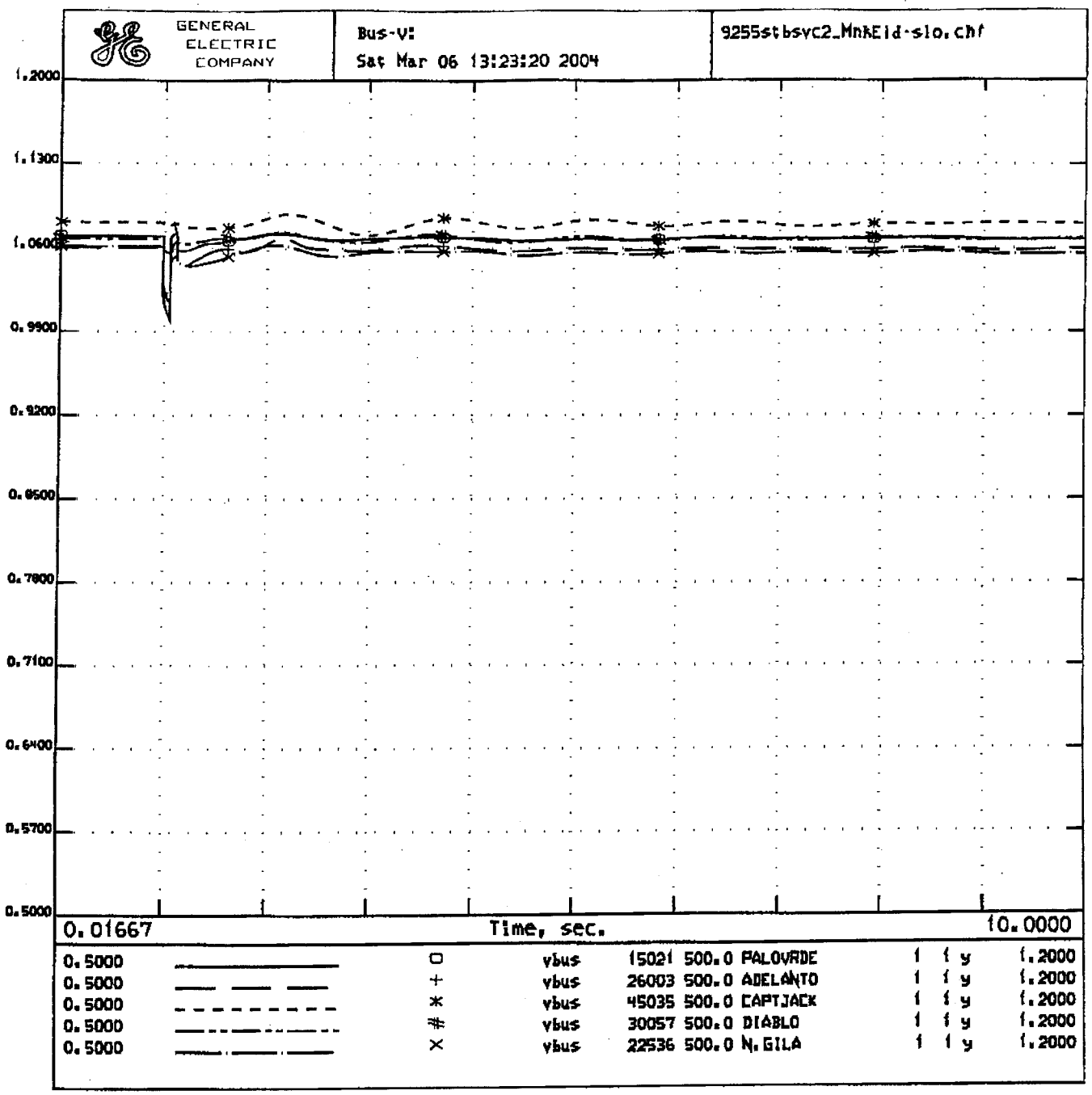

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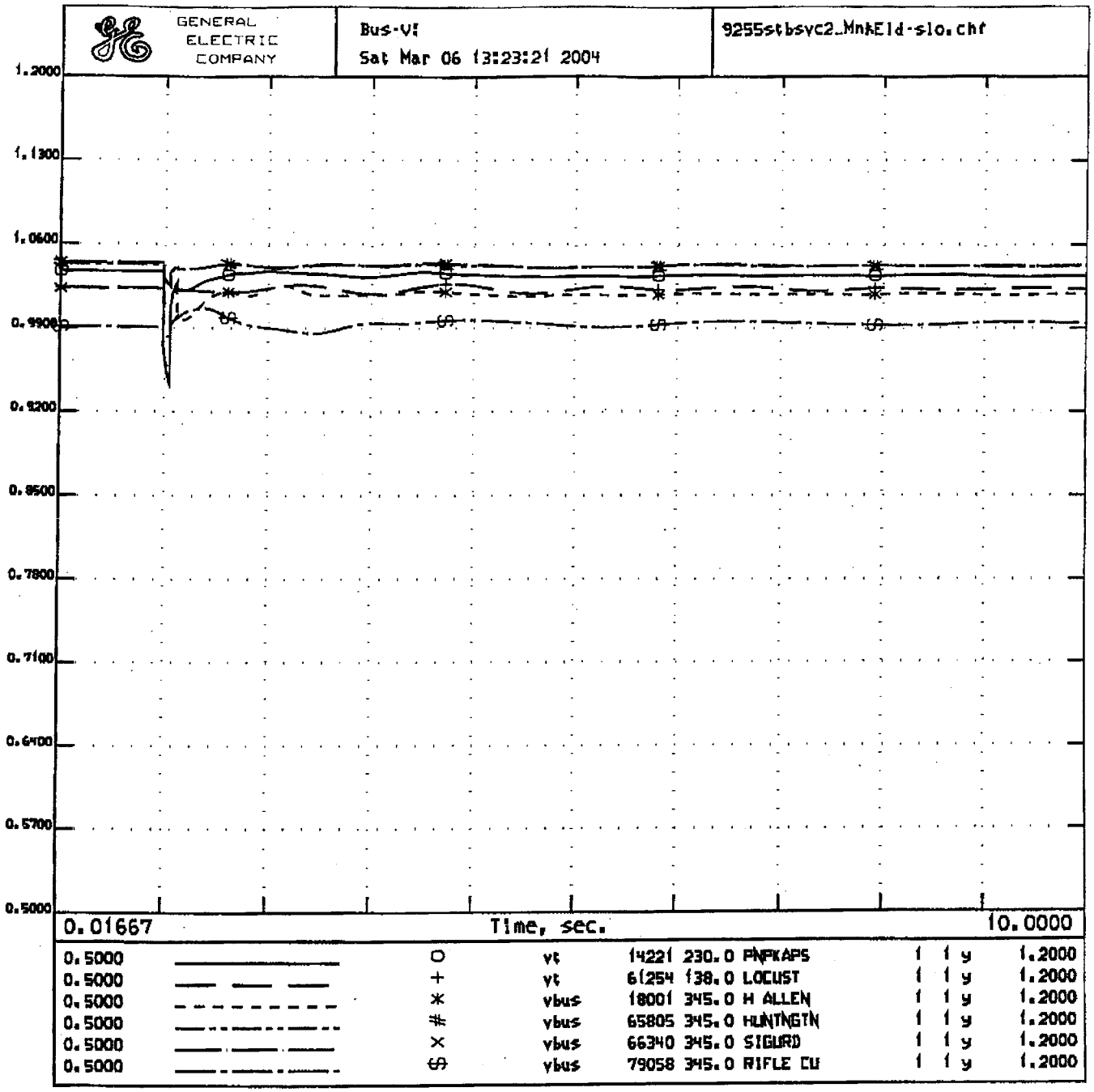

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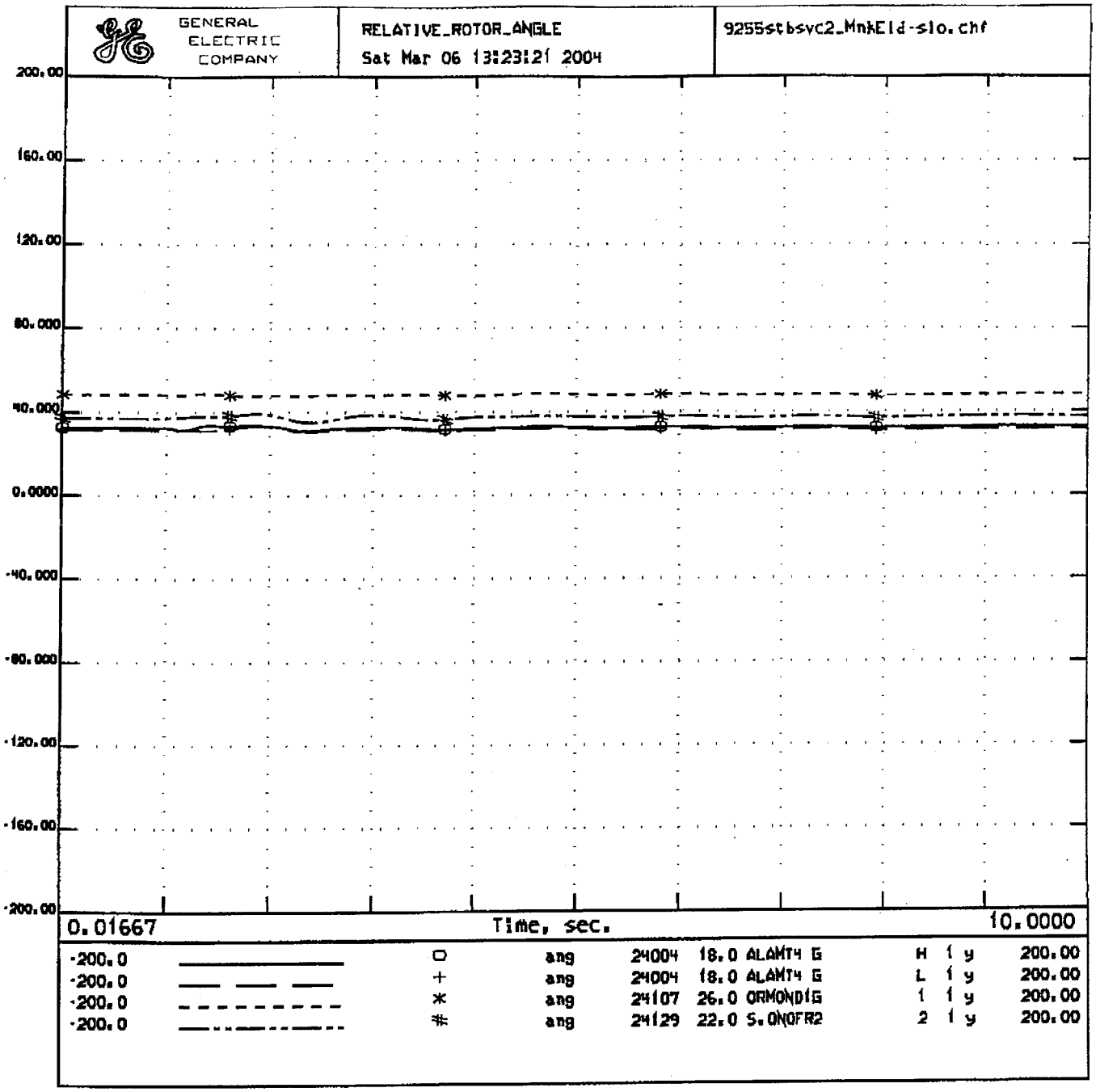

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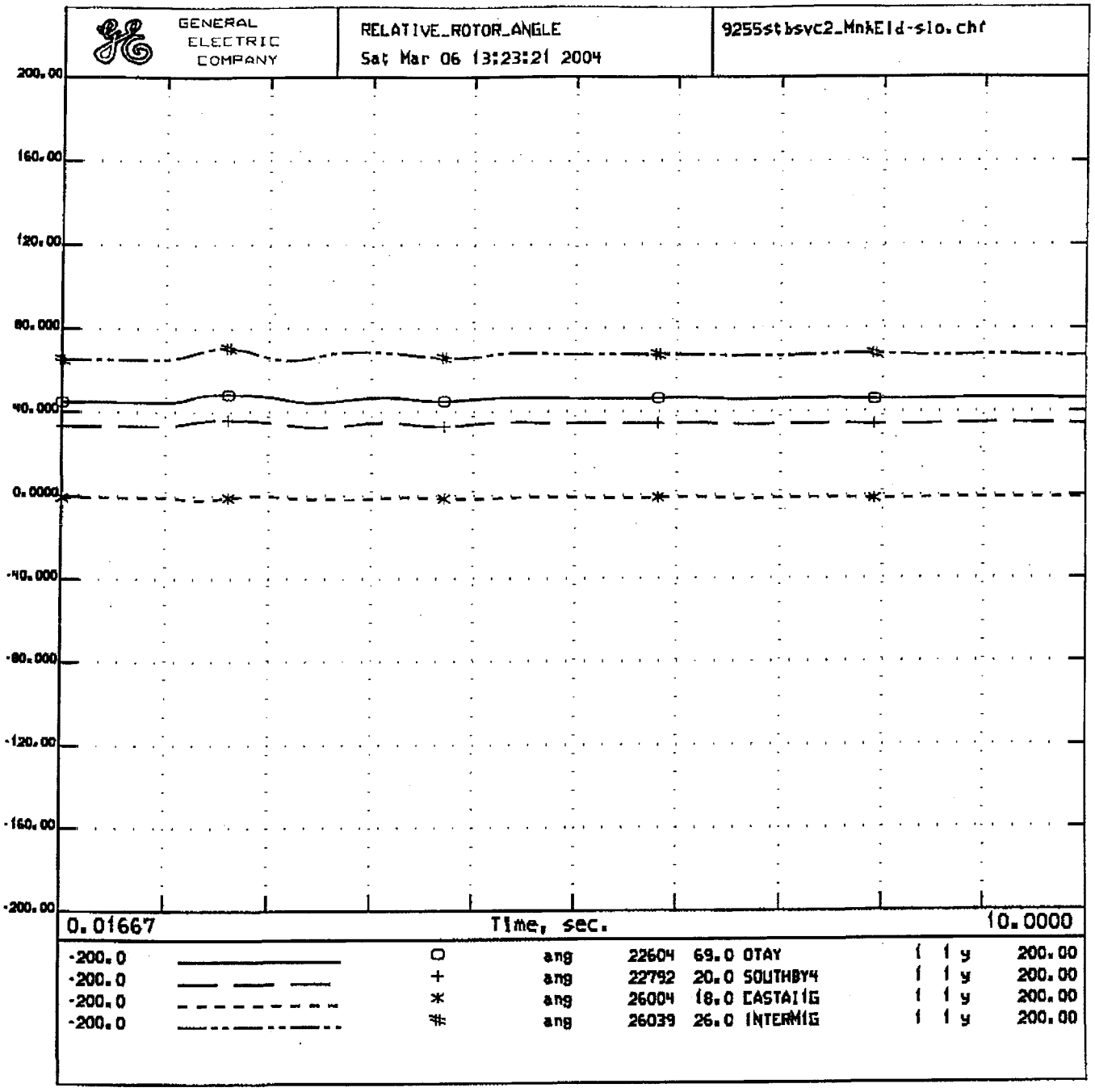

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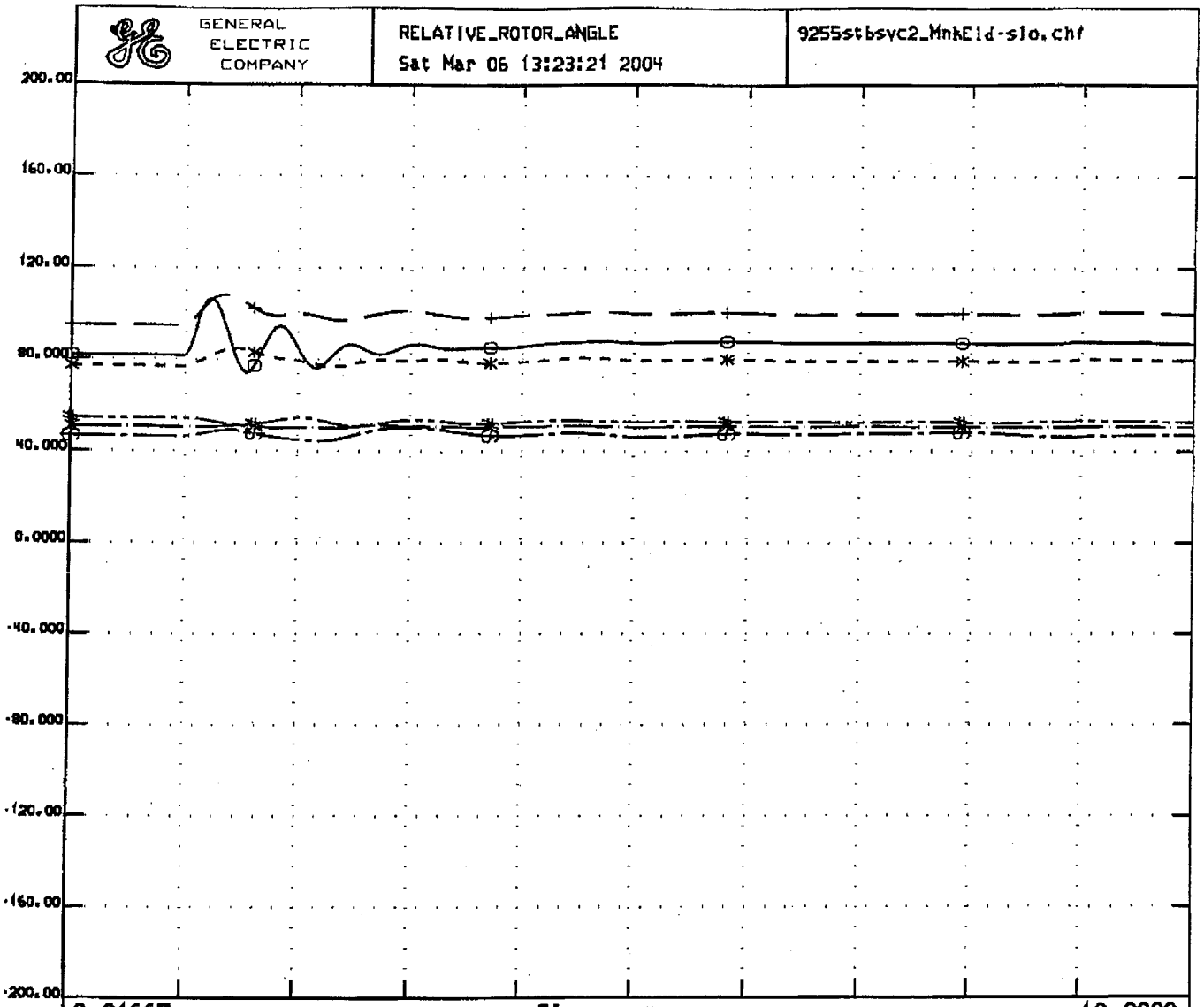

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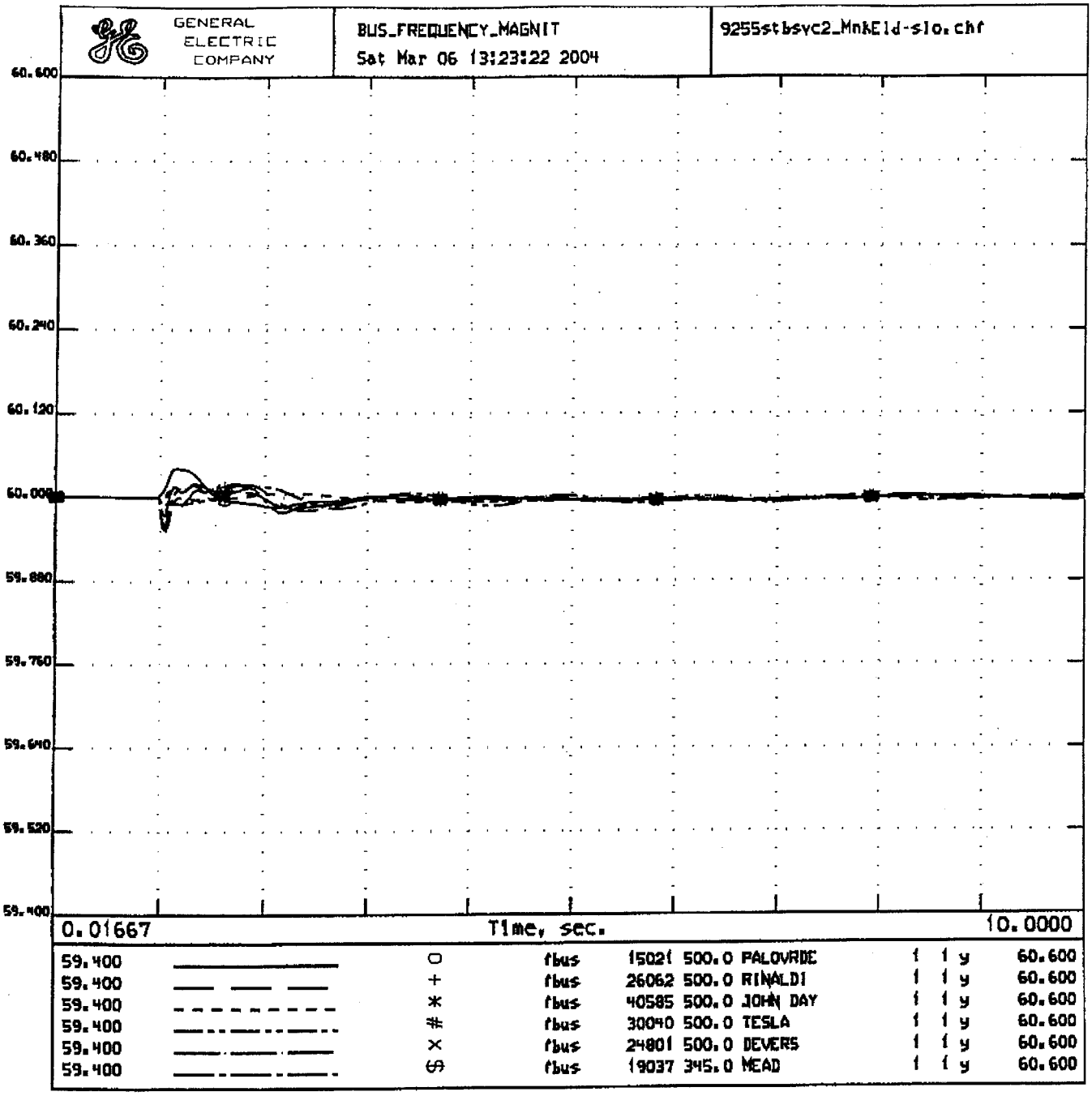

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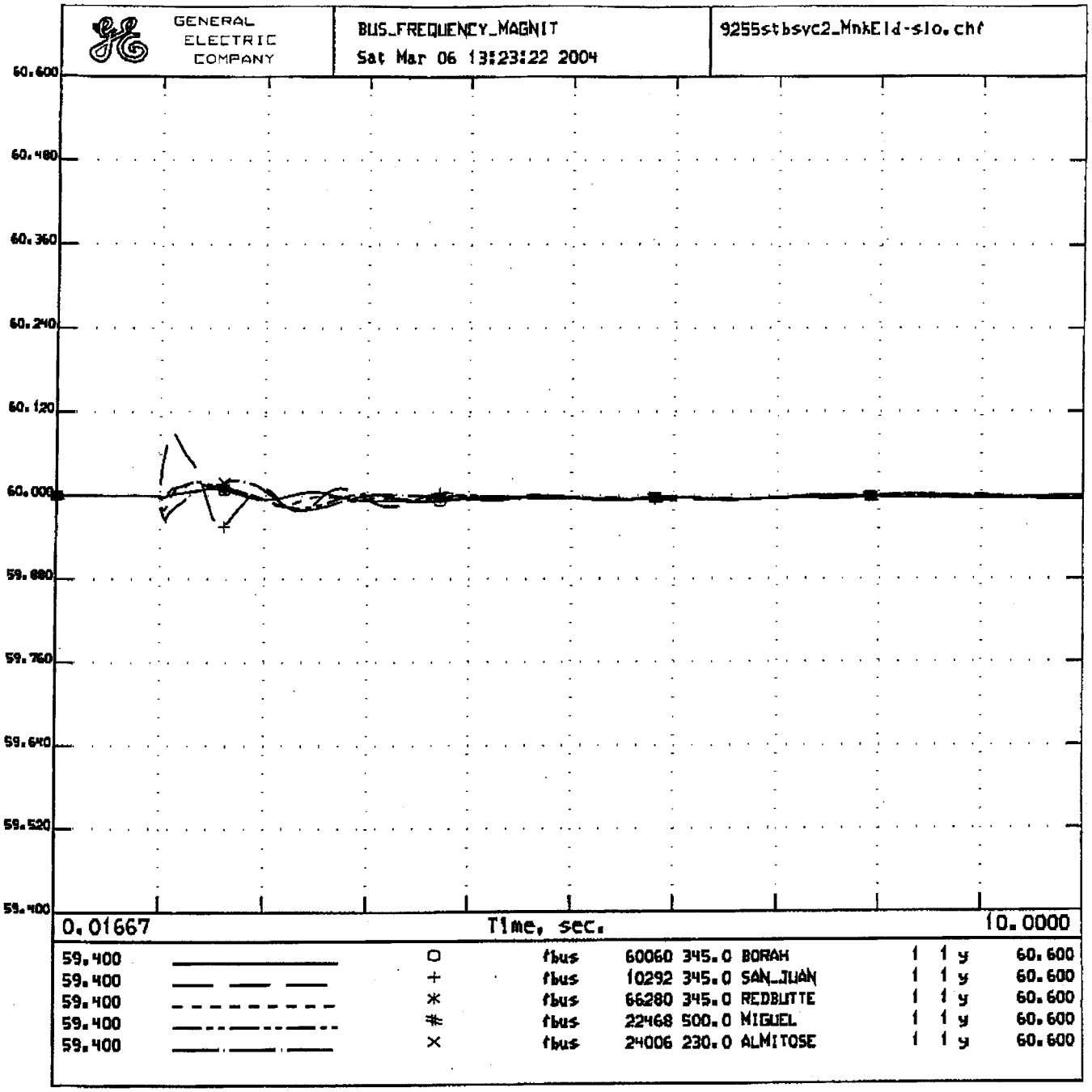

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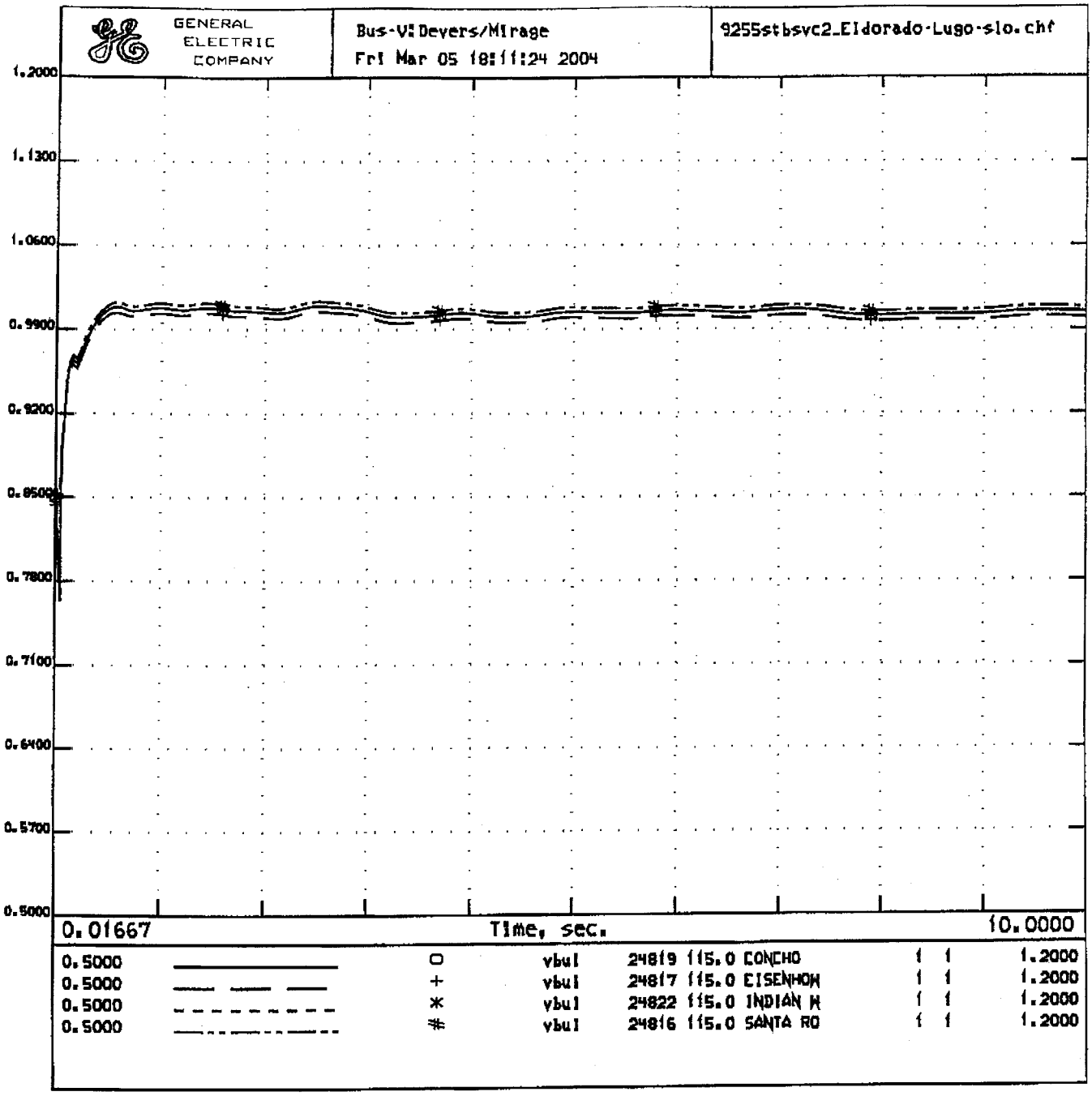
Transient Stability Study Plots - 4

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Eldorado-Lugo 500 kV Line**
EOR MARGIN:	**None**
NOTES:	



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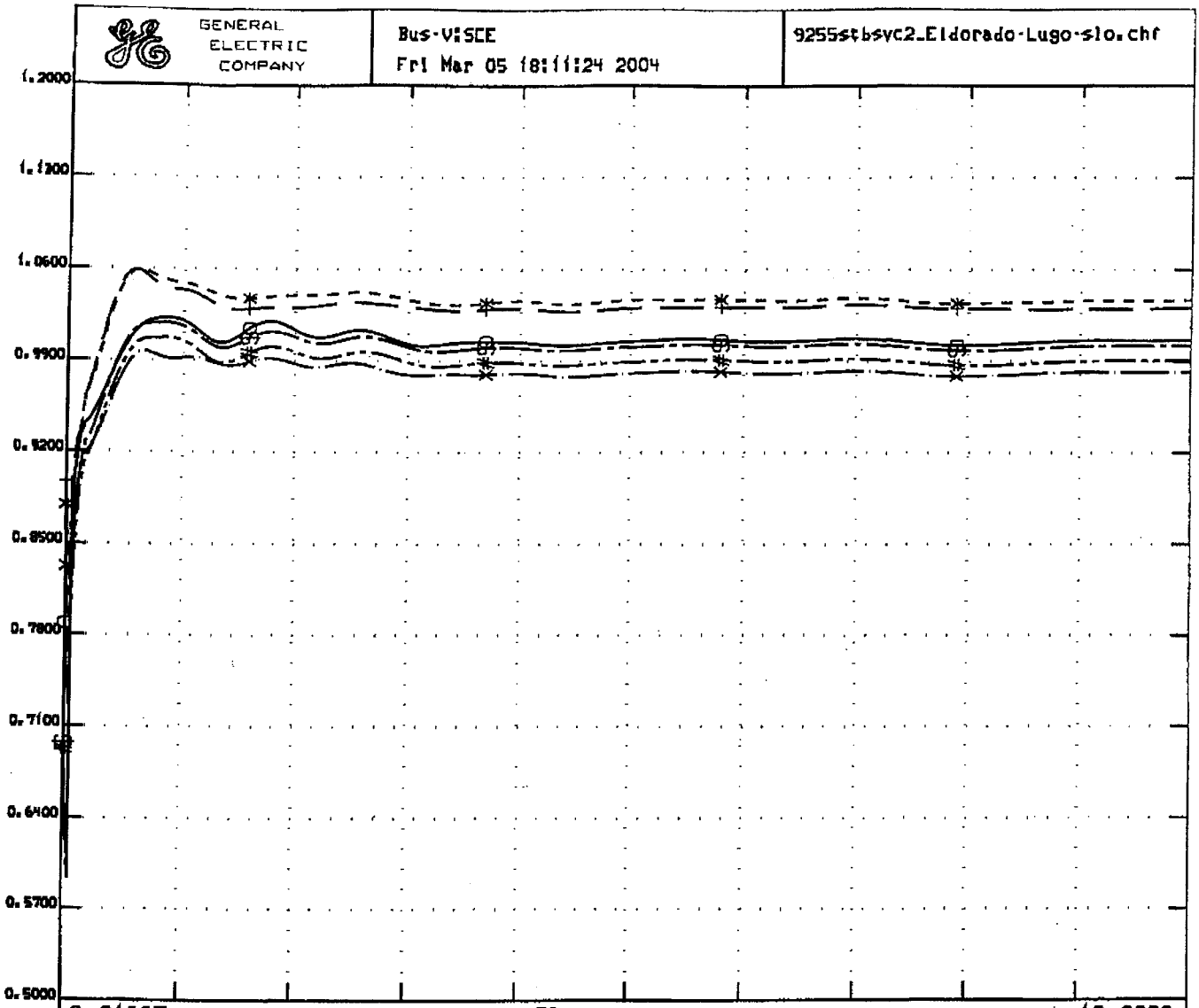

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0.5000	- - - - - - - - -	*	vbul	24213	66.0	RIOHONDO	1	1	y	1.2000
0.5000	—— - - —— - -	#	vbul	24608	115.0	SAVAGE	1	1	y	1.2000
0.5000	—— . —— . ——	×	vbul	24770	115.0	SOUTHBAS	1	1	y	1.2000
0.5000	—— - —— - ——	⊕	vbul	24602	115.0	VICTOR	1	1	y	1.2000

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Terminal output log is CASE.trm

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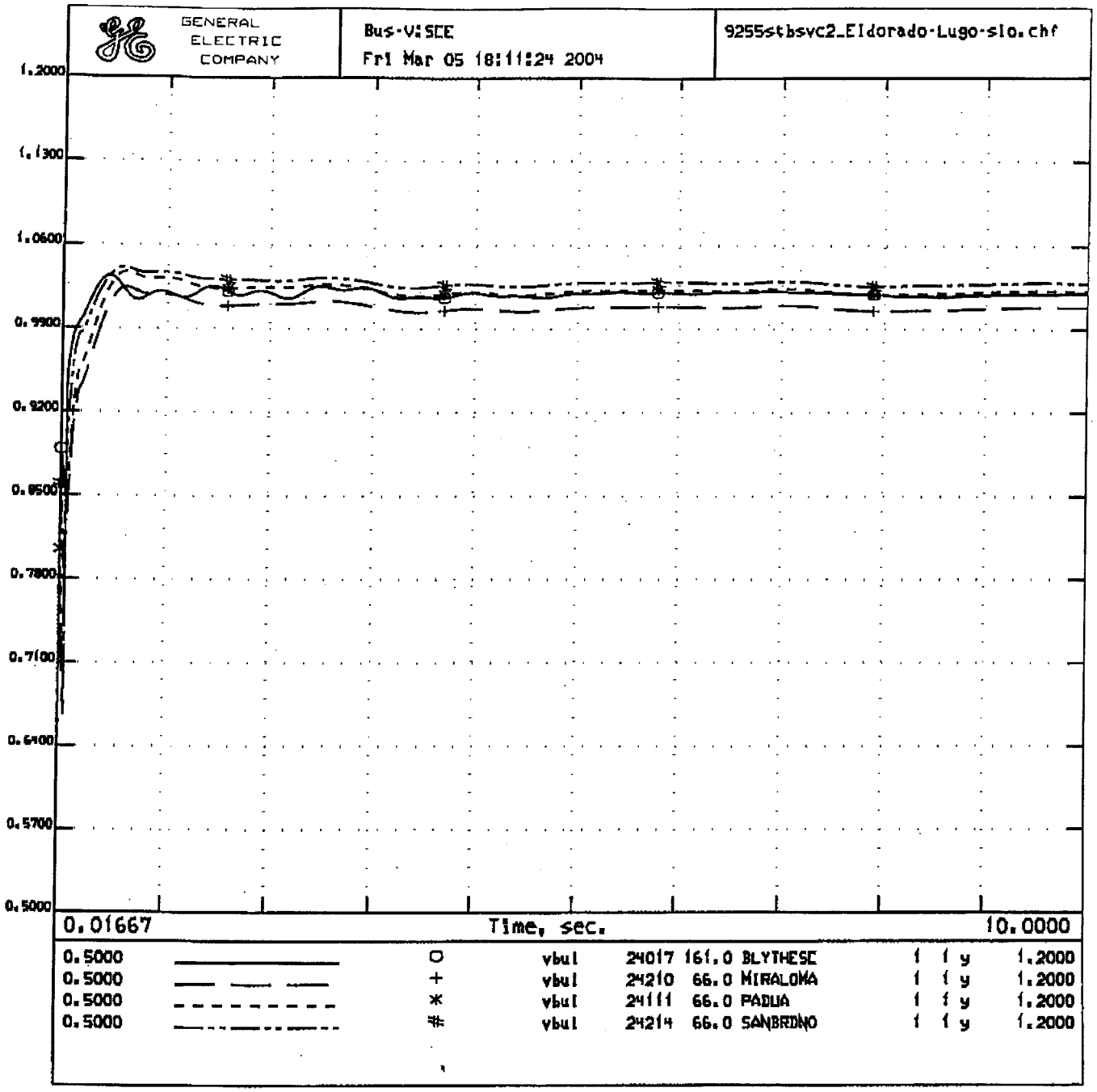

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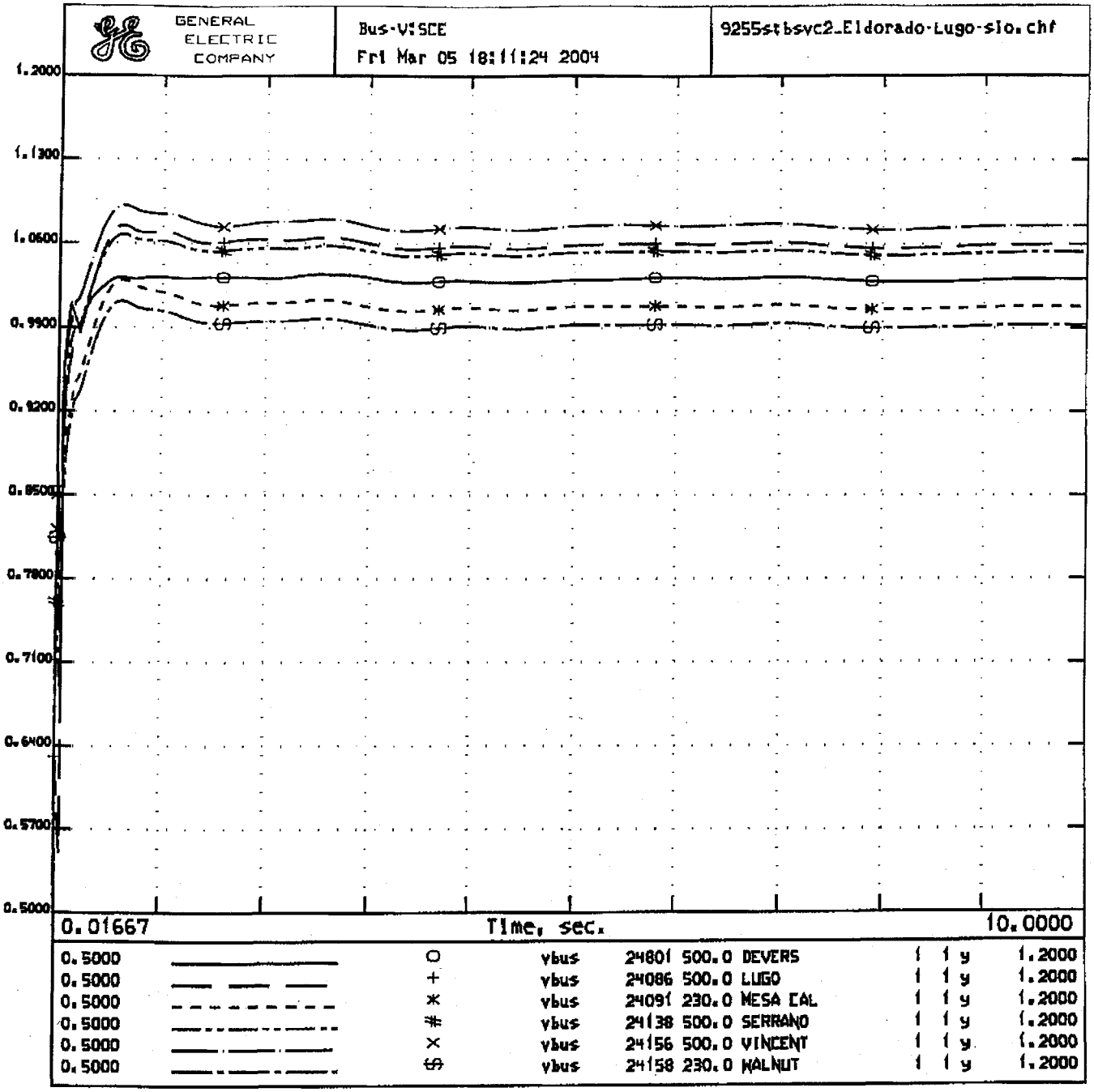

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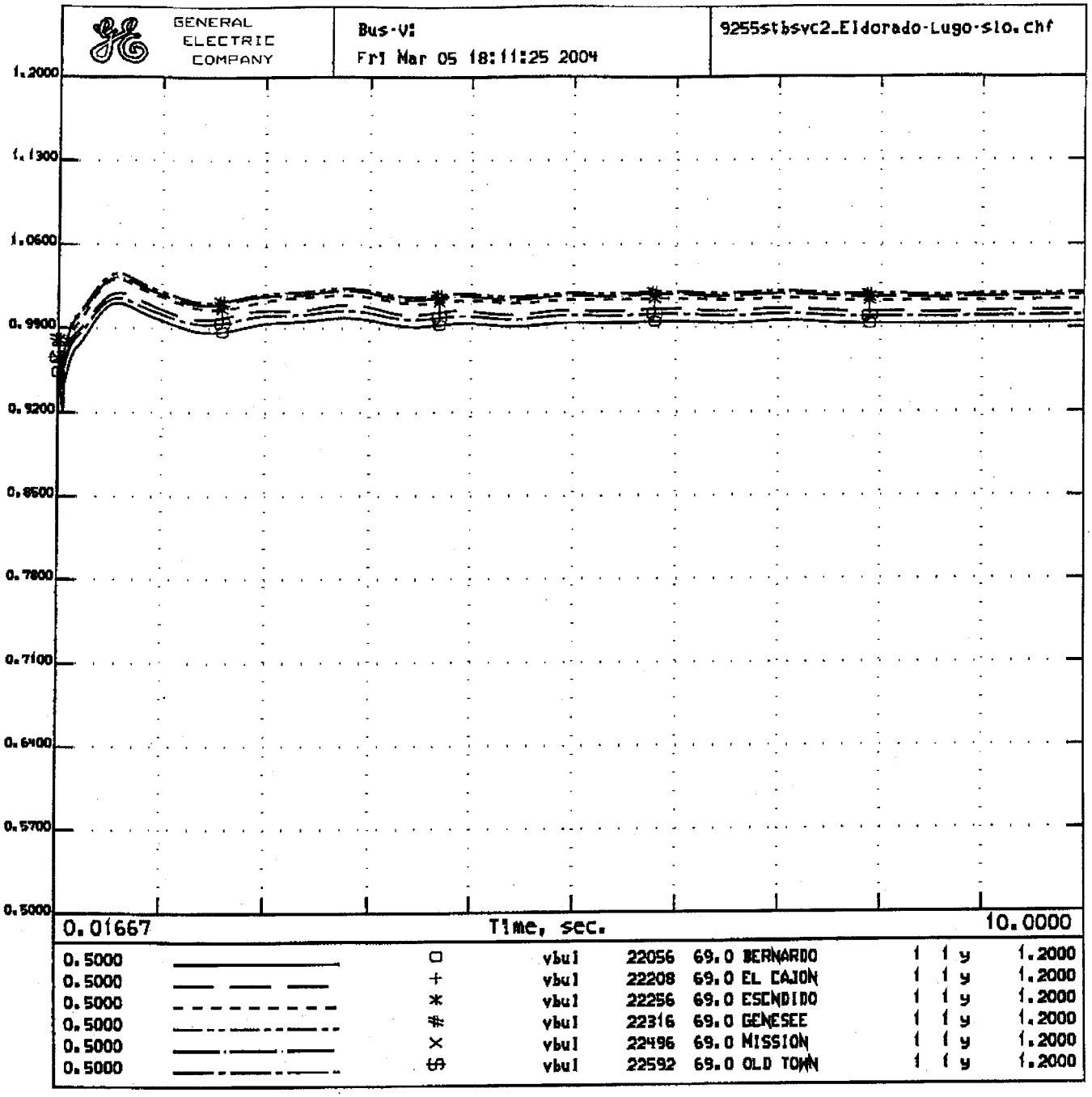

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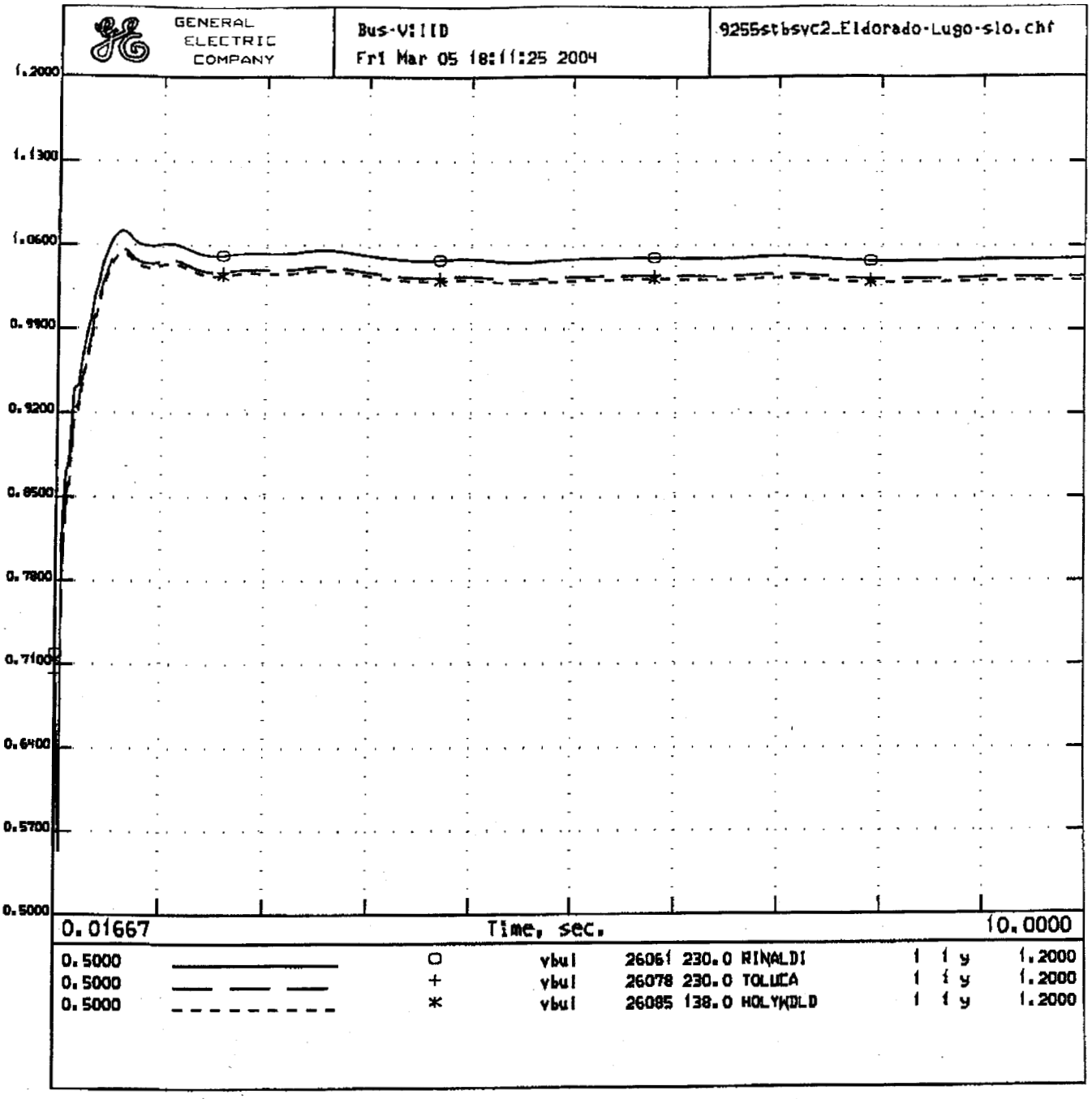

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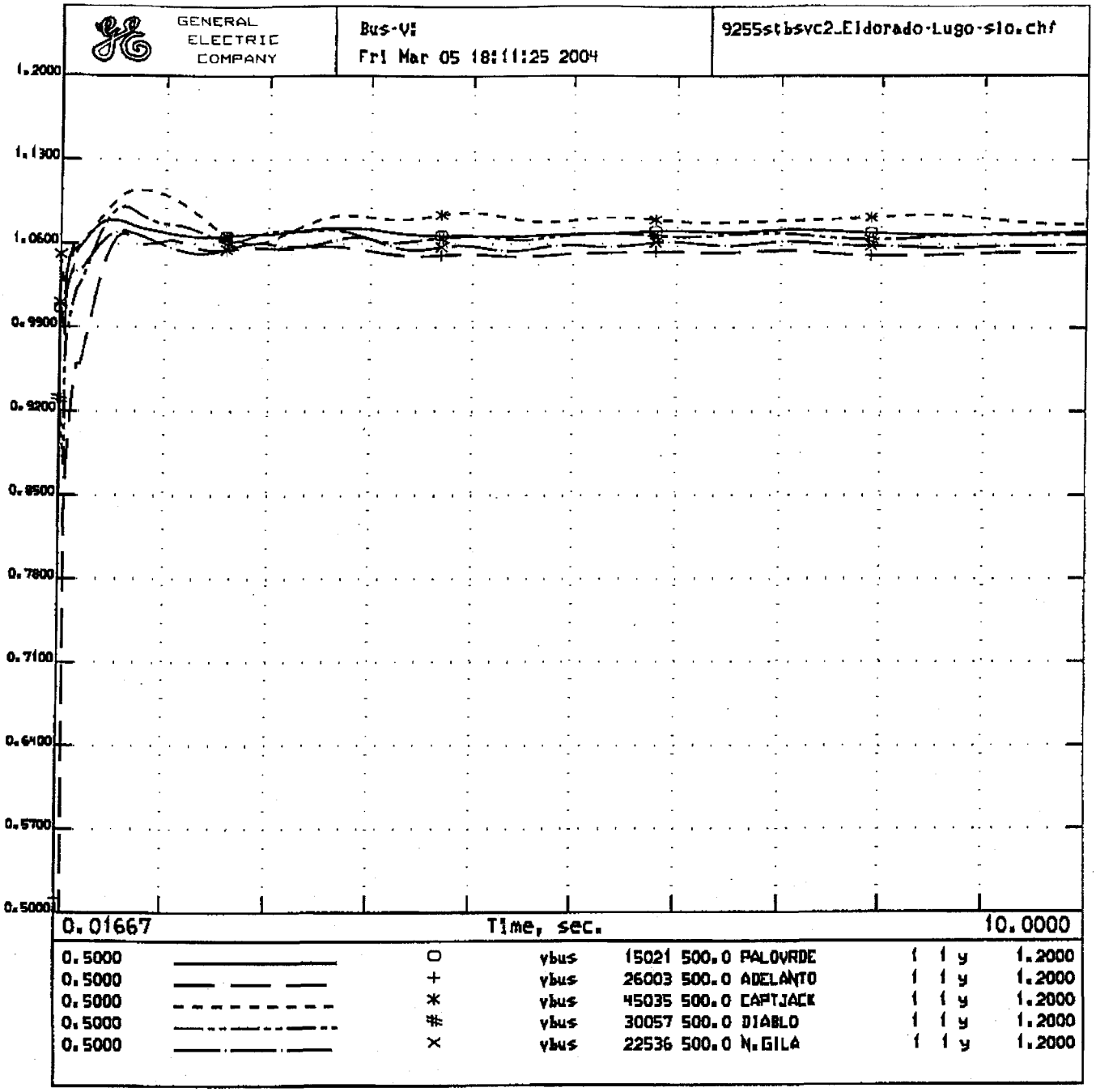

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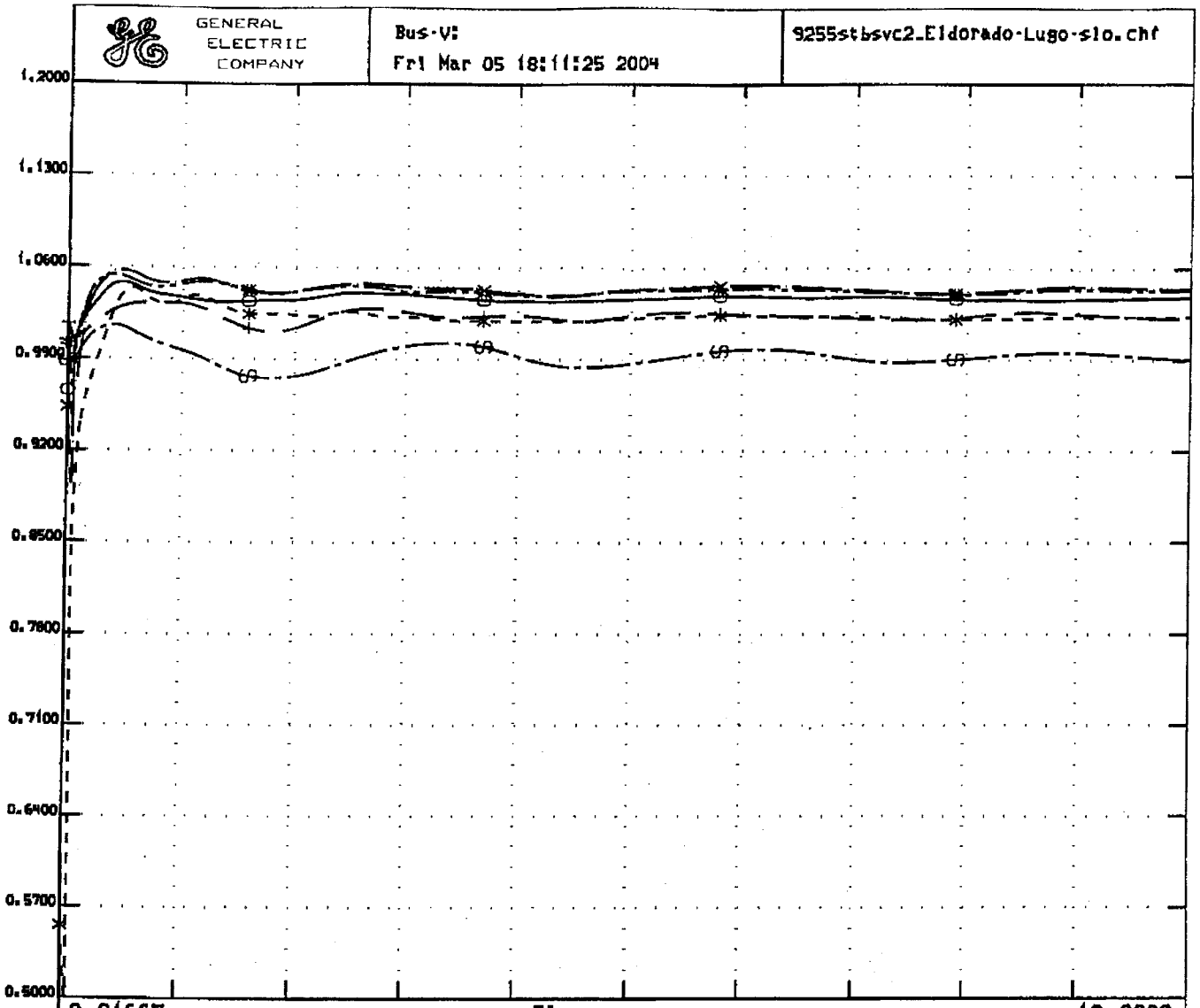

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0.5000	— — —	+	vt	61254	138.0	LOCUST	1 1 y	1.2000
0.5000	- - - - - - - - -	*	vbus	18001	345.0	H ALLEN	1 1 y	1.2000
0.5000	—··—··—	#	vbus	65805	345.0	HUNTNGTN	1 1 y	1.2000
0.5000	—·—·—	×	vbus	66340	345.0	SIGURD	1 1 y	1.2000
0.5000	—·—··—	⊗	vbus	79058	345.0	RIFLE CU	1 1 y	1.2000

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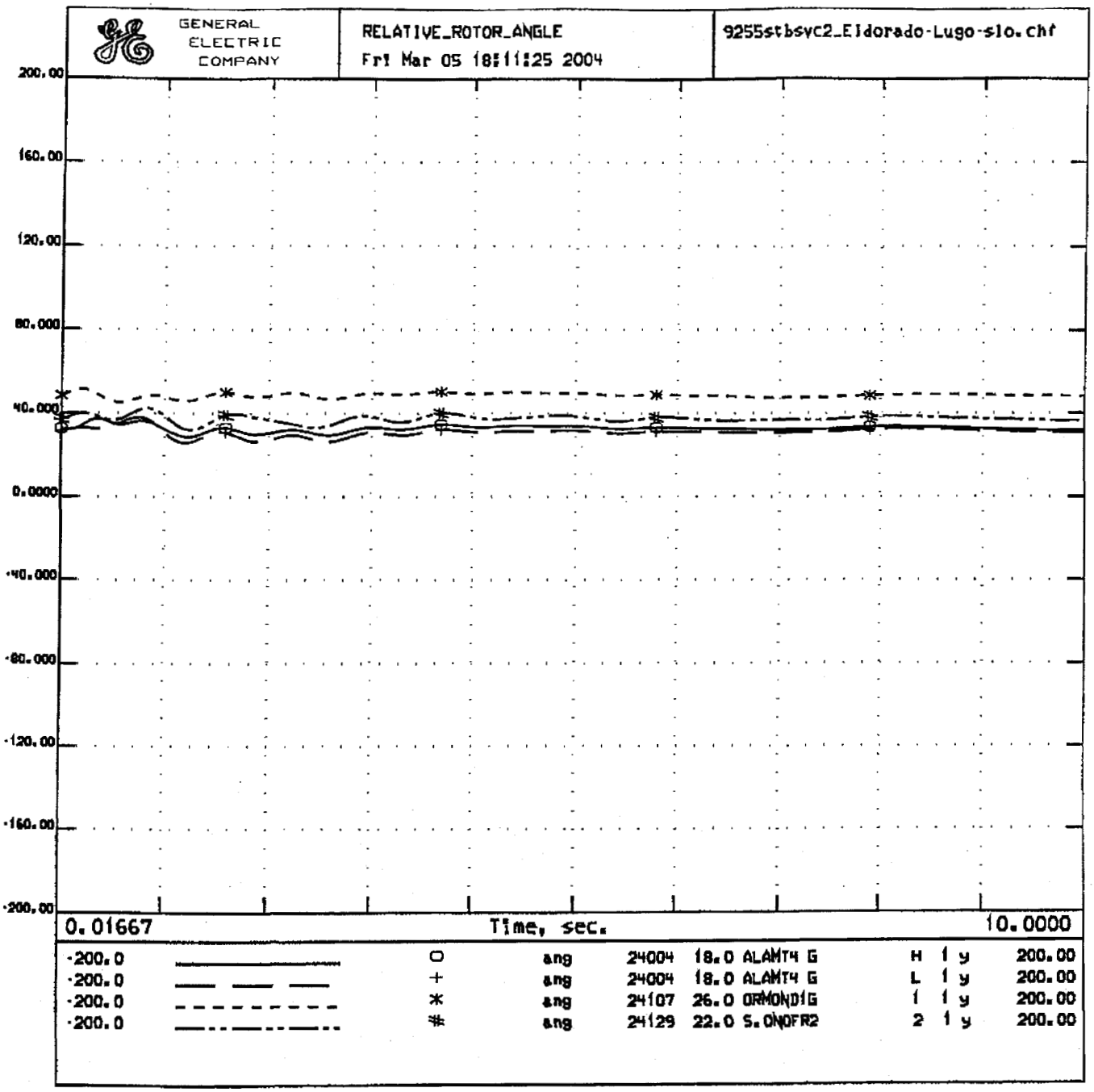

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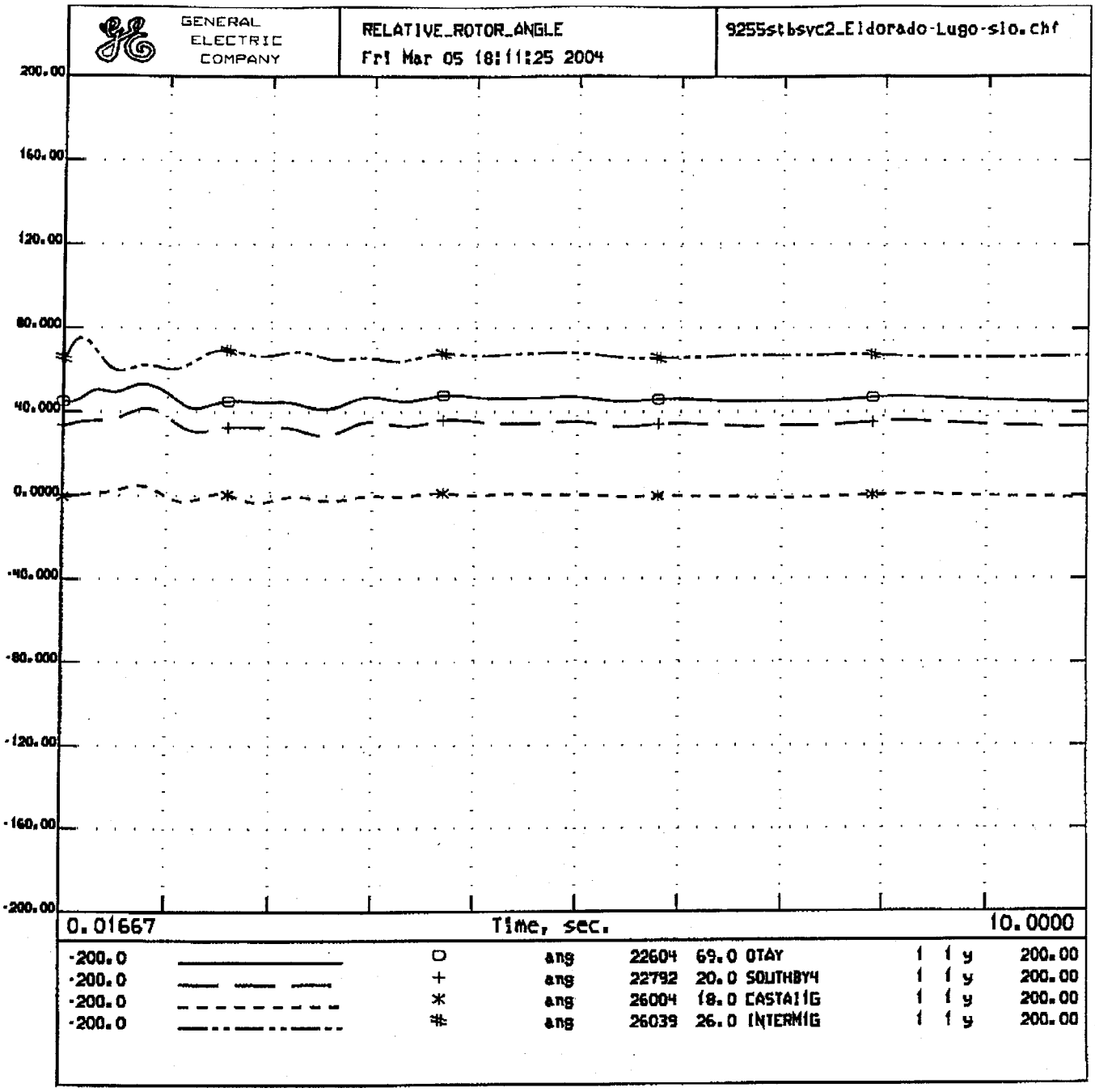

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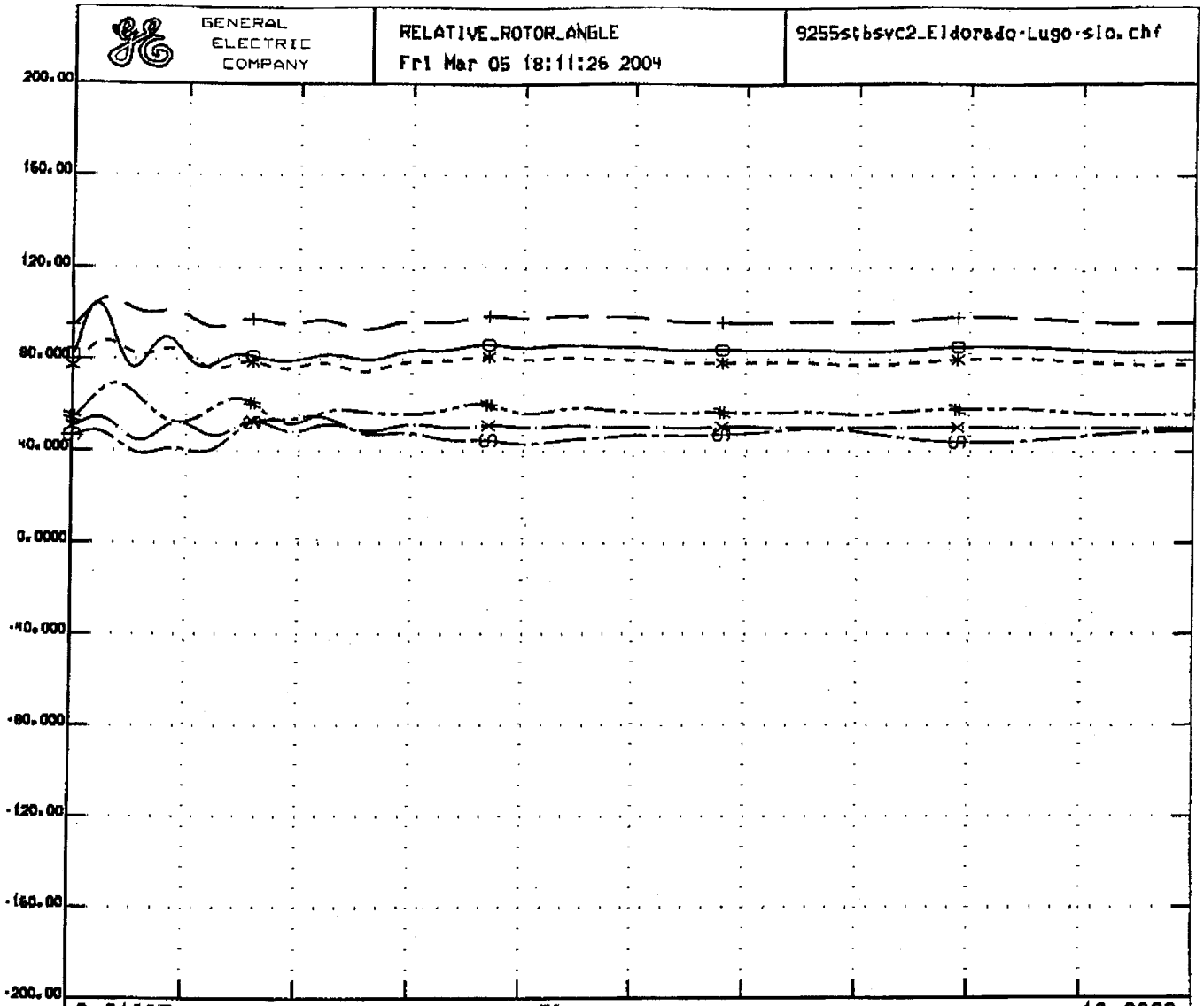

-200.0		○	ang	15981	26.0	NAVAJO 1	1	1 y	200.00
-200.0		+	ang	14912	20.0	FENGEN 2	1	1 y	200.00
-200.0		*	ang	14931	24.0	PALOVRD1	1	1 y	200.00
-200.0		#	ang	18258	13.8	CLARK 8	8	1 y	200.00
-200.0		×	ang	36412	25.0	DIABLO 2	1	1 y	200.00
-200.0		⊕	ang	40296	15.0	COULEE22	1	1 y	200.00

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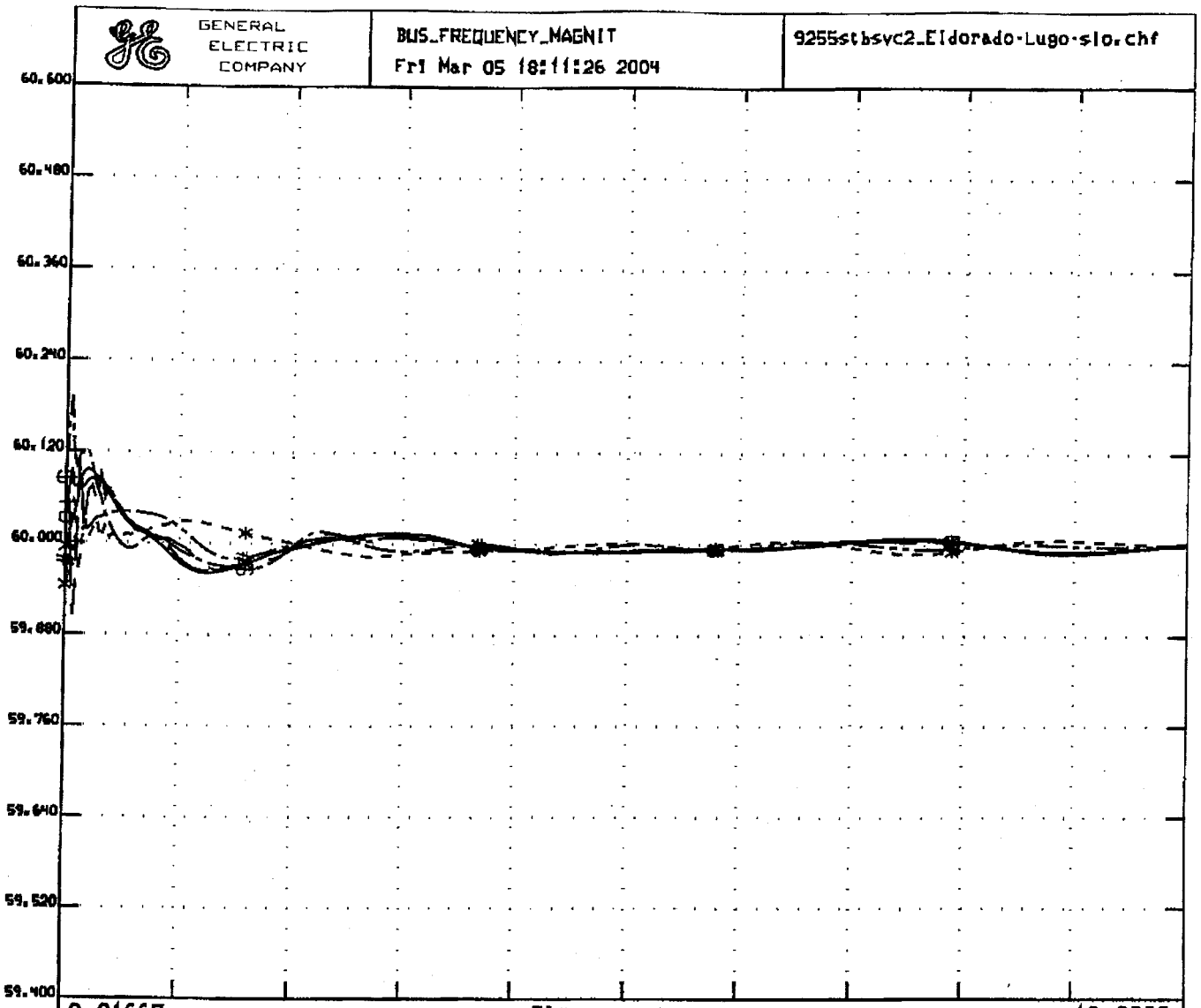
Terminal output log is CASE.trm

ADDED MOUNTAINVIEW GENERATION PROJECT (SCE)
STRESSED EOR BY DECREASING LOADLEVEL ACCORDING TO OSS MANUAL
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



59.400	———	o	fbus	15021	500.0	PALOVRDE	1	1	y	60.600
59.400	— — —	+	fbus	26062	500.0	RINALDI	1	1	y	60.600
59.400	- - - - - -	*	fbus	40585	500.0	JOHN DAY	1	1	y	60.600
59.400	—-—-—-	#	fbus	30040	500.0	TESLA	1	1	y	60.600
59.400	—.—.—	×	fbus	24801	500.0	DEVERS	1	1	y	60.600
59.400	—.—.—	⊕	fbus	19037	345.0	MEAD	1	1	y	60.600

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Terminal output log is CASE.trm

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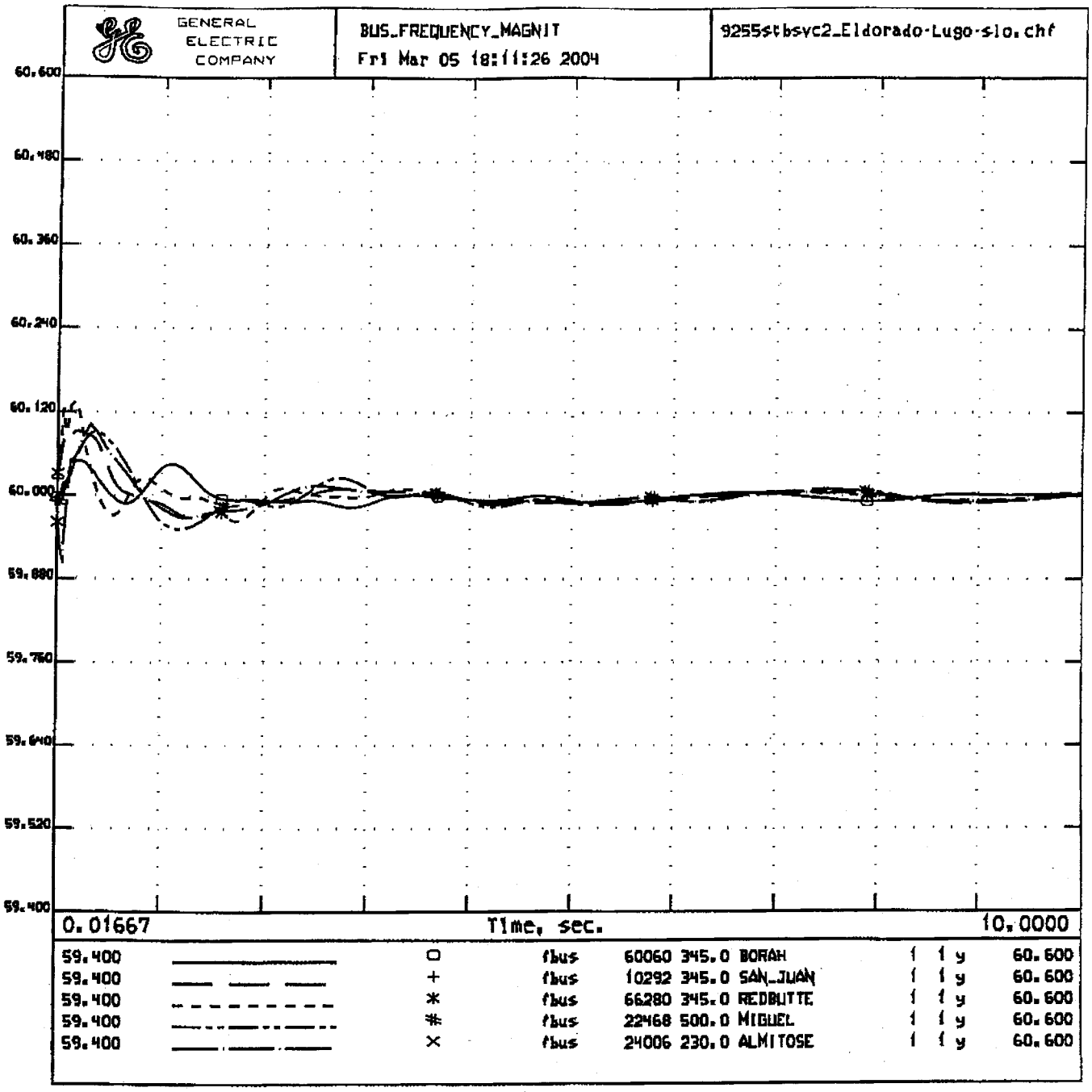

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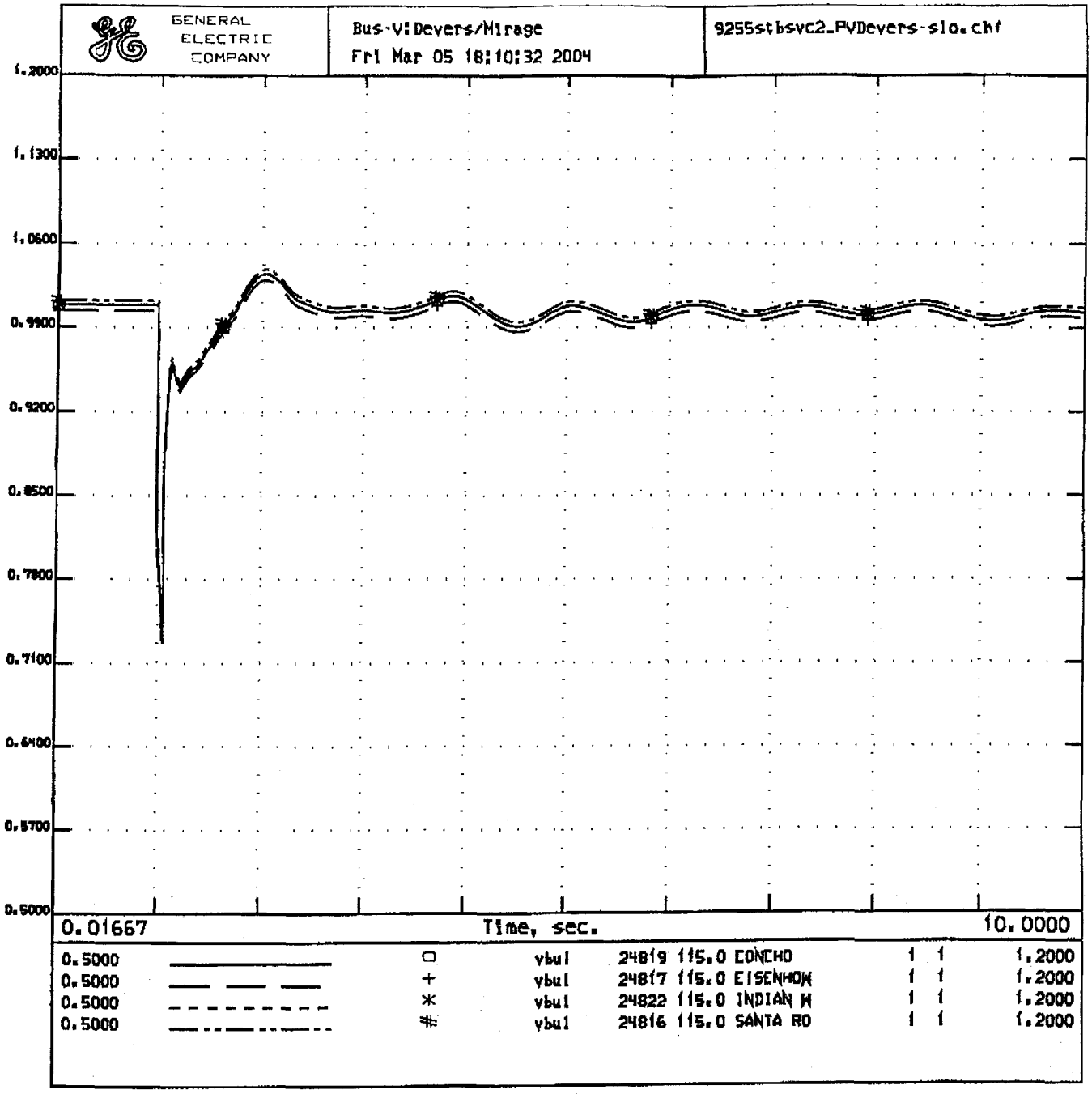
Transient Stability Study Plots - 5

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Palo Verde-Devers 500 kV Line**
EOR MARGIN:	**None**
NOTES:	



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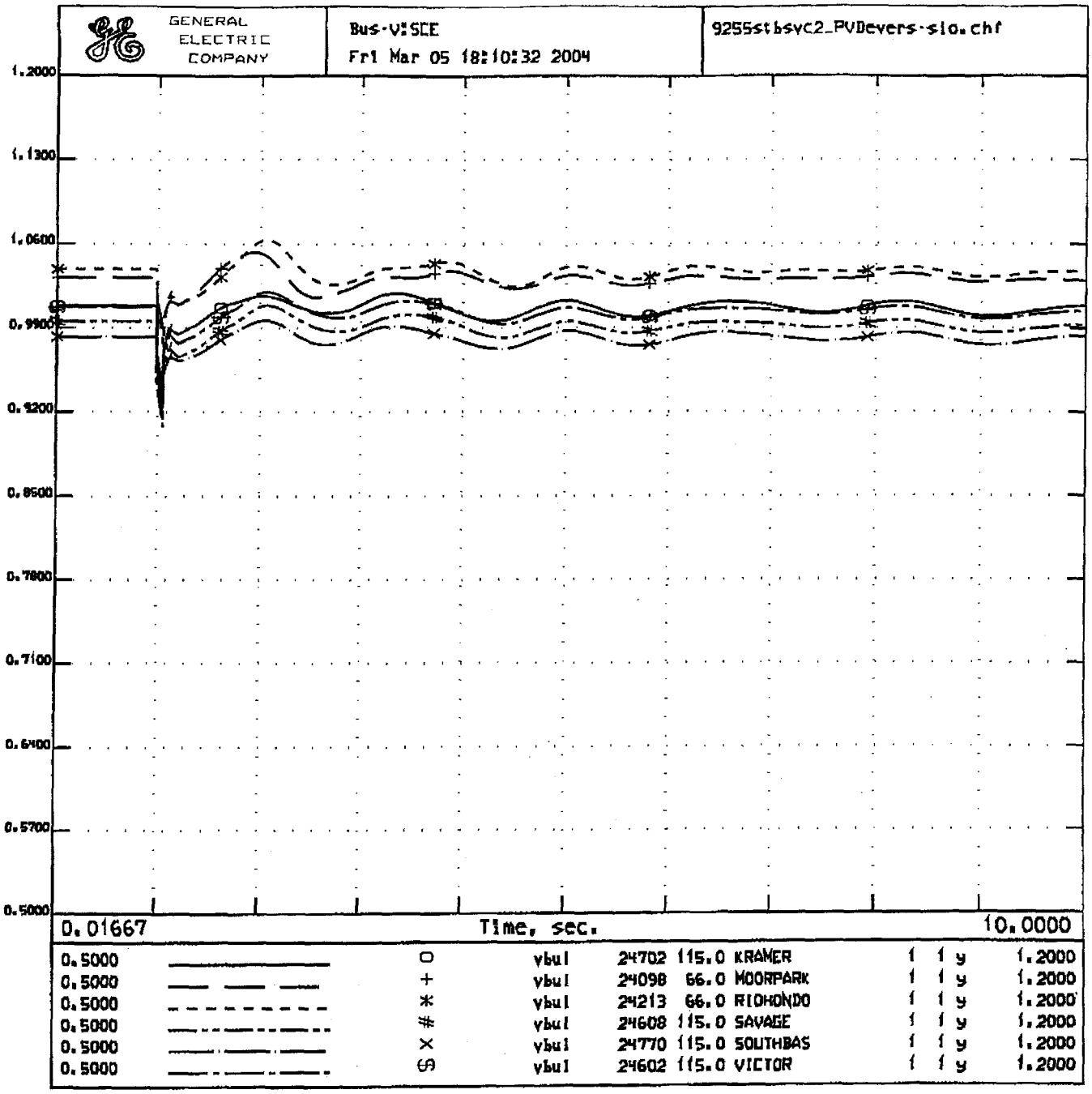

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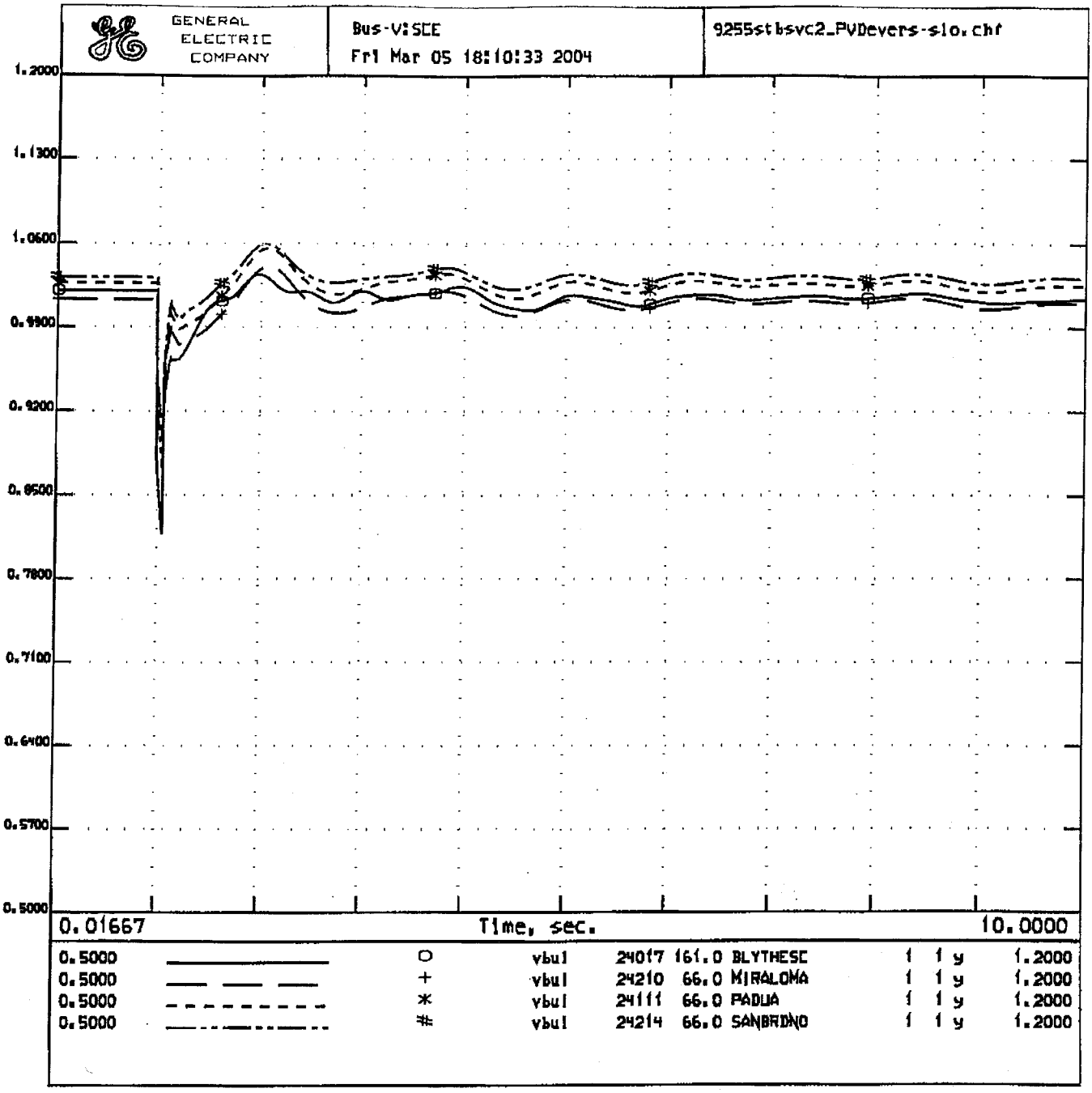

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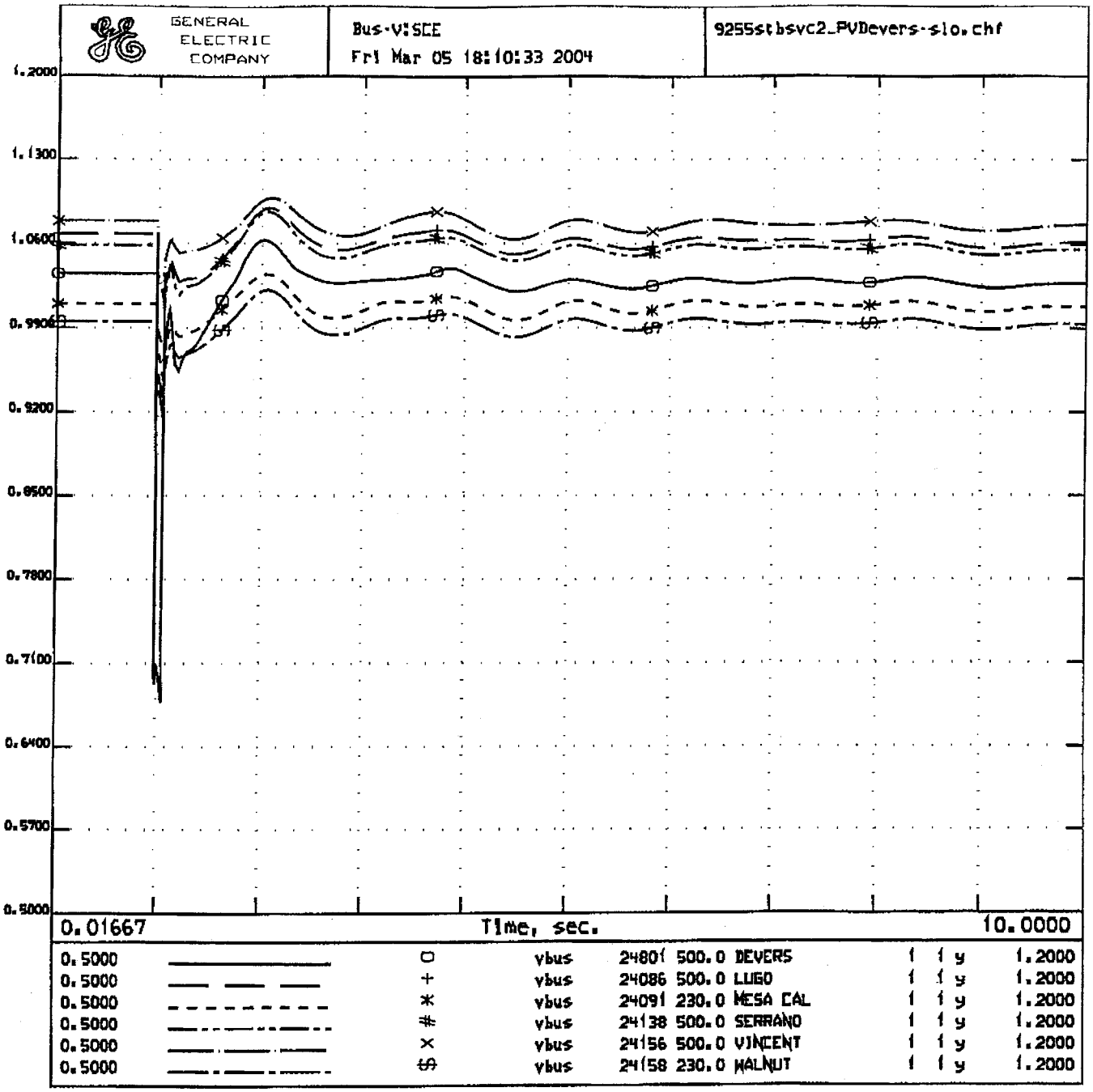

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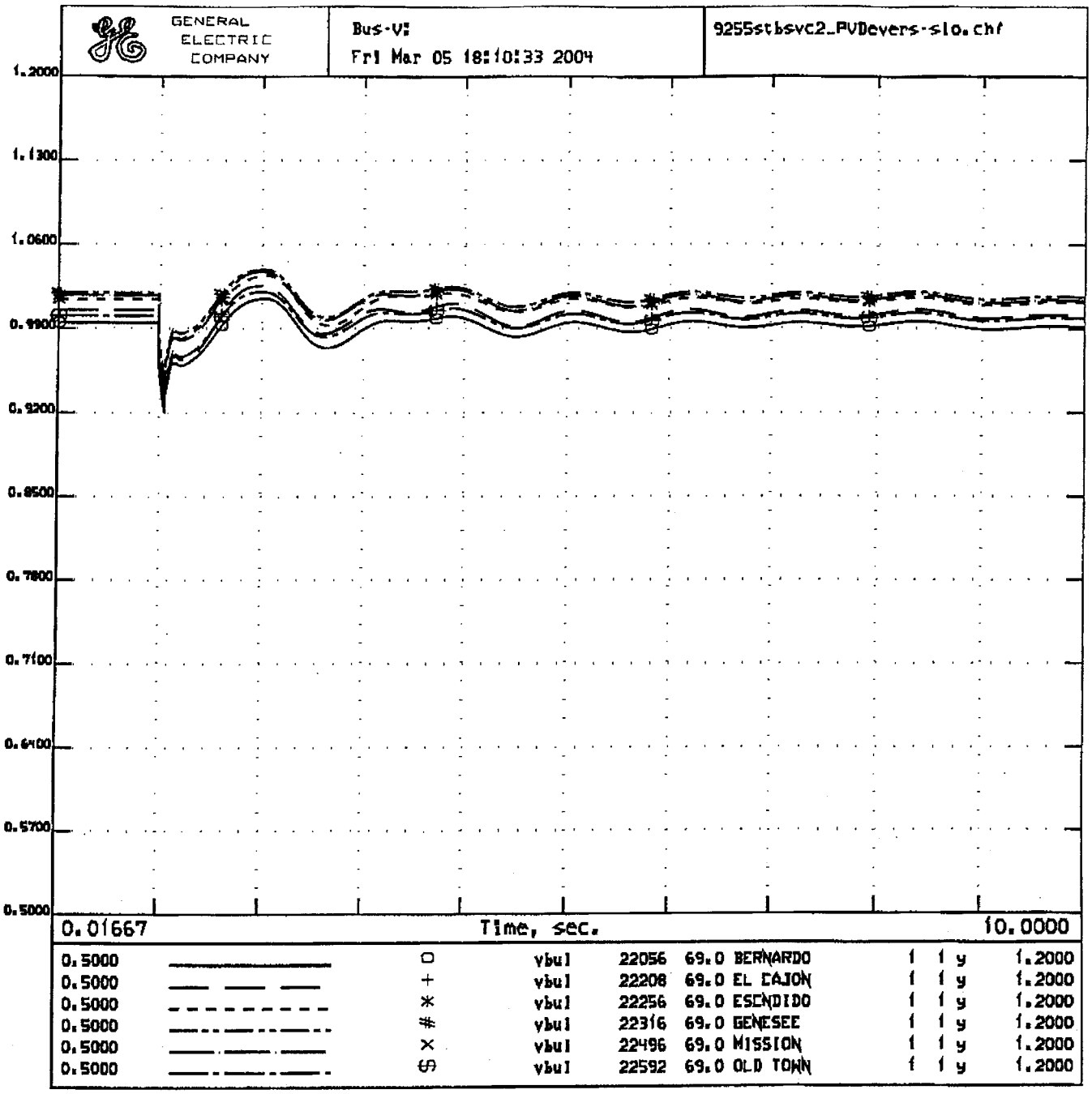

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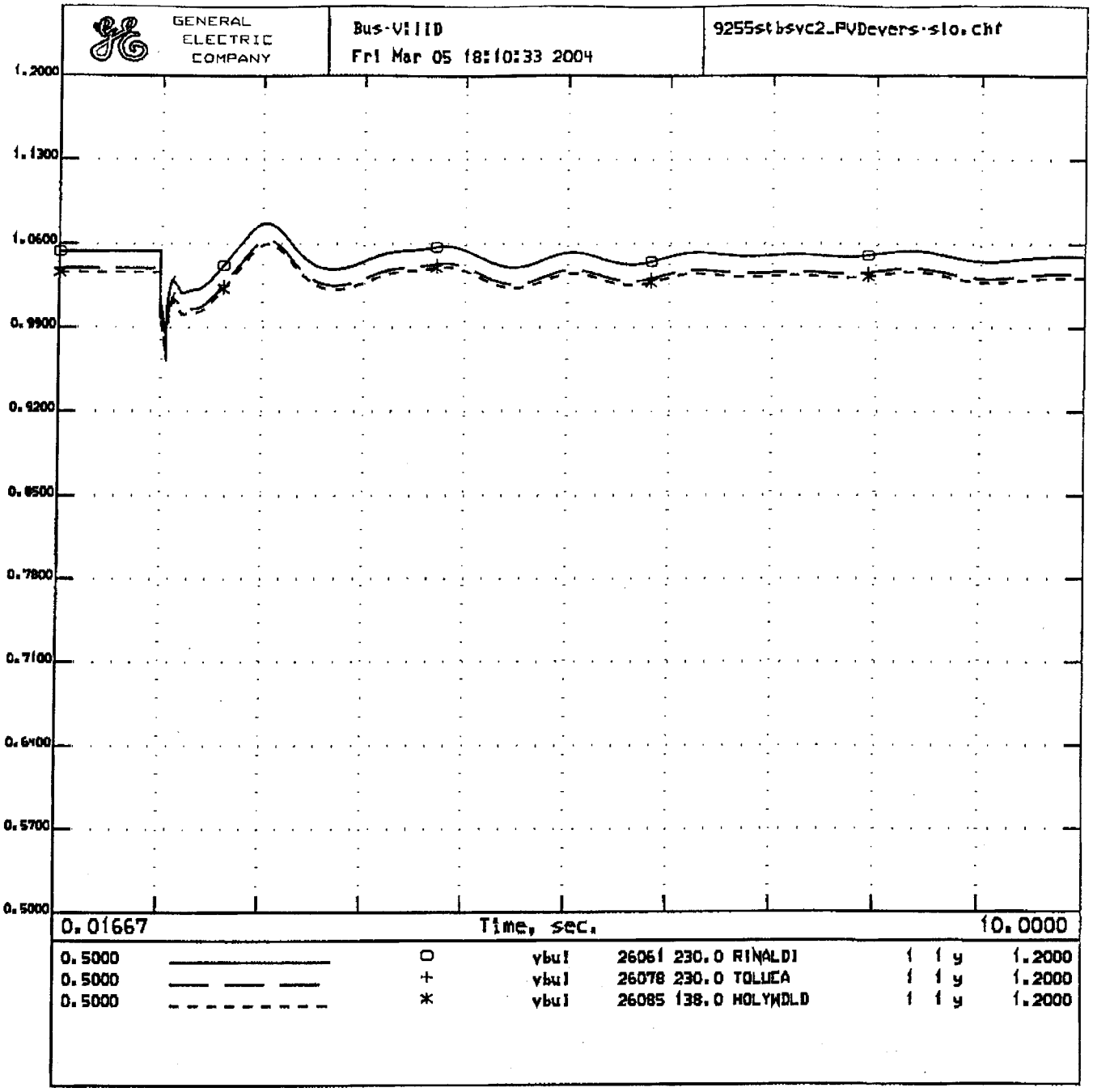

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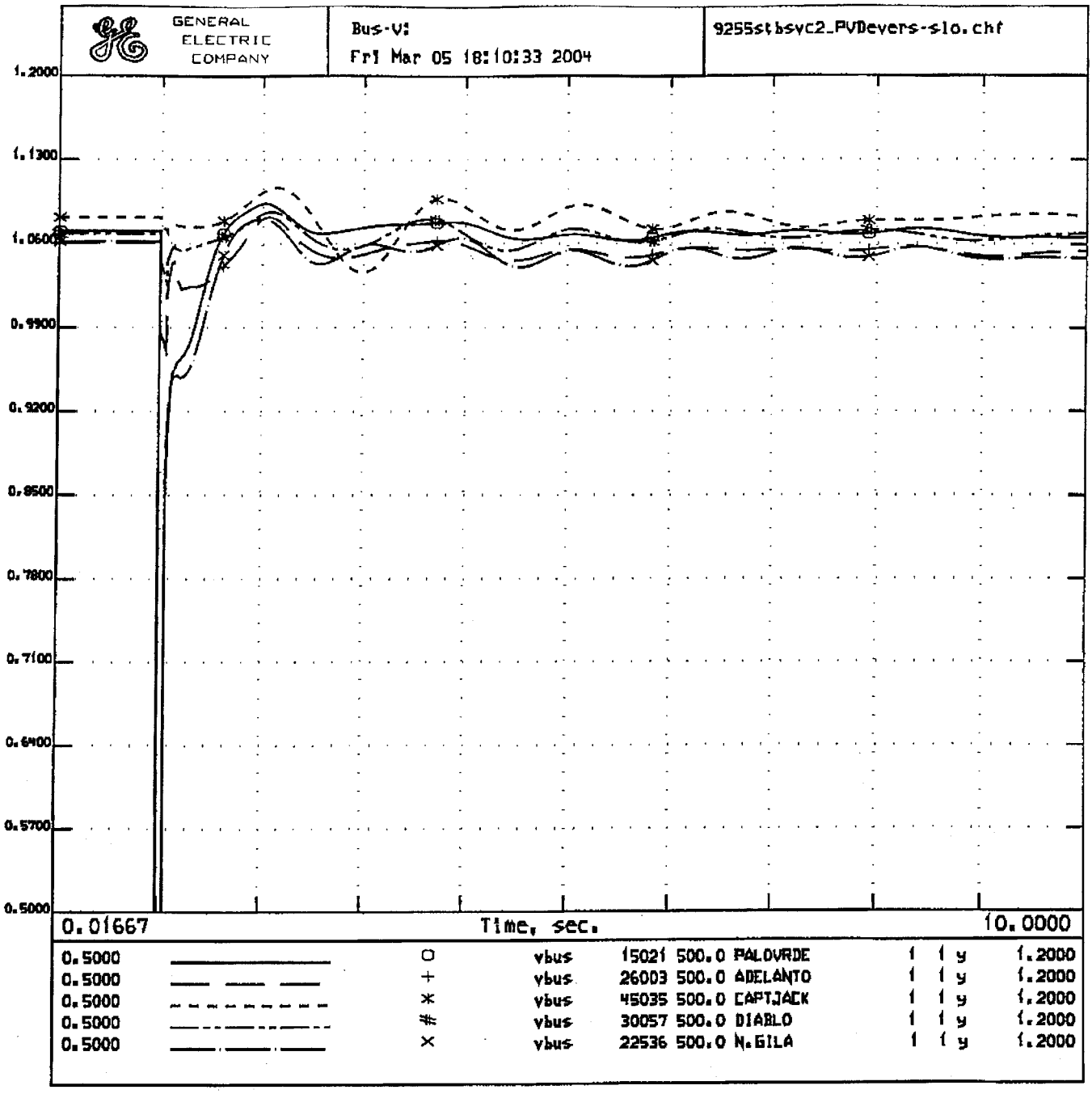

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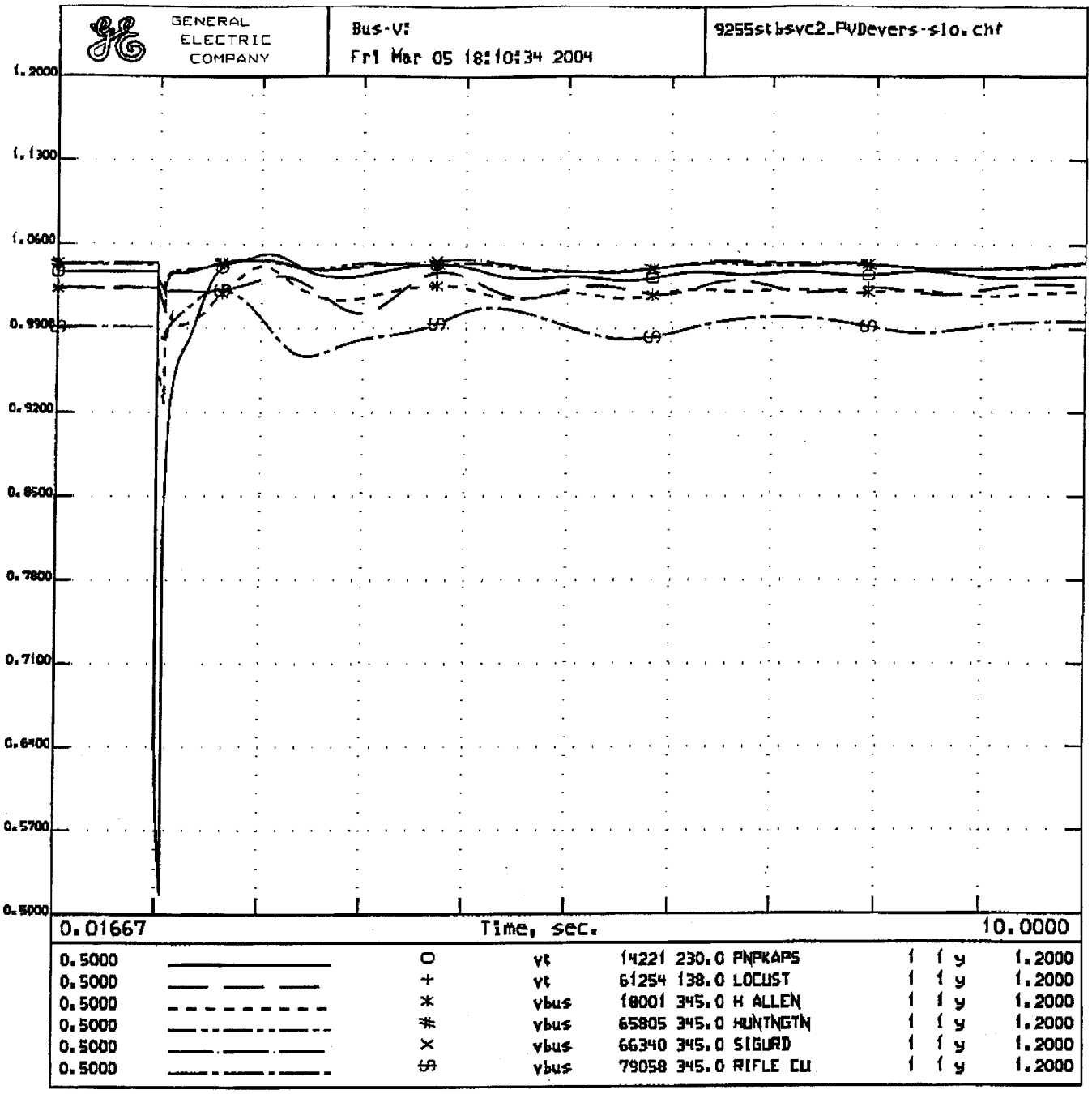

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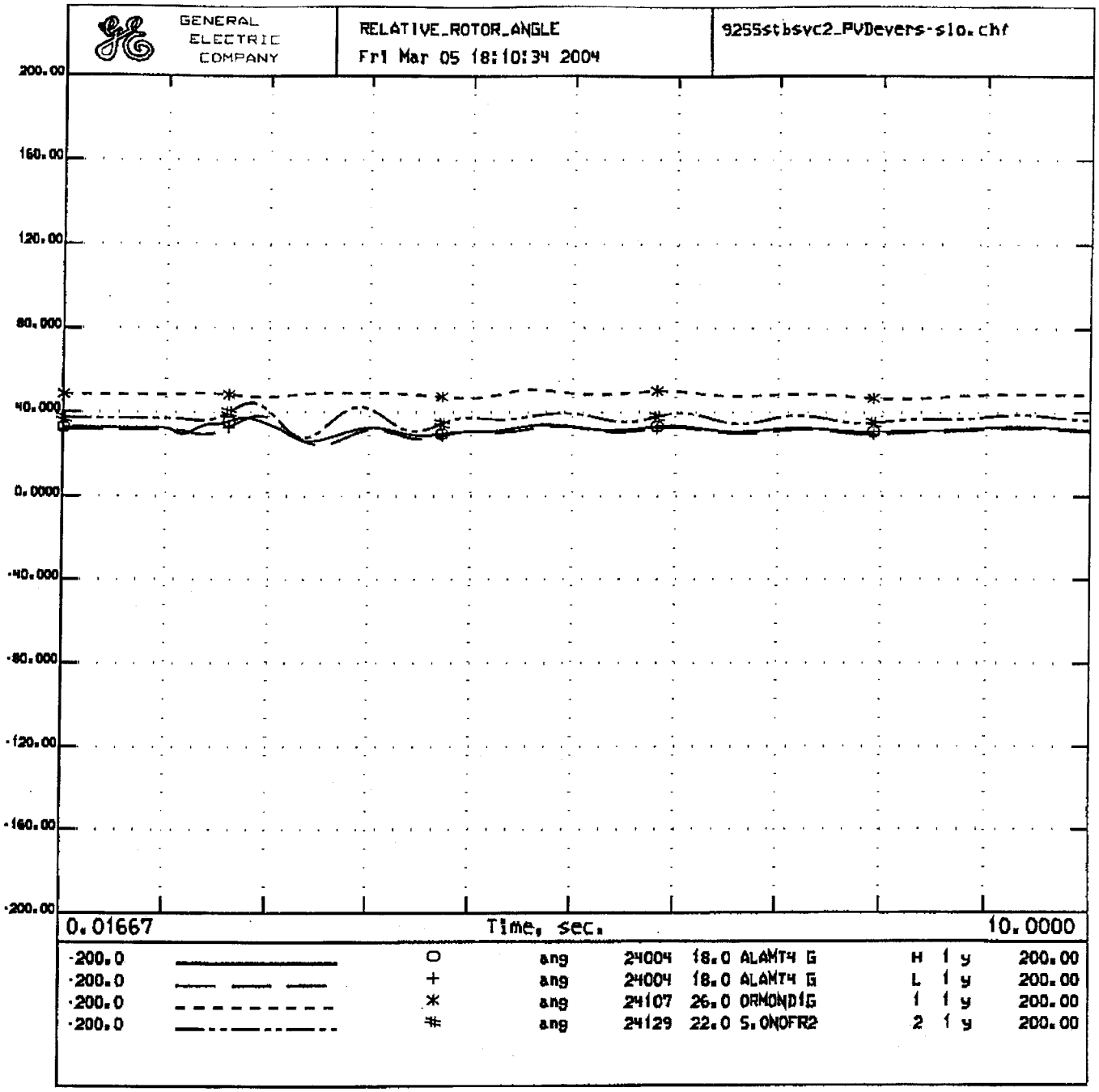

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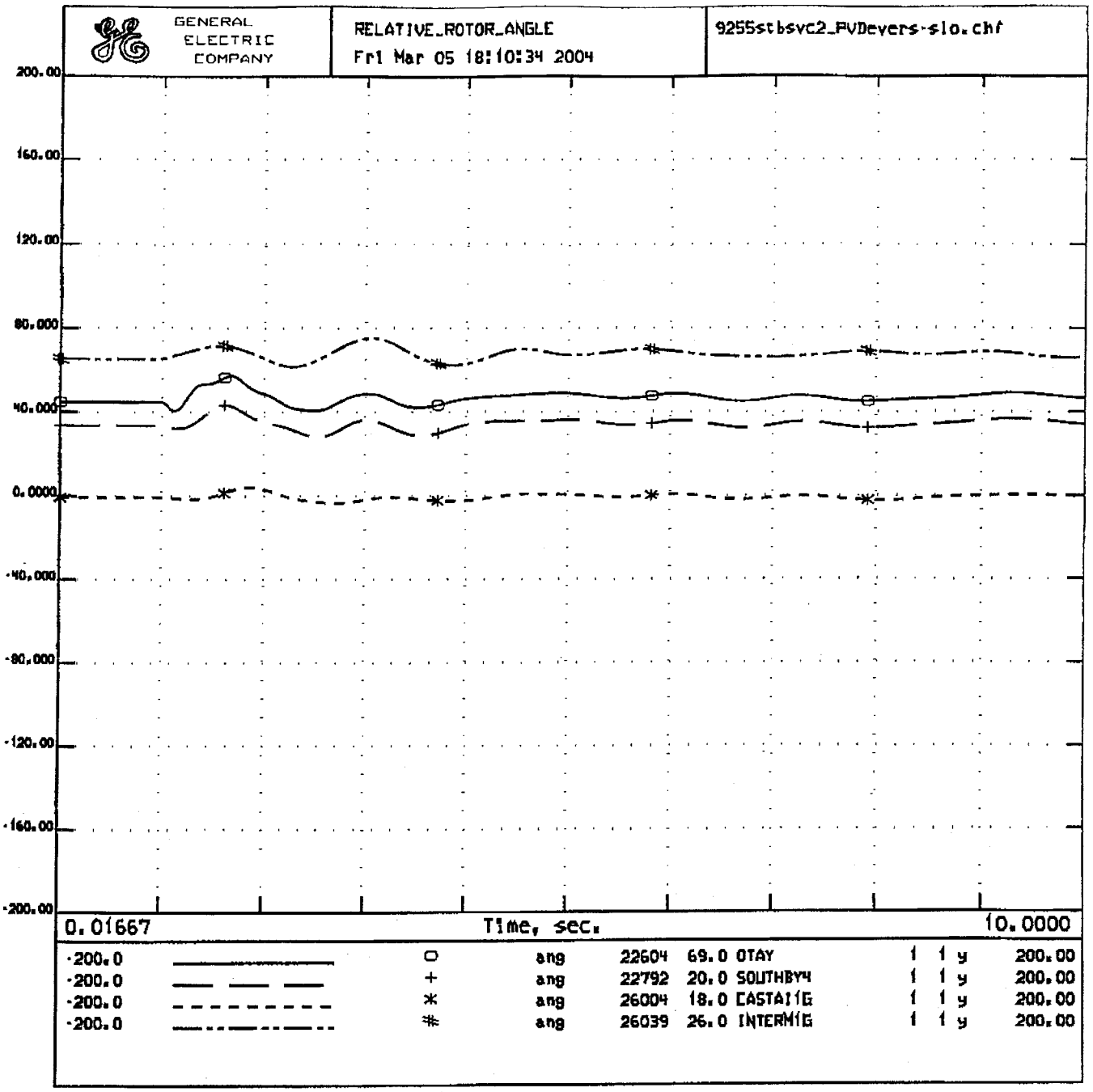

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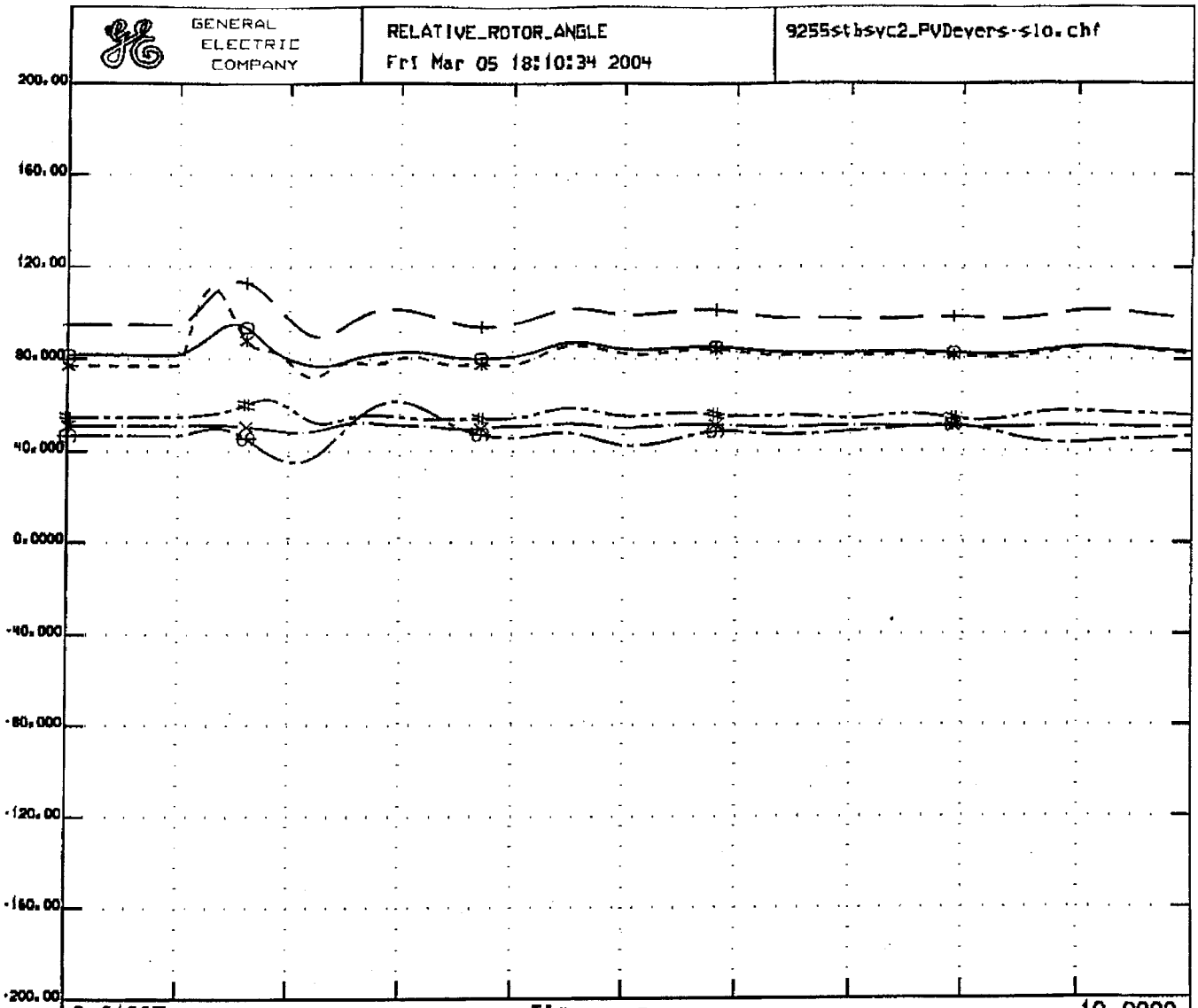

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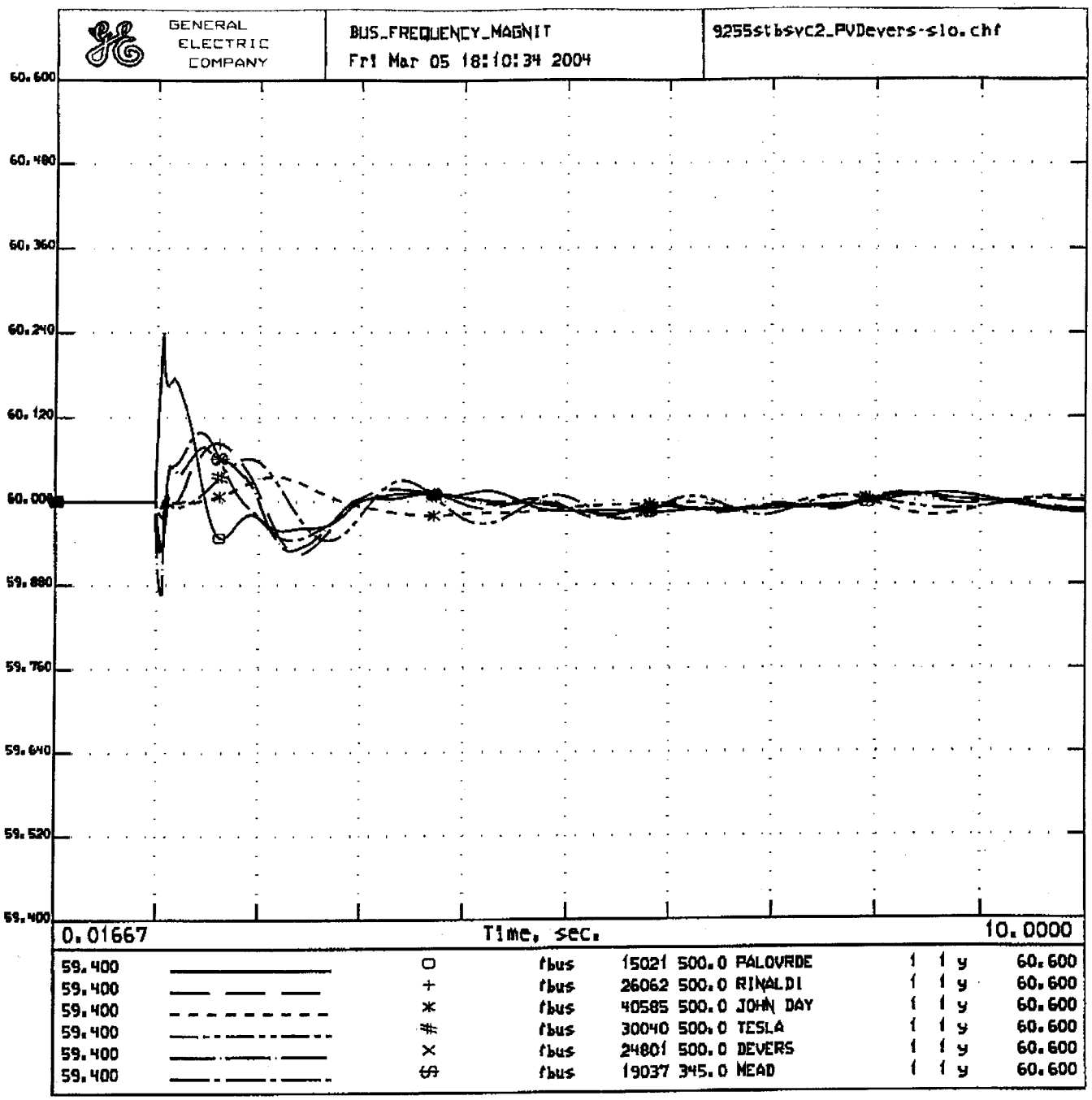

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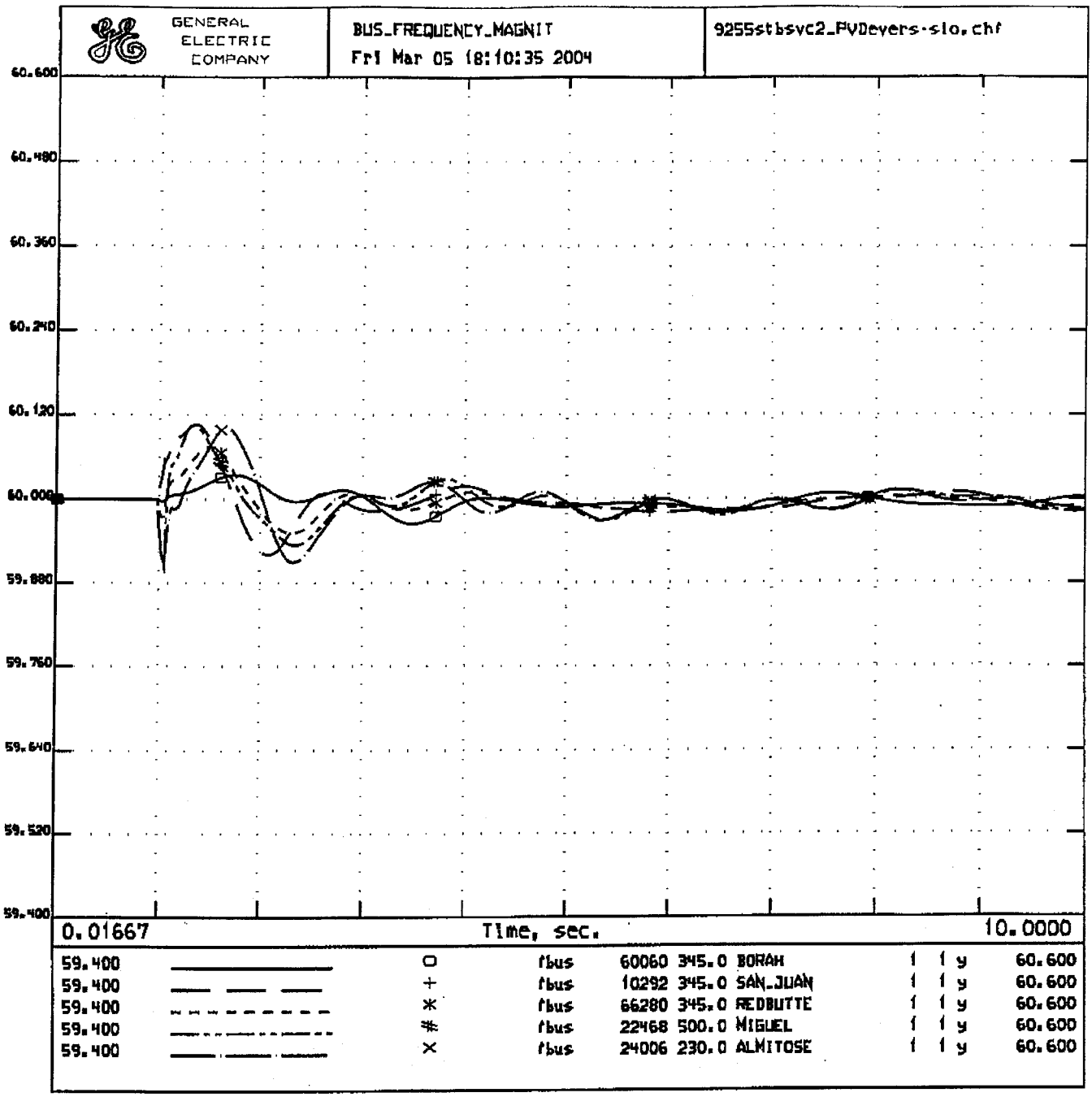

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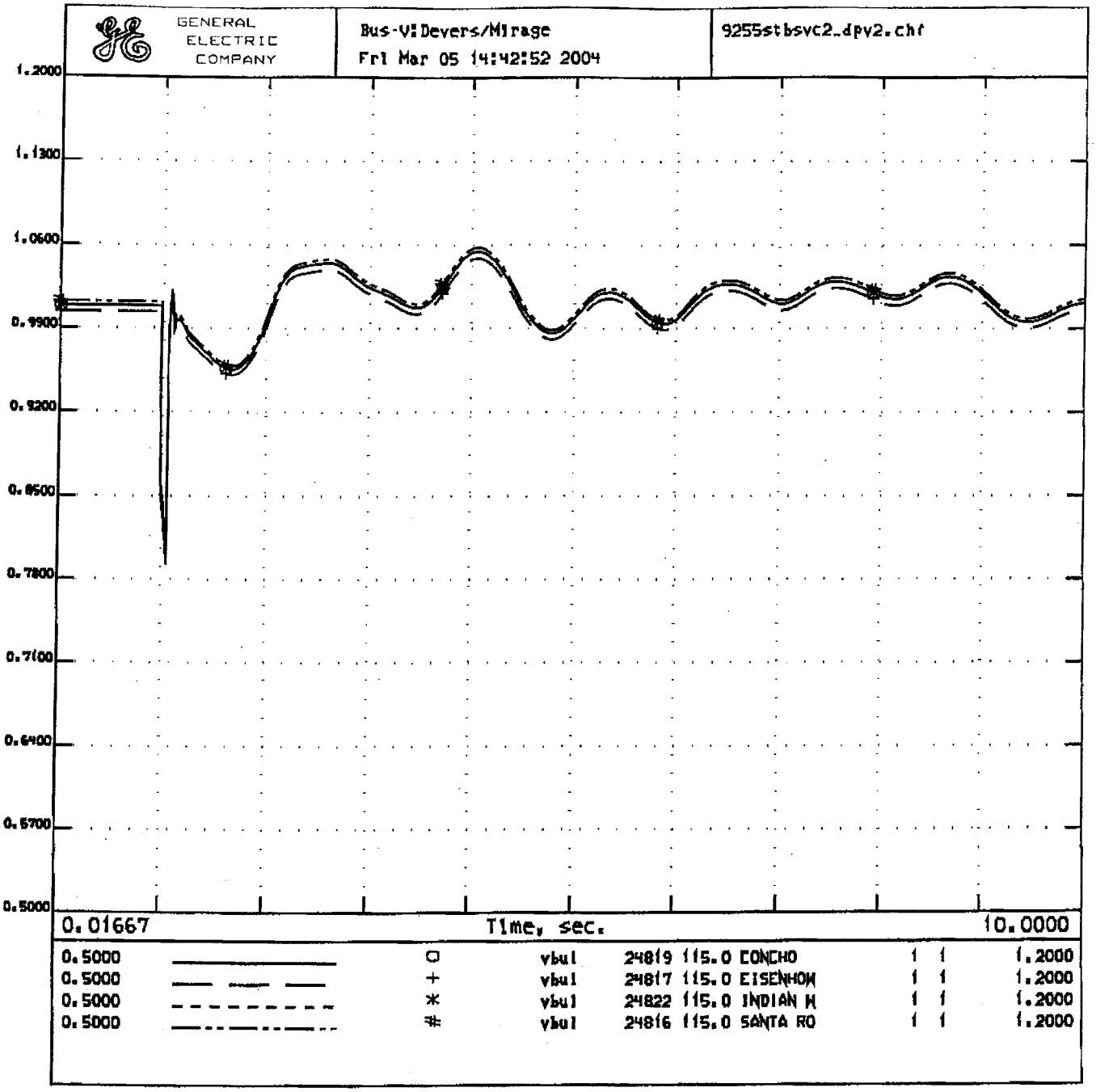
Transient Stability Study Plots - 6

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Devers-Harquahala 500 kV Line**
EOR MARGIN:	**None**
NOTES:	



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Terminal output log is CASE.trm

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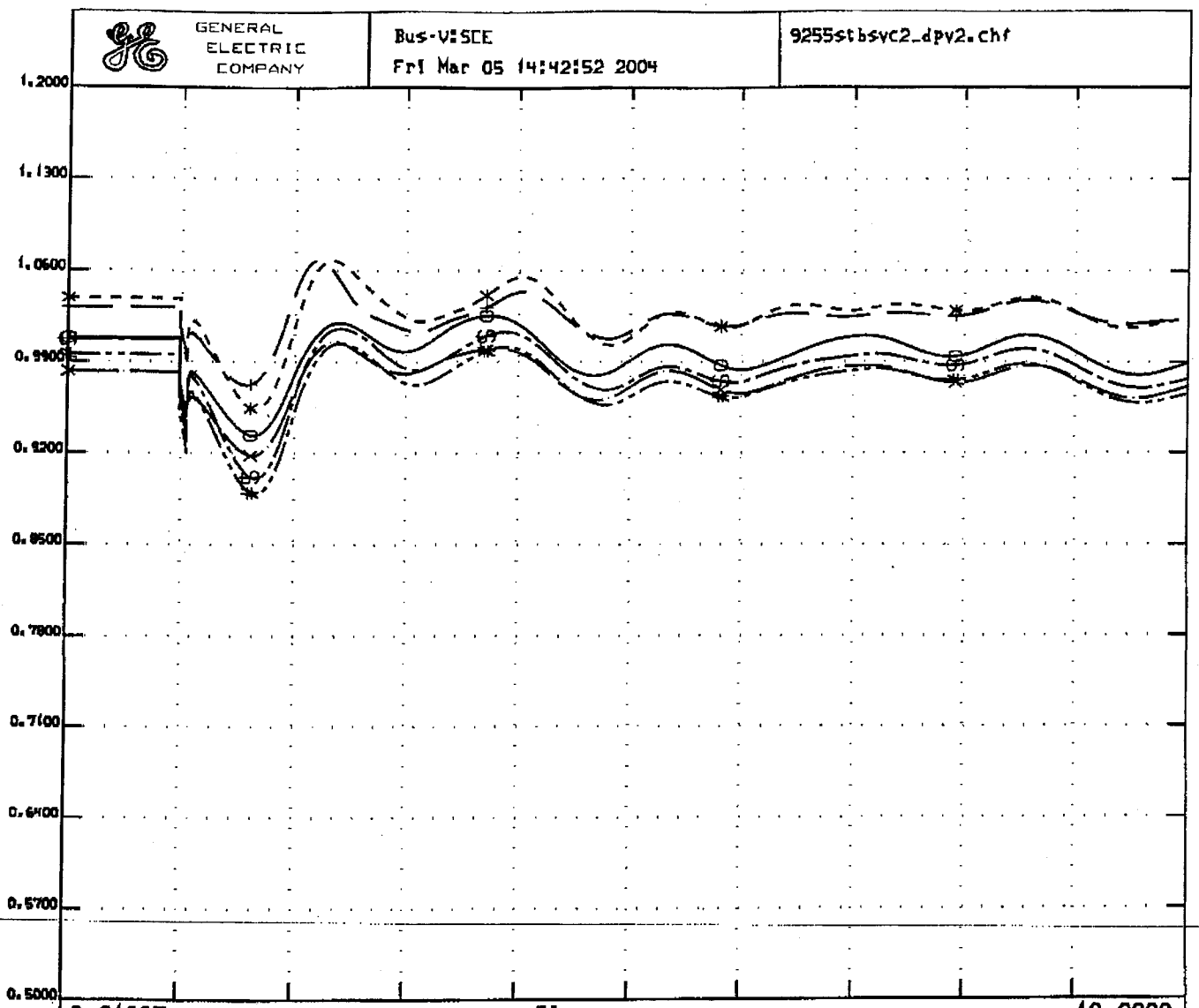

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0.5000	- - - - - -	*	vbul	24213	66.0	RIOHONDO	1	1 y	1.2000
0.5000	—--	#	vbul	24608	115.0	SAVAGE	1	1 y	1.2000
0.5000	——	×	vbul	24770	115.0	SOUTHBAS	1	1 y	1.2000
0.5000	—--	⊕	vbul	24602	115.0	VICTOR	1	1 y	1.2000

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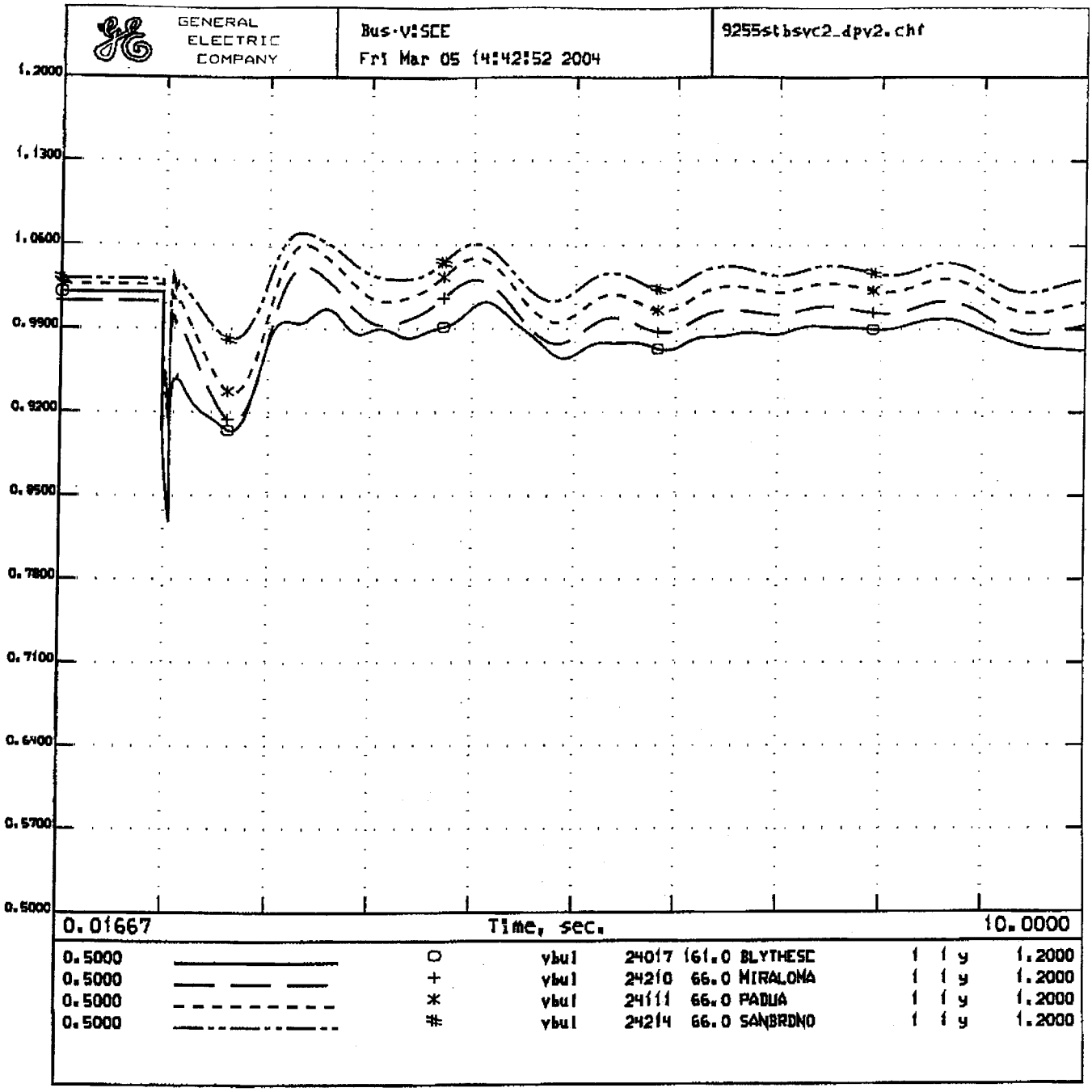

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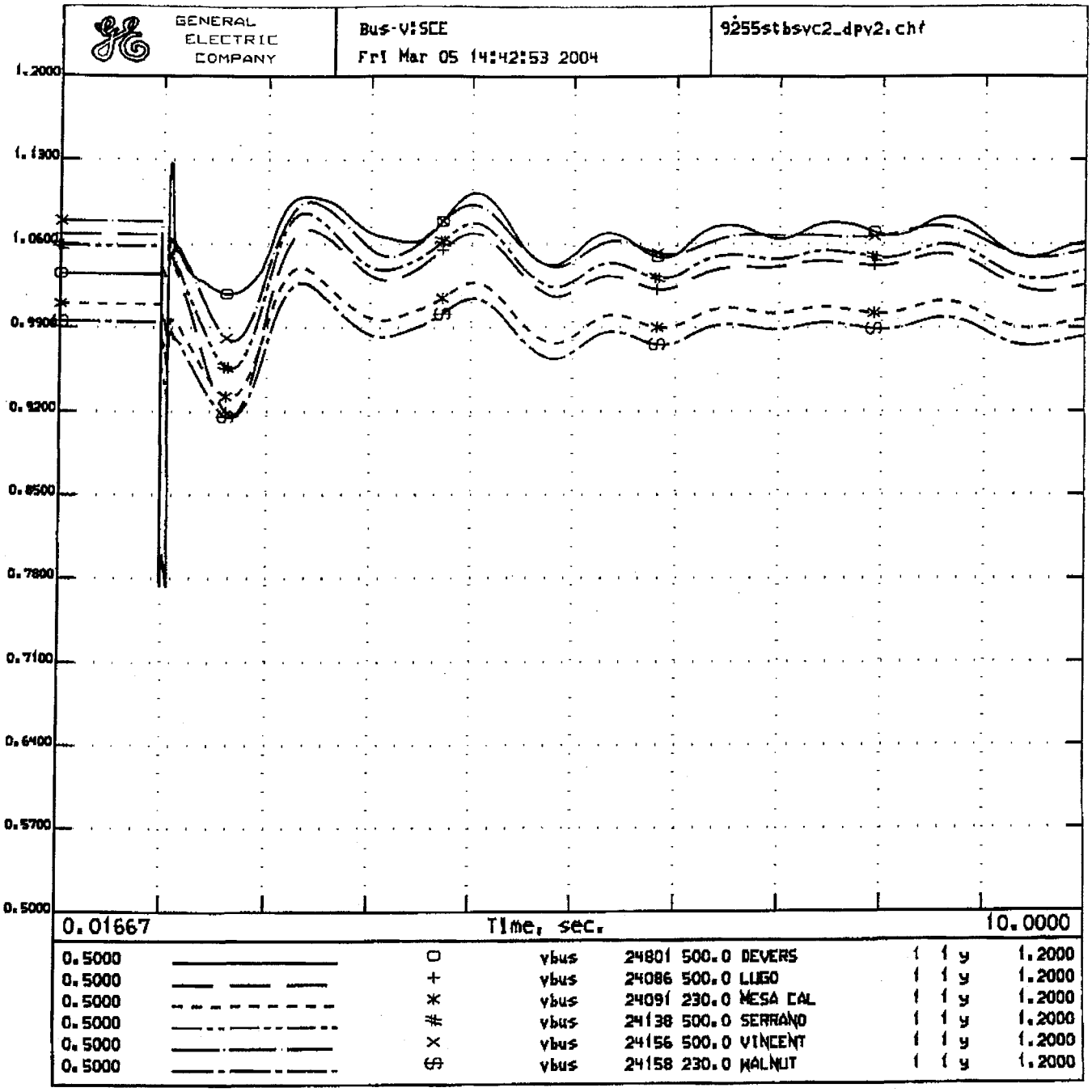

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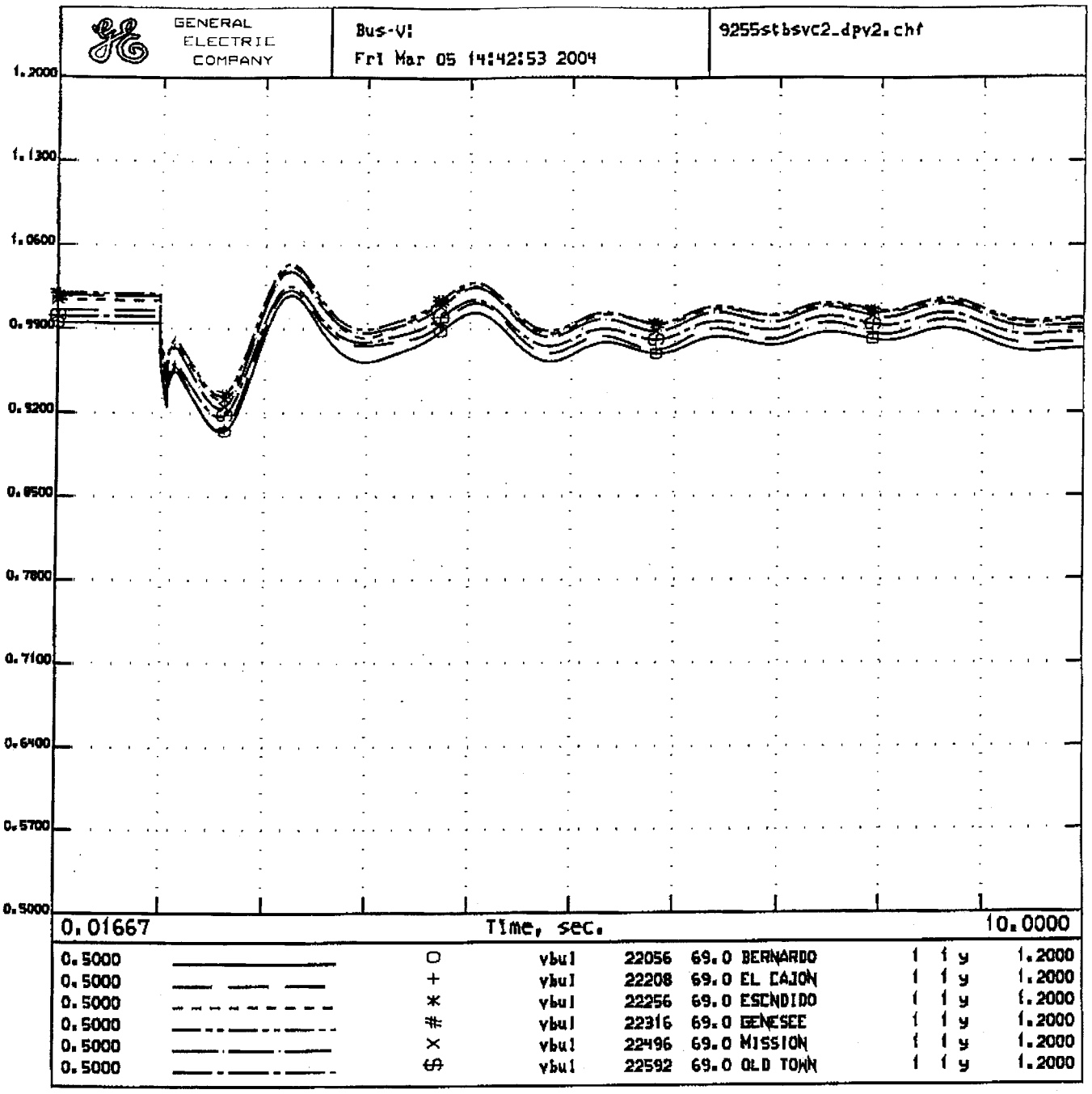
Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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Terminal output log is CASE.trm

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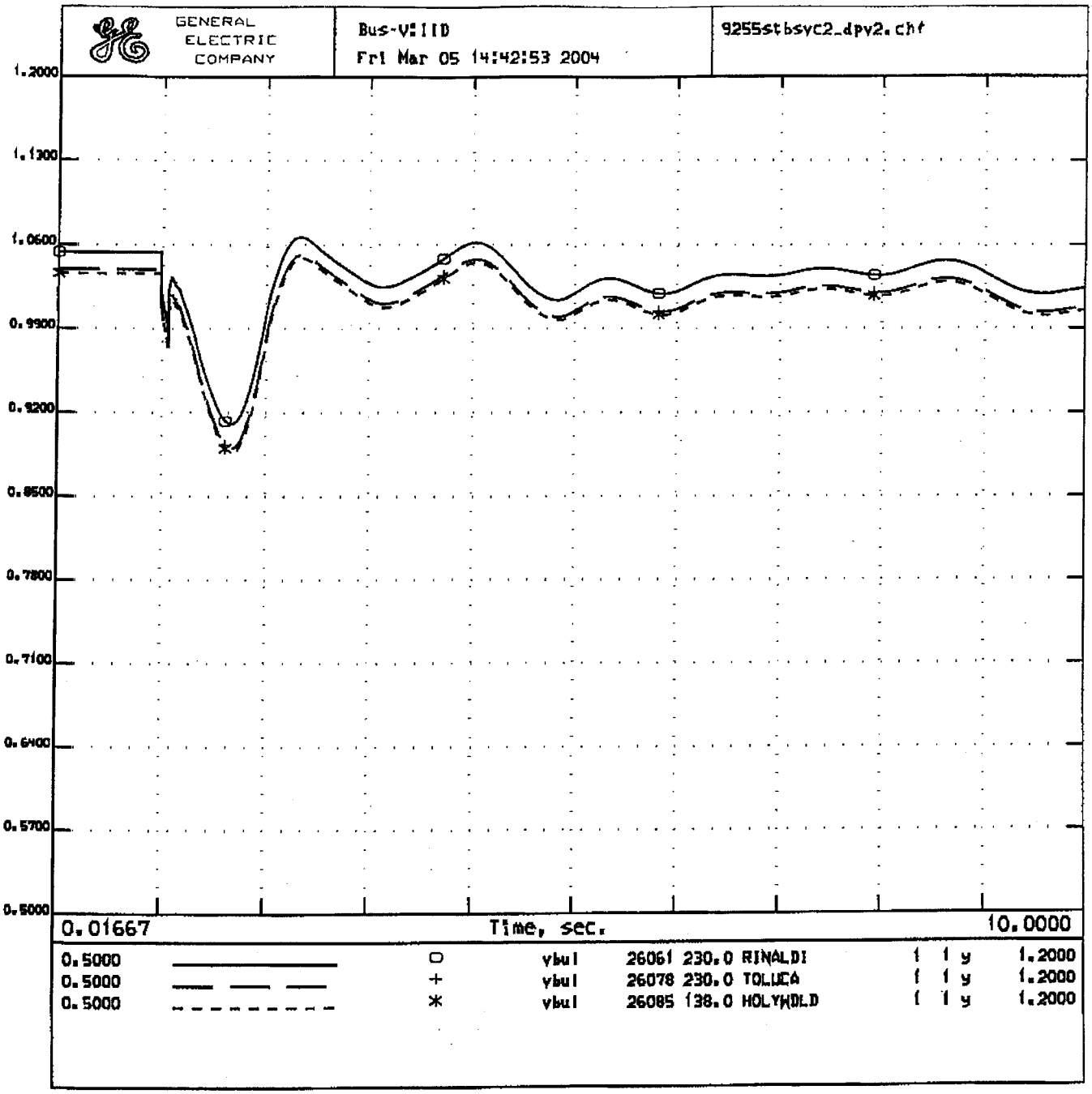

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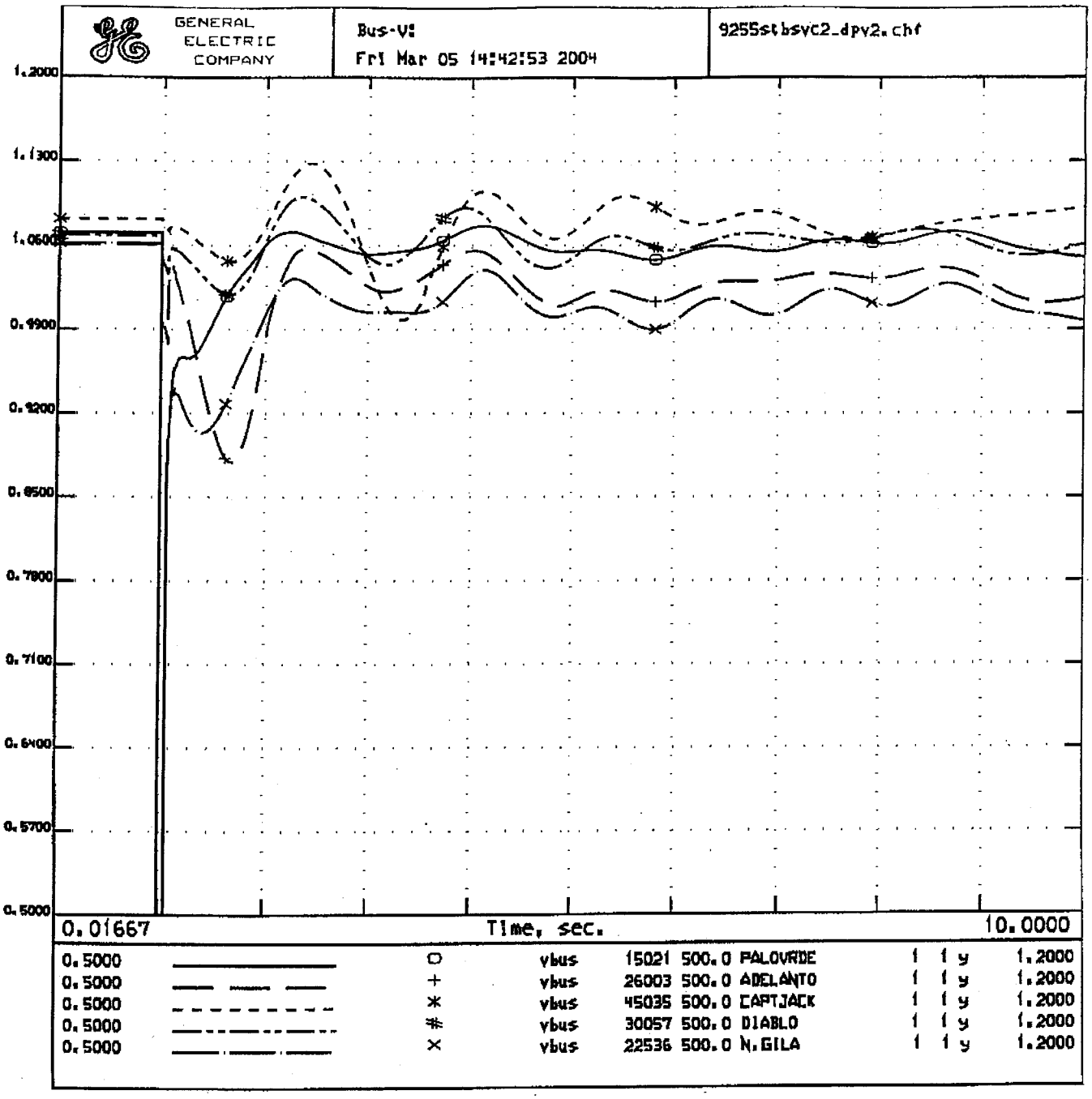

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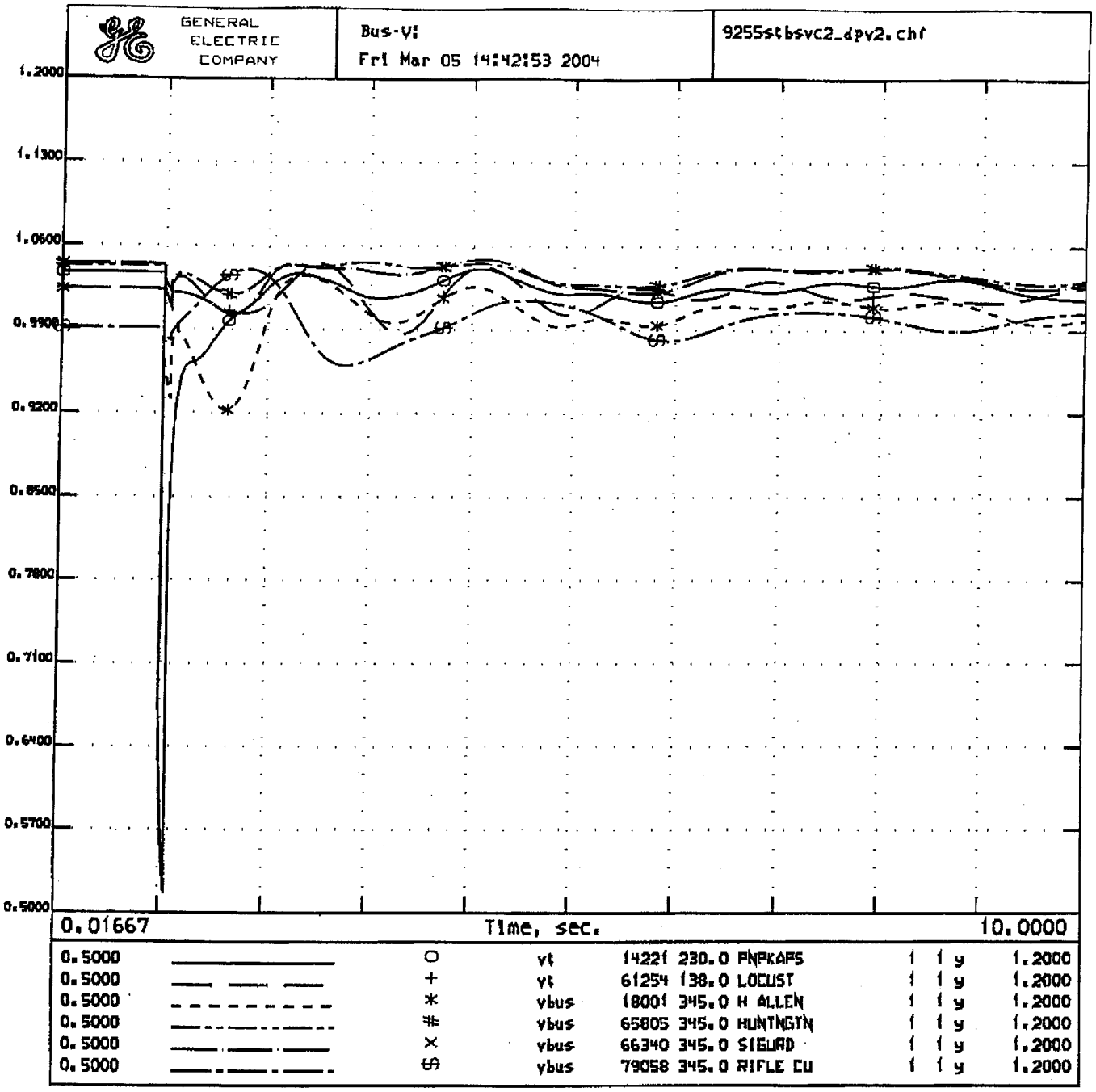

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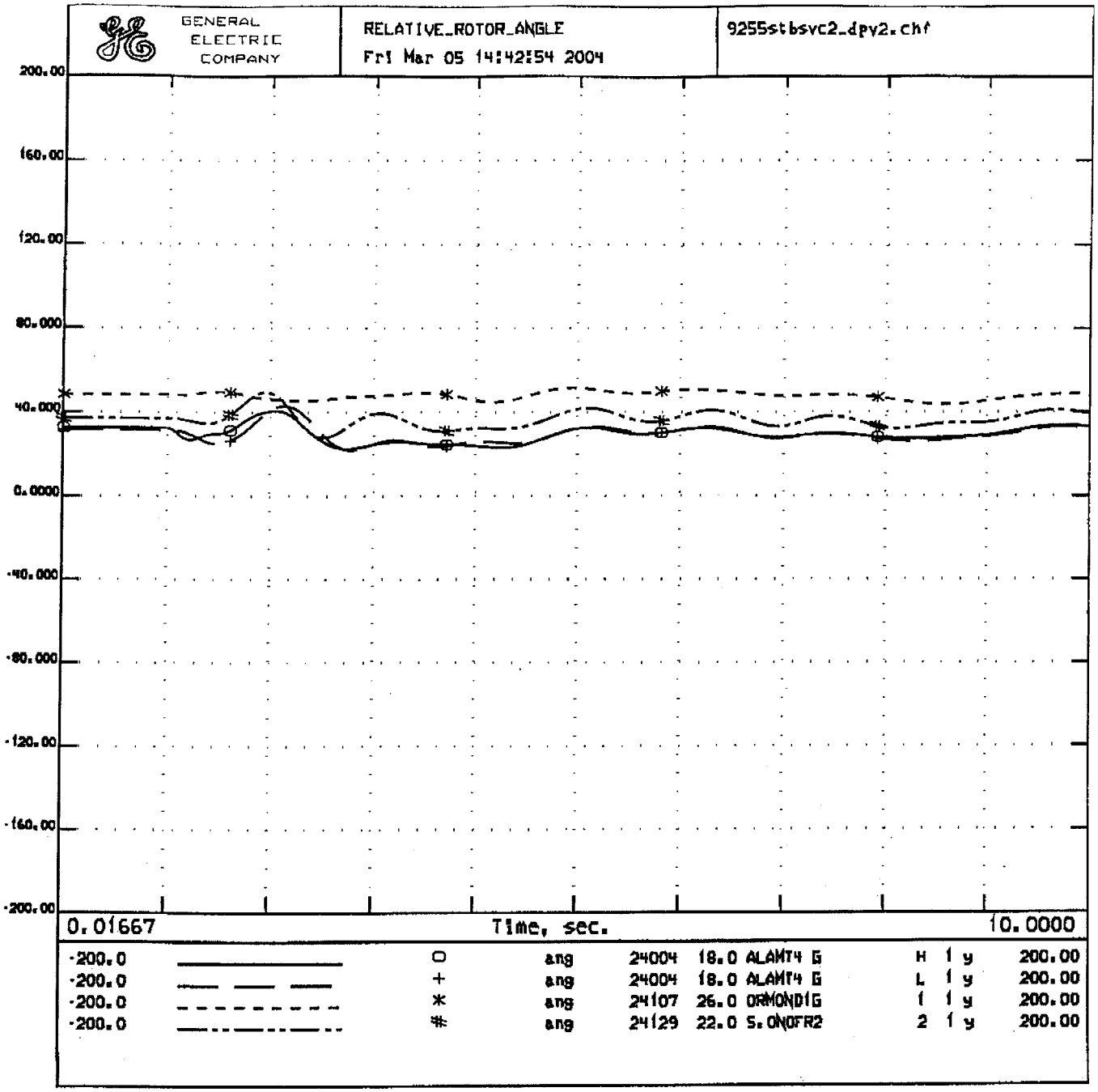

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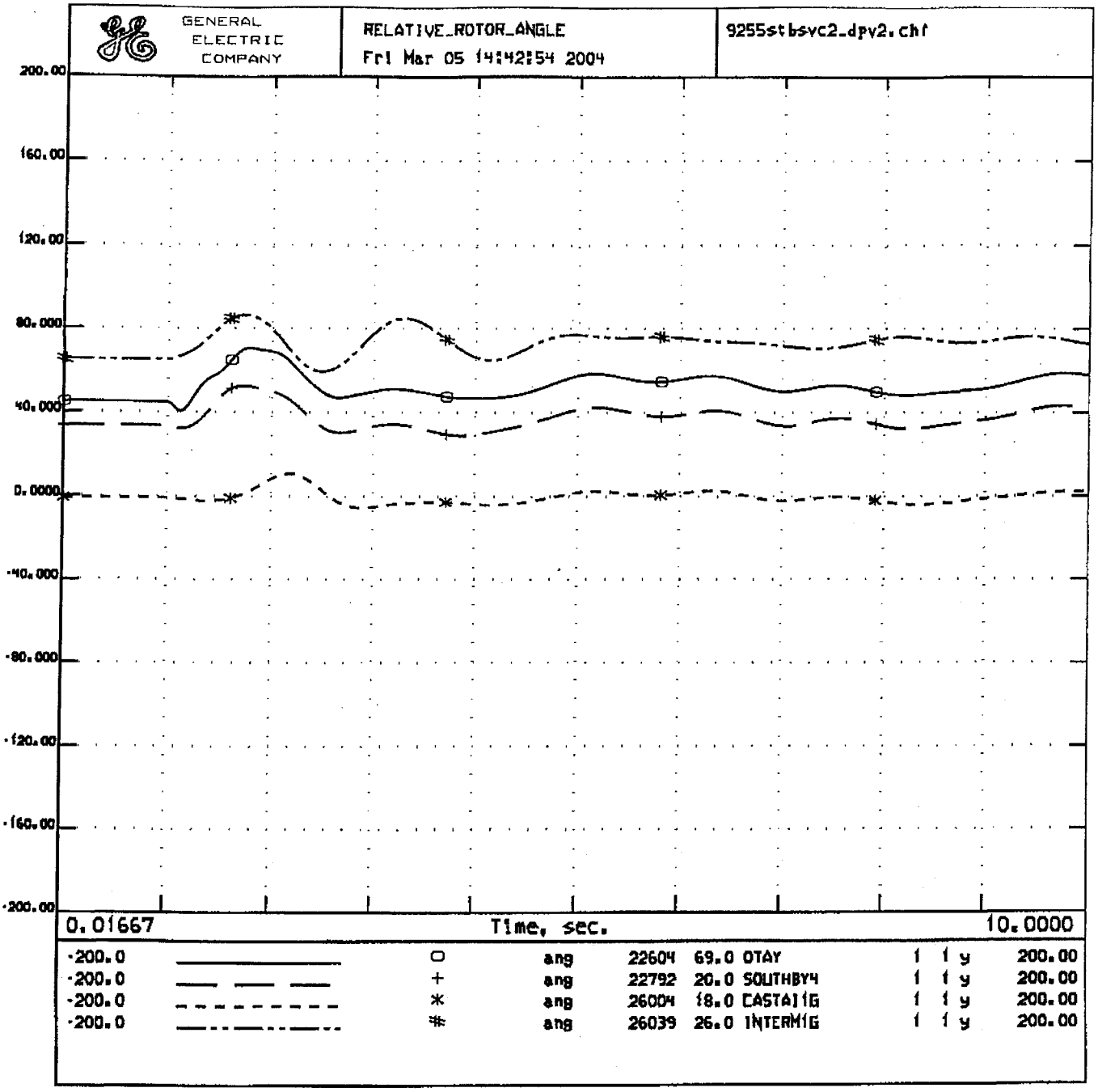

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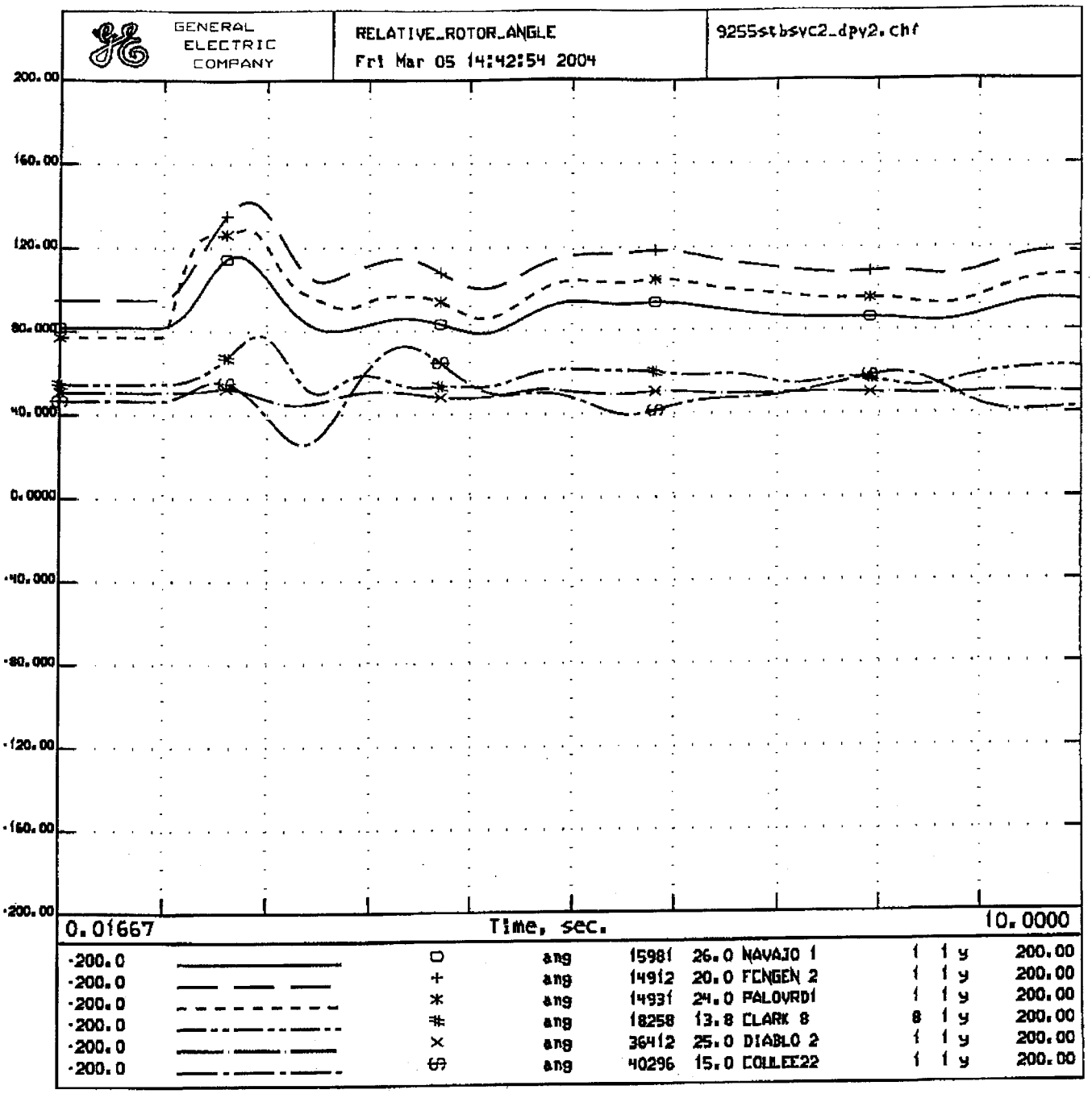

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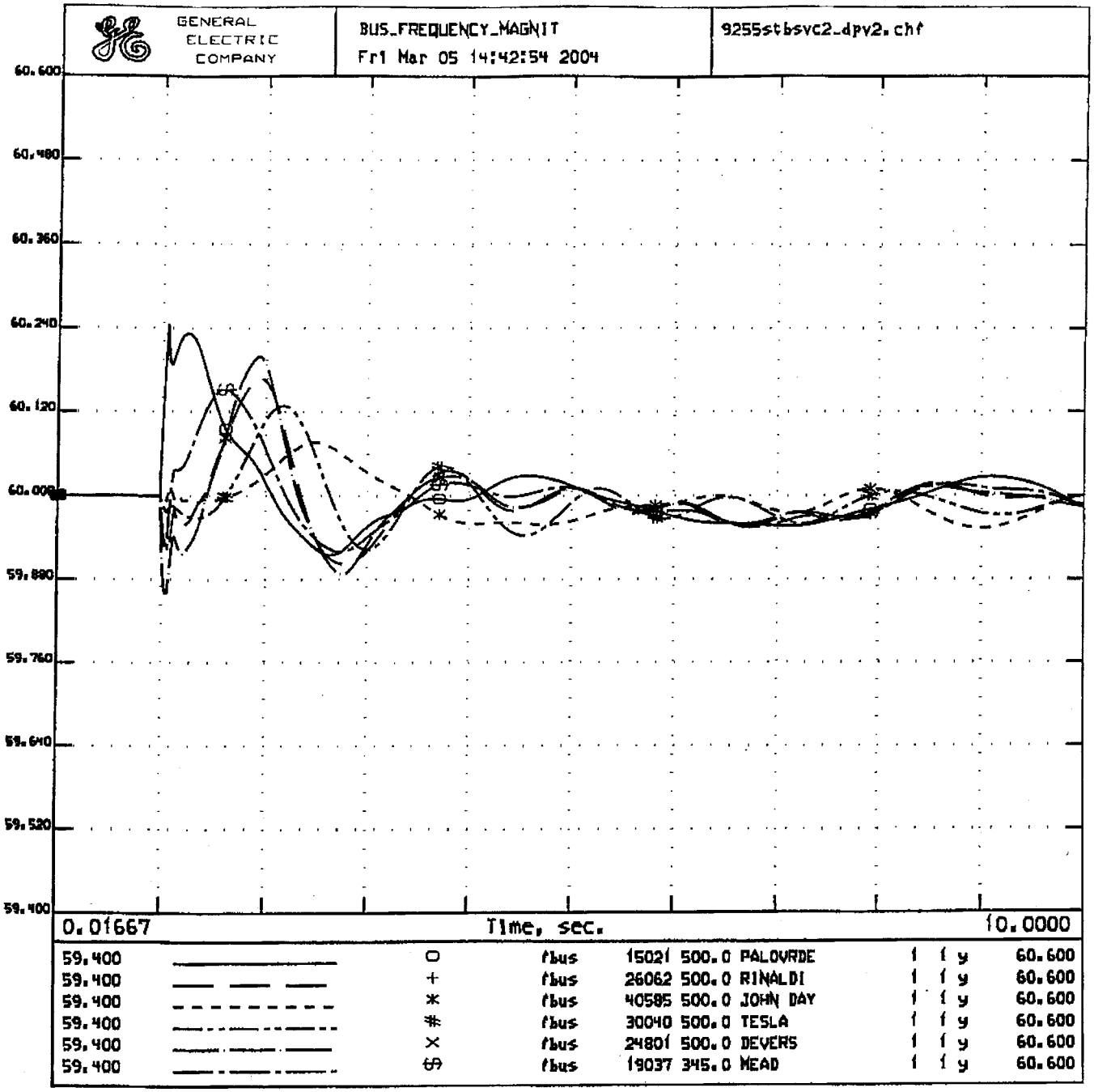

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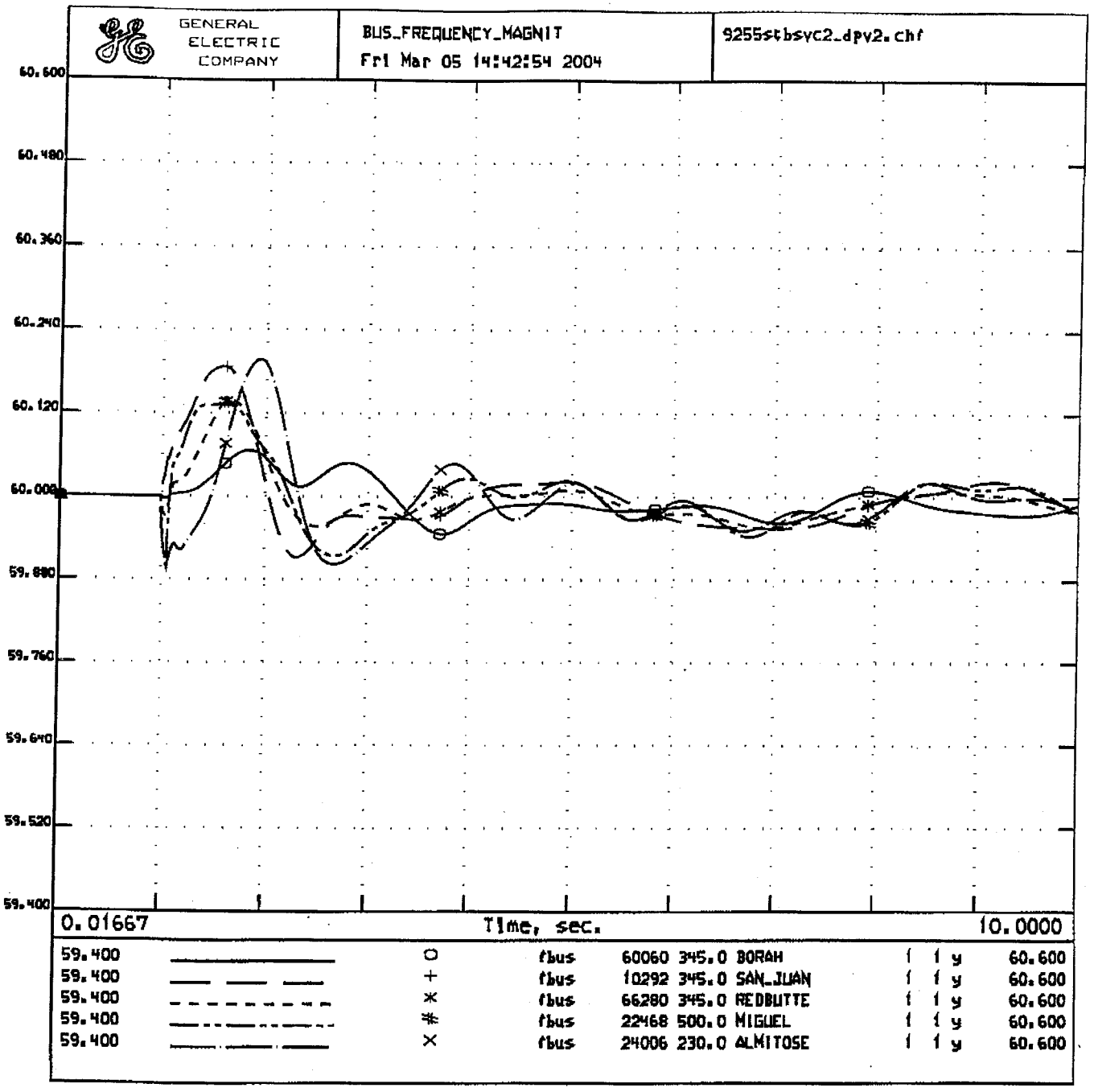

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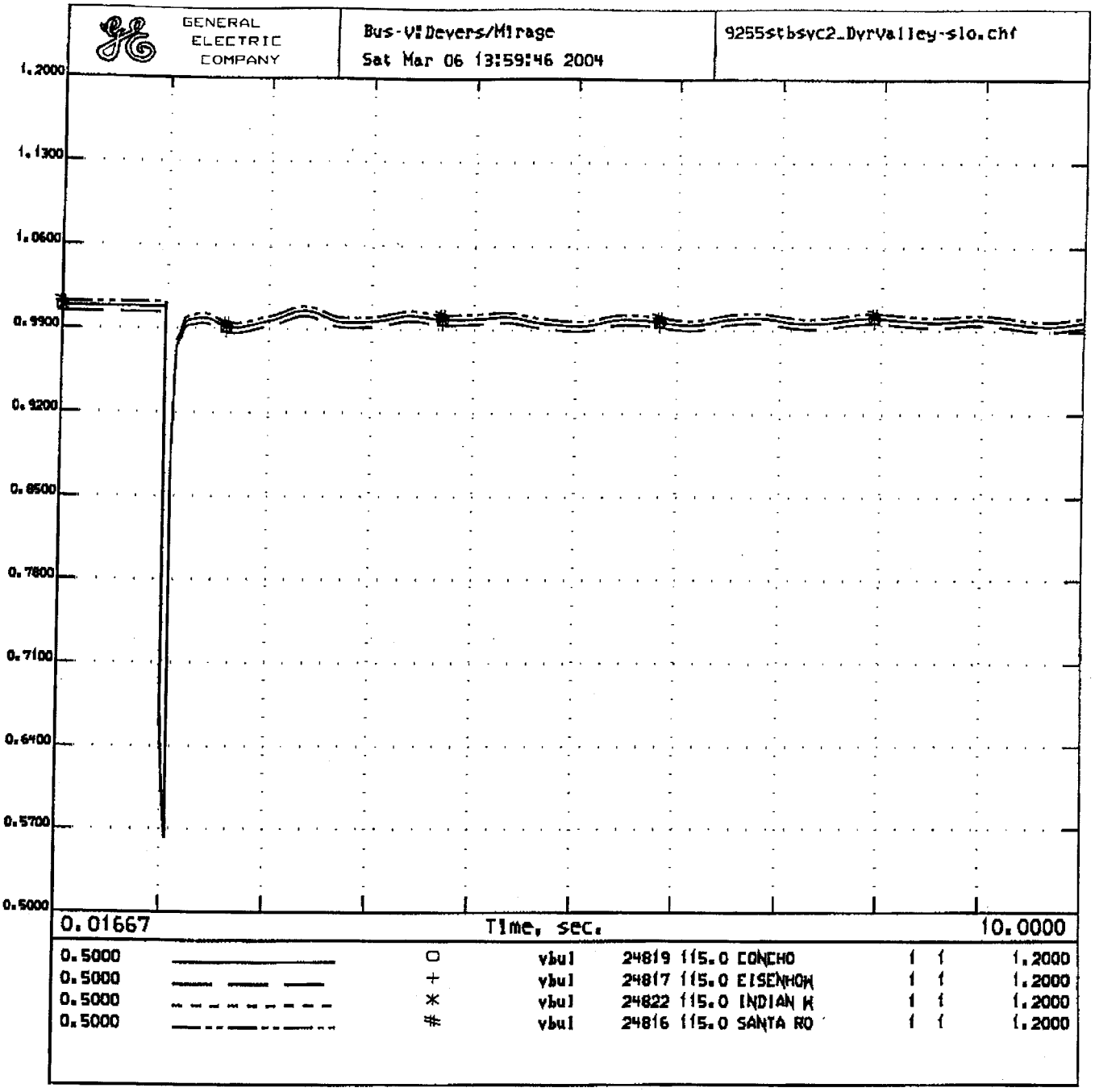
Transient Stability Study Plots - 7

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Devers-Valley 500 kV Line**
EOR MARGIN:	**None**
NOTES:	



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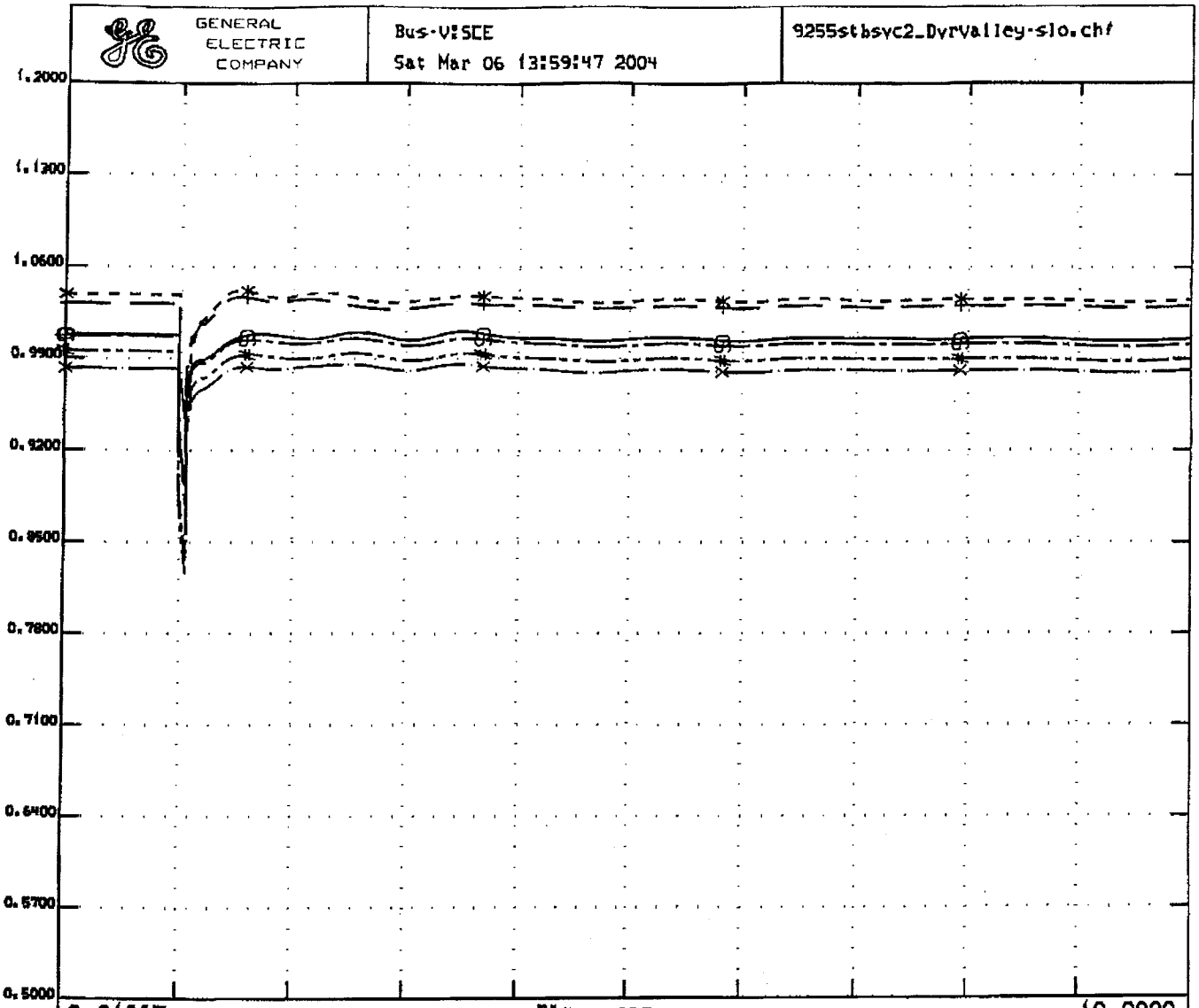

0.5000	———	○	vbul	24702	115.0	KRAMER	1	1	y	1.2000
0.5000	— — —	+	vbul	24098	66.0	MOORPARK	1	1	y	1.2000
0.5000	- - - - - - - - -	*	vbul	24213	66.0	RICHONDO	1	1	y	1.2000
0.5000	—-—-—-—	#	vbul	24608	115.0	SAVAGE	1	1	y	1.2000
0.5000	—.—.—	×	vbul	24770	115.0	SOUTHBAS	1	1	y	1.2000
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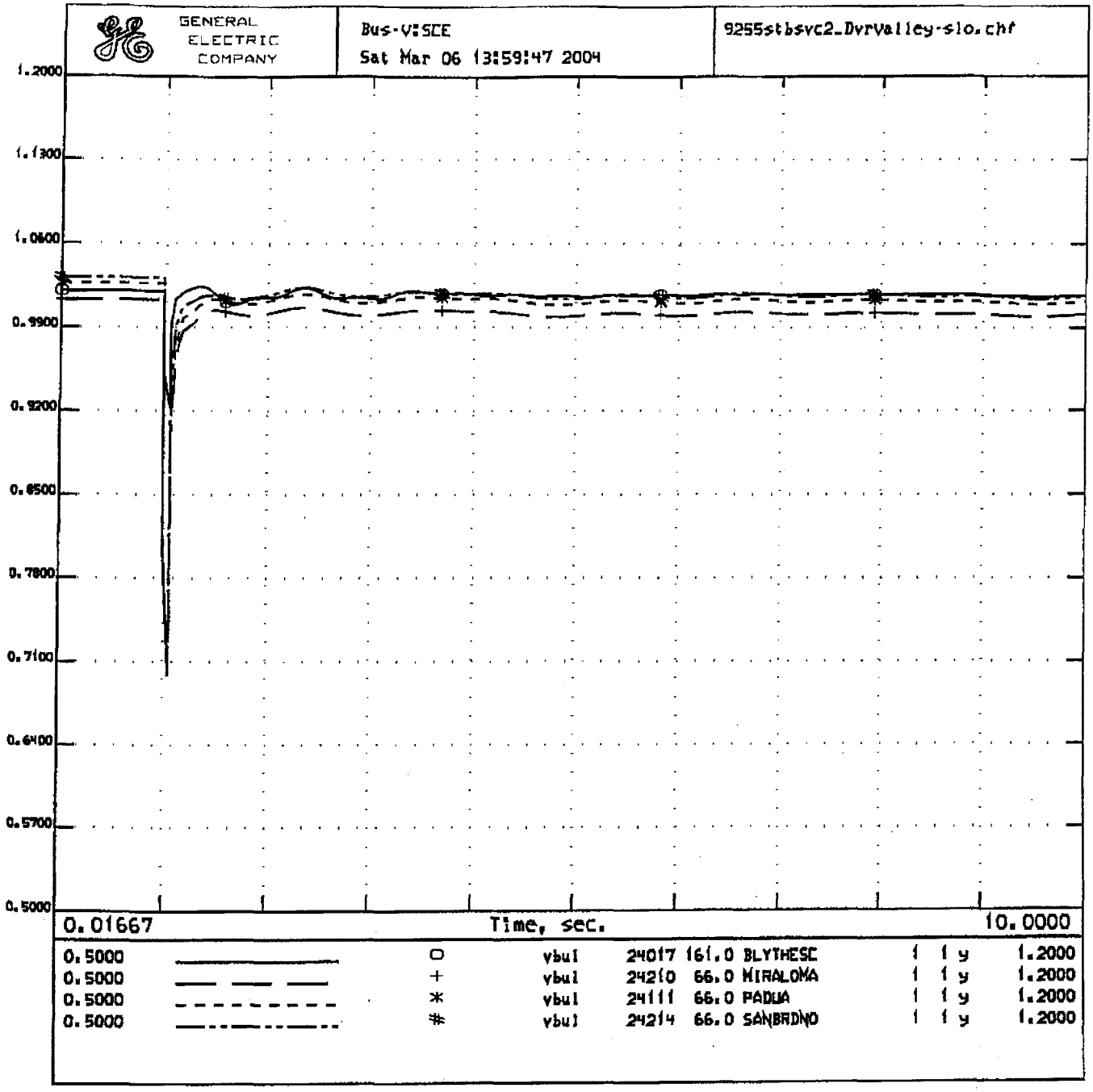

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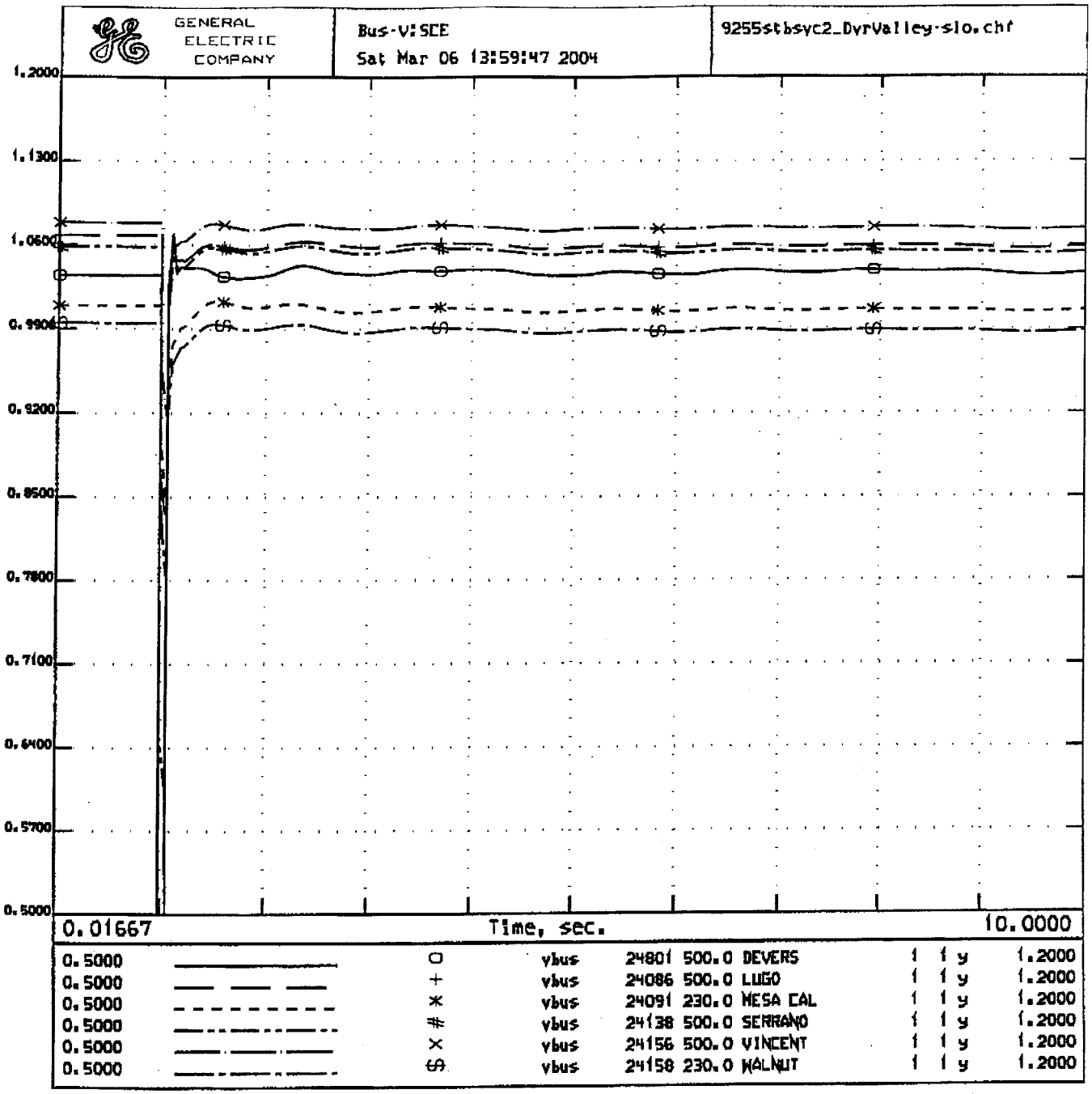

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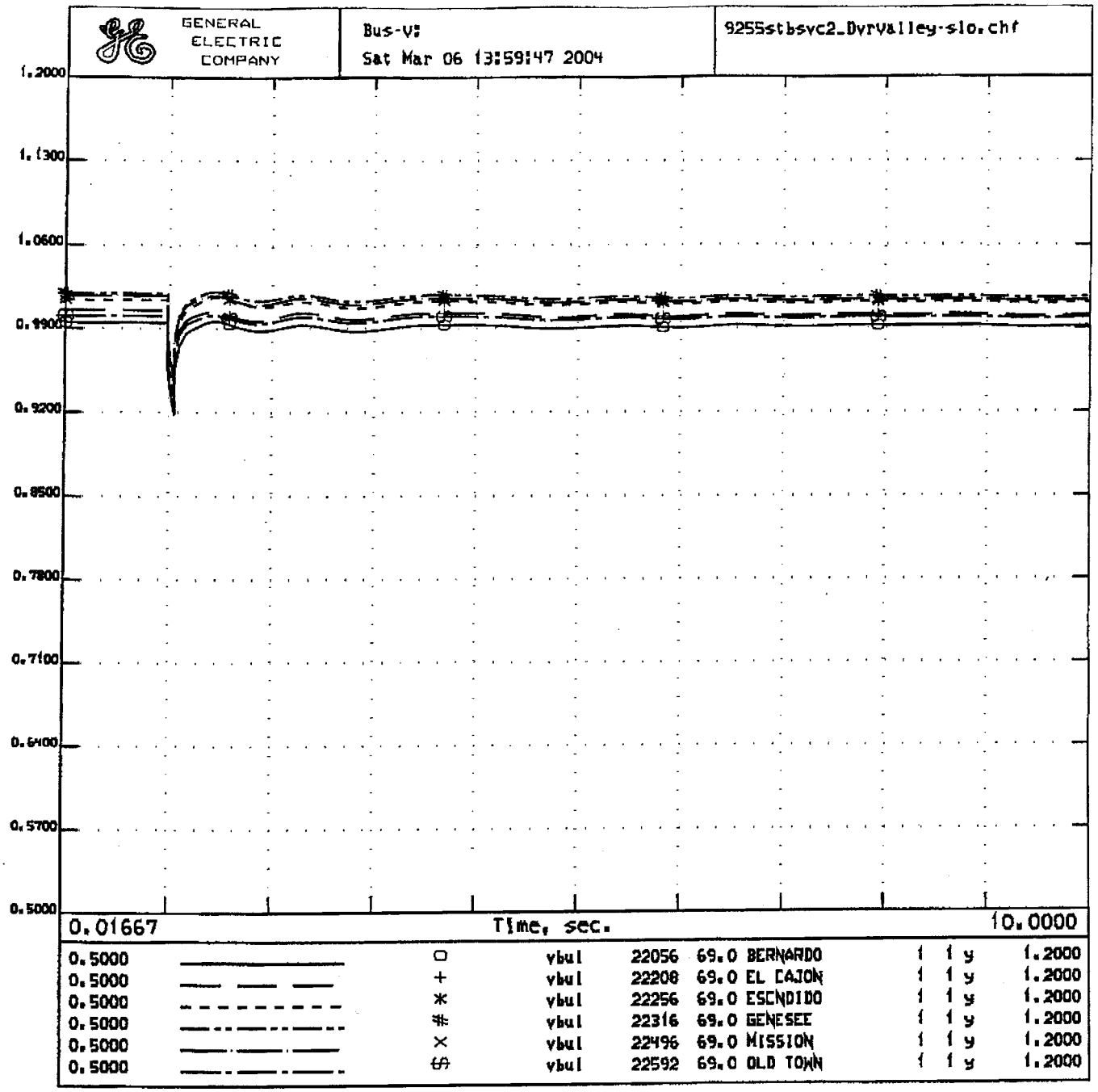

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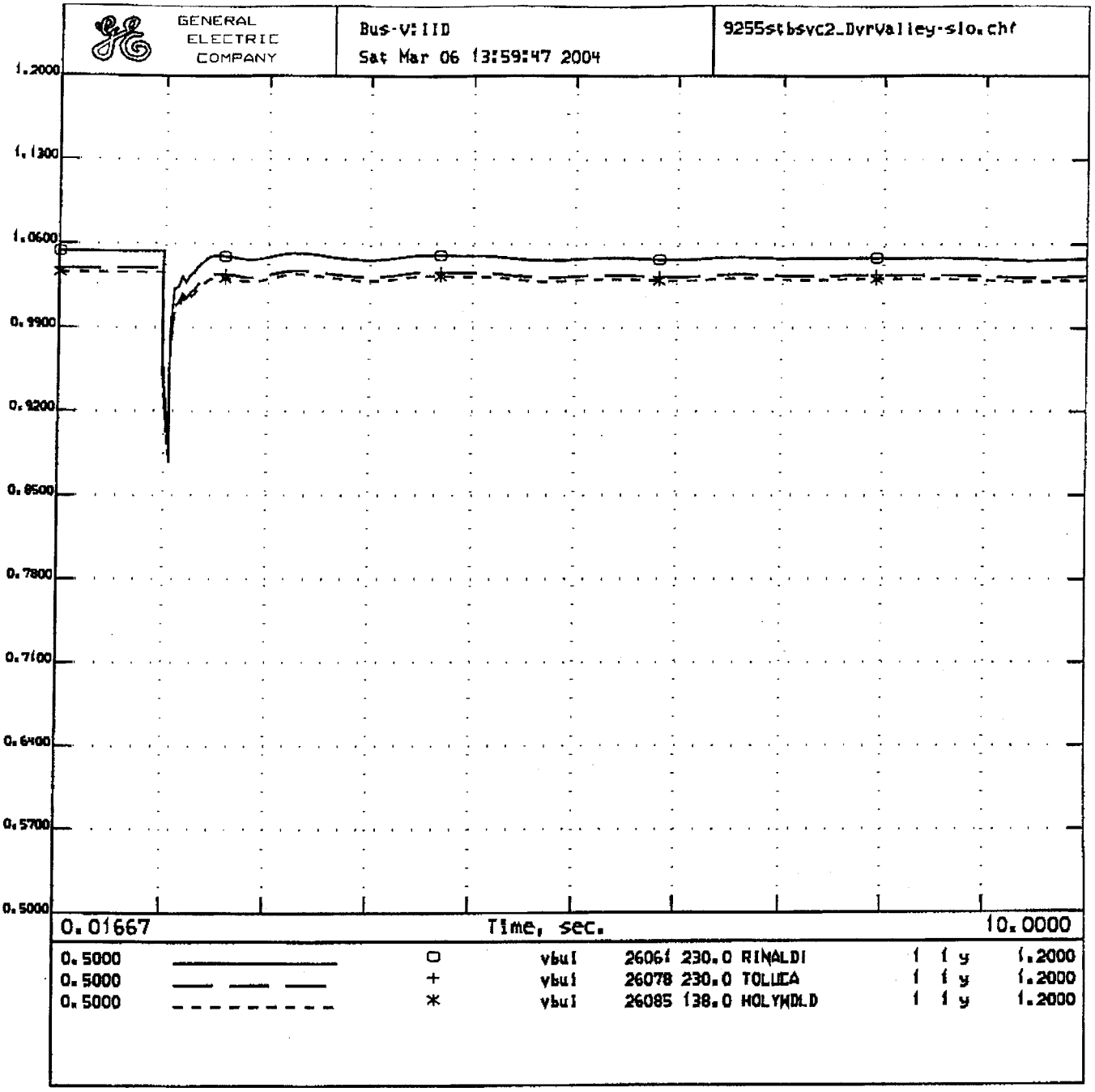

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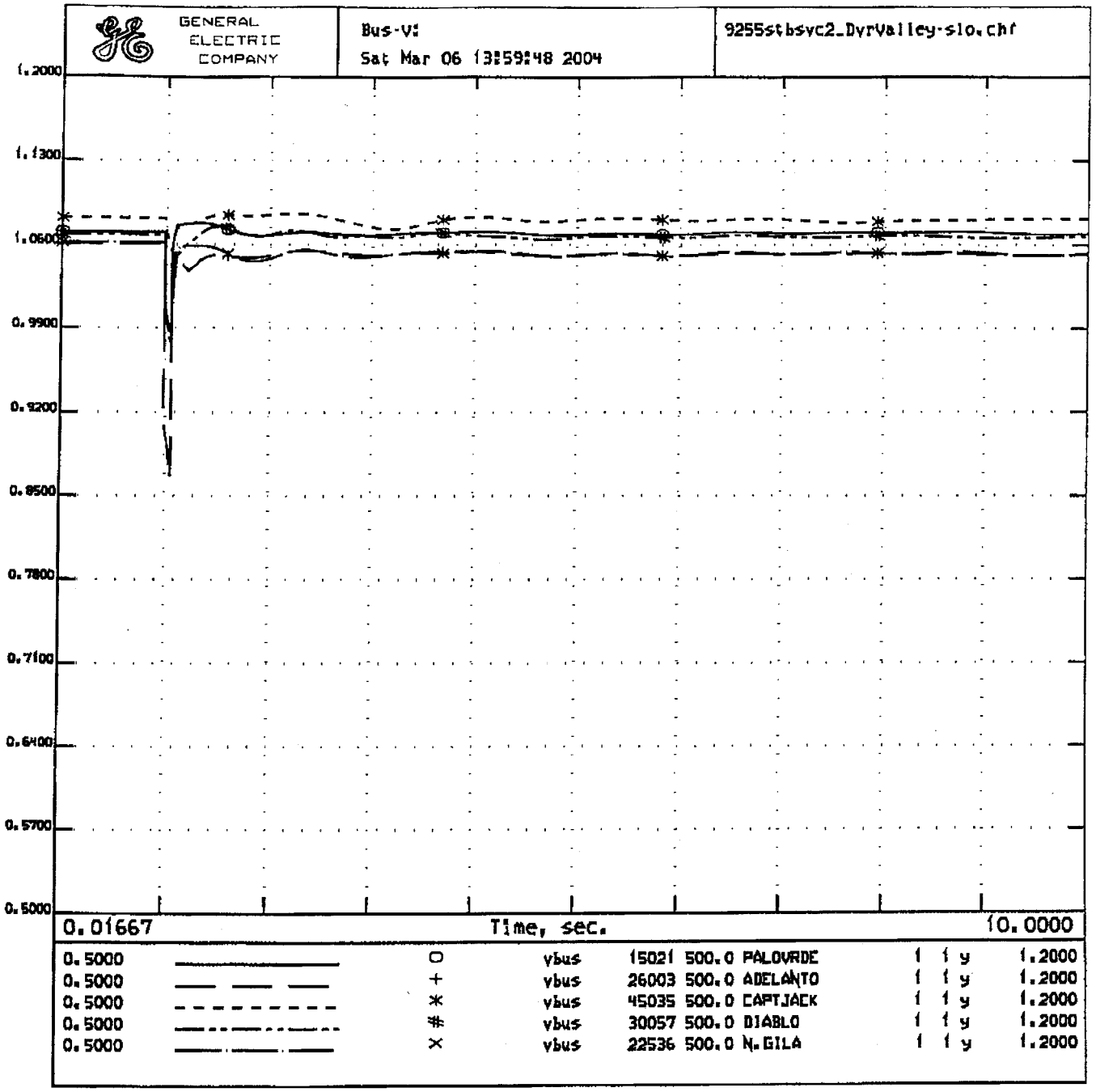

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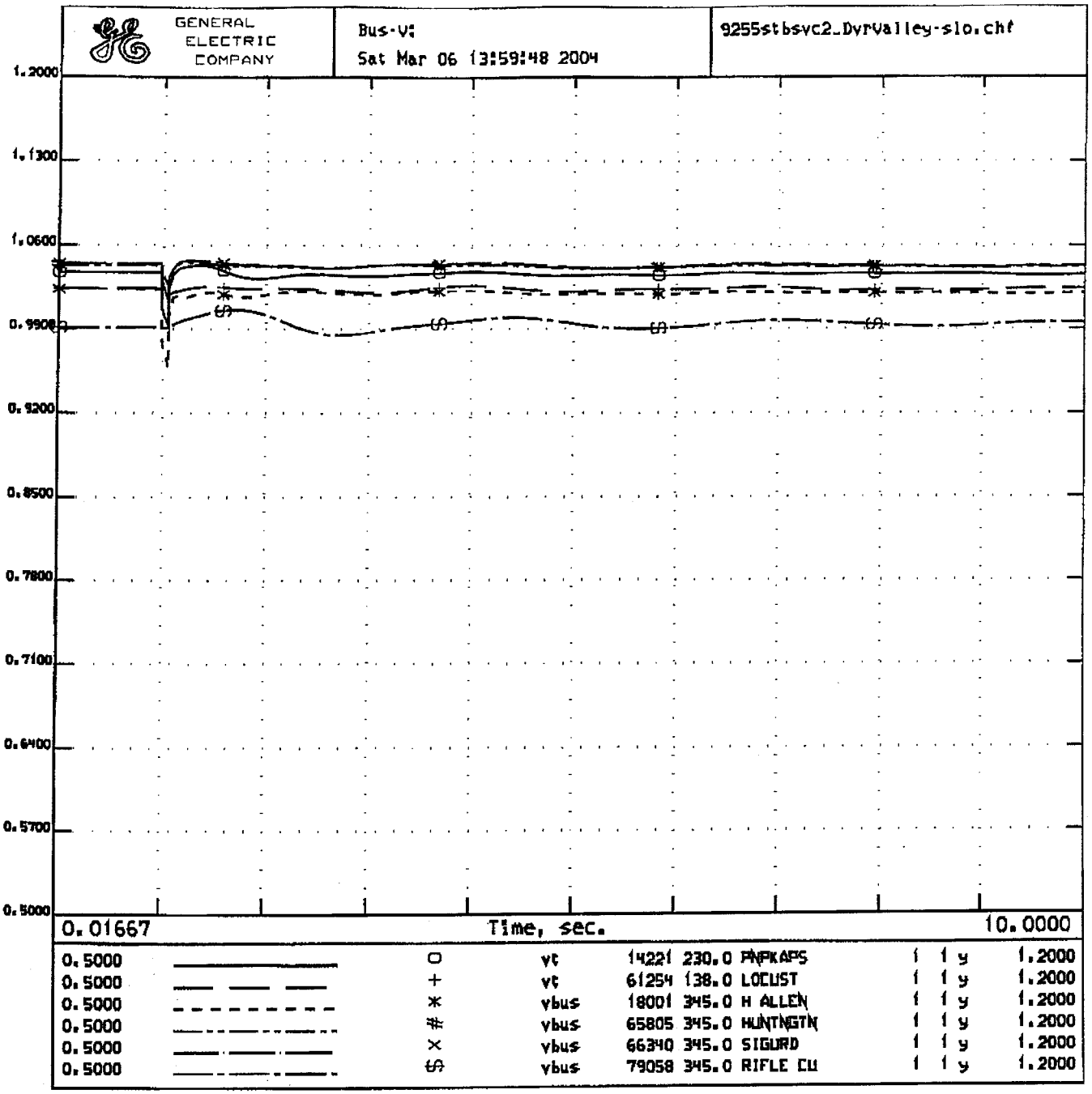

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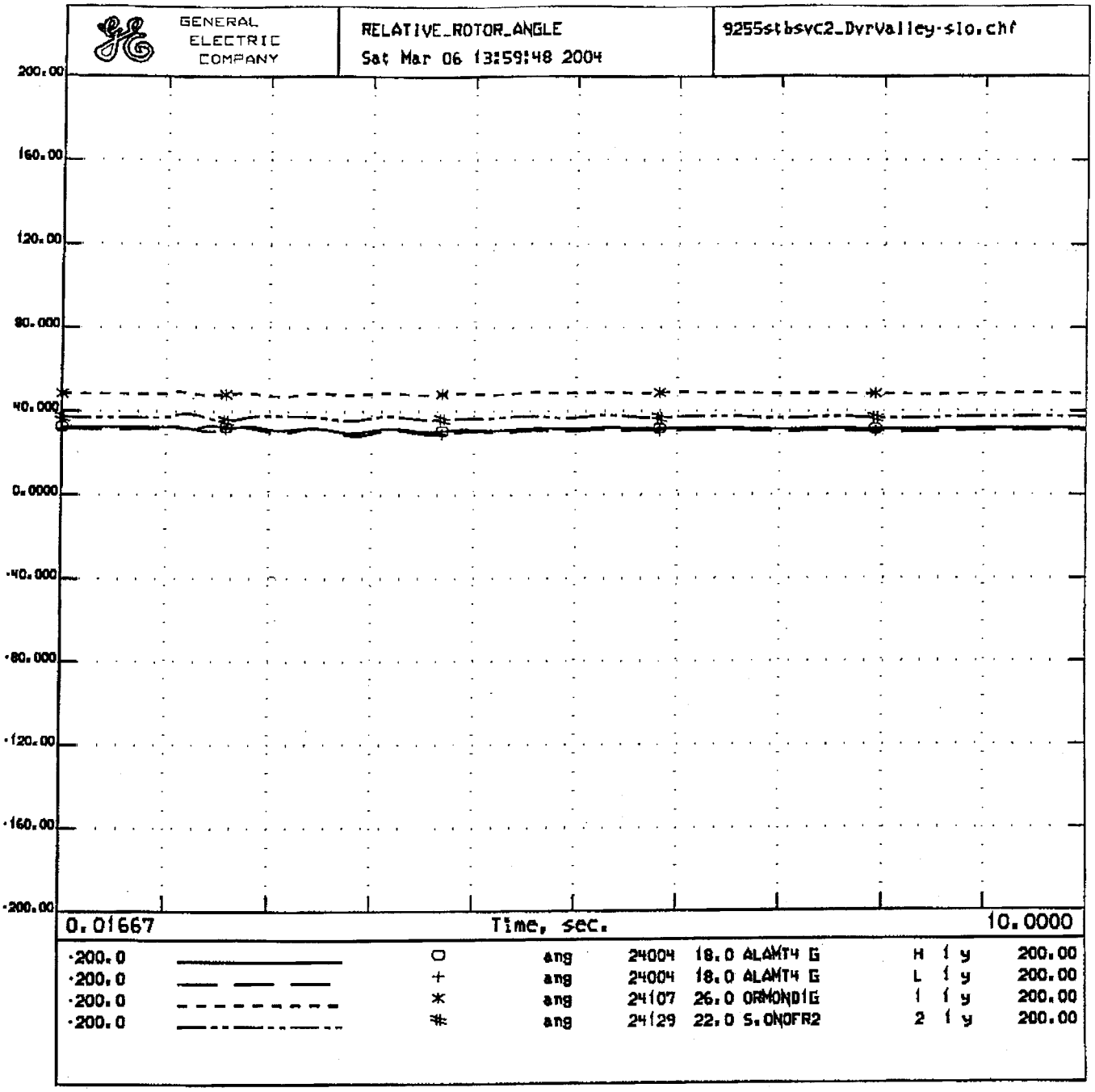

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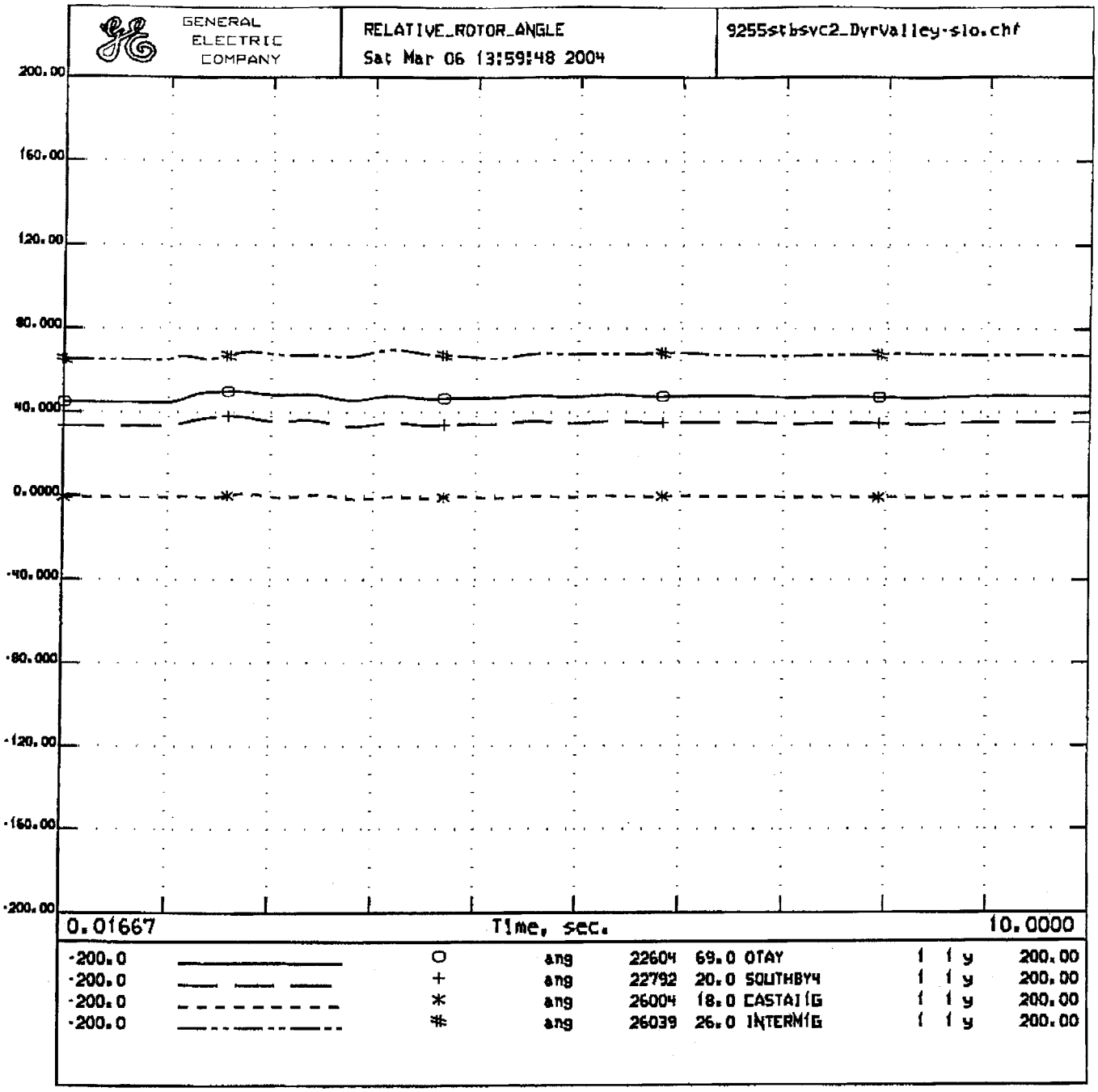

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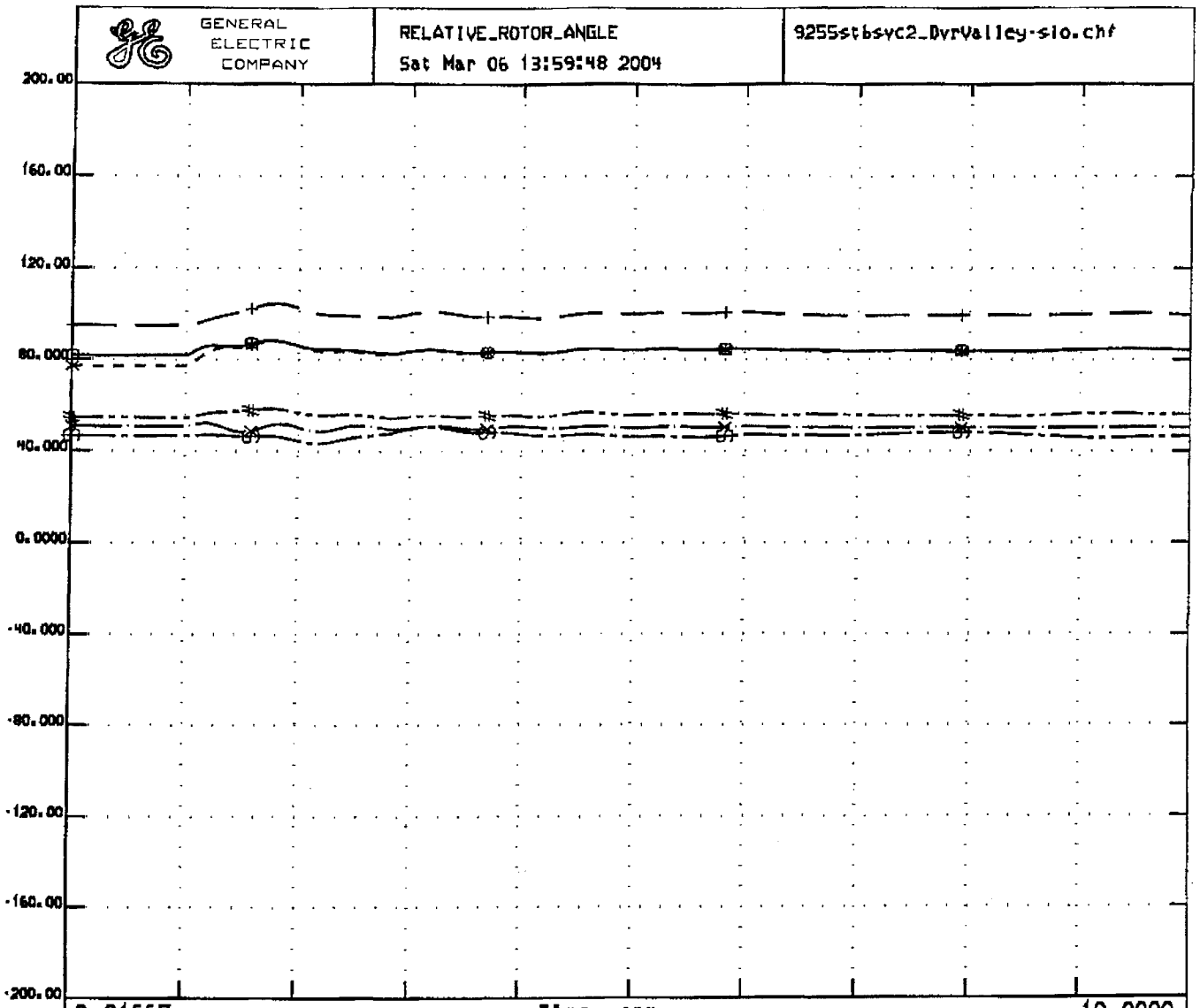

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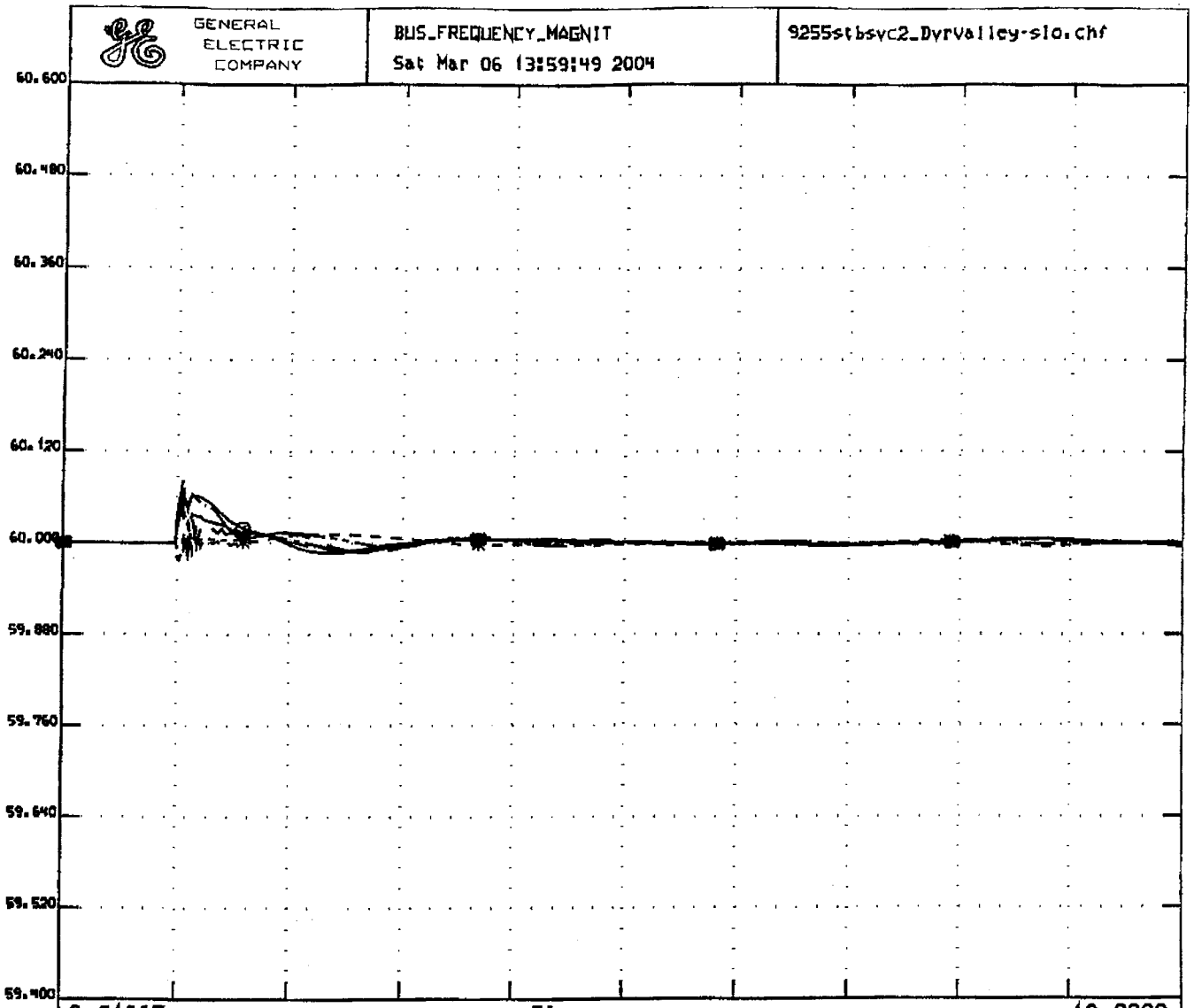

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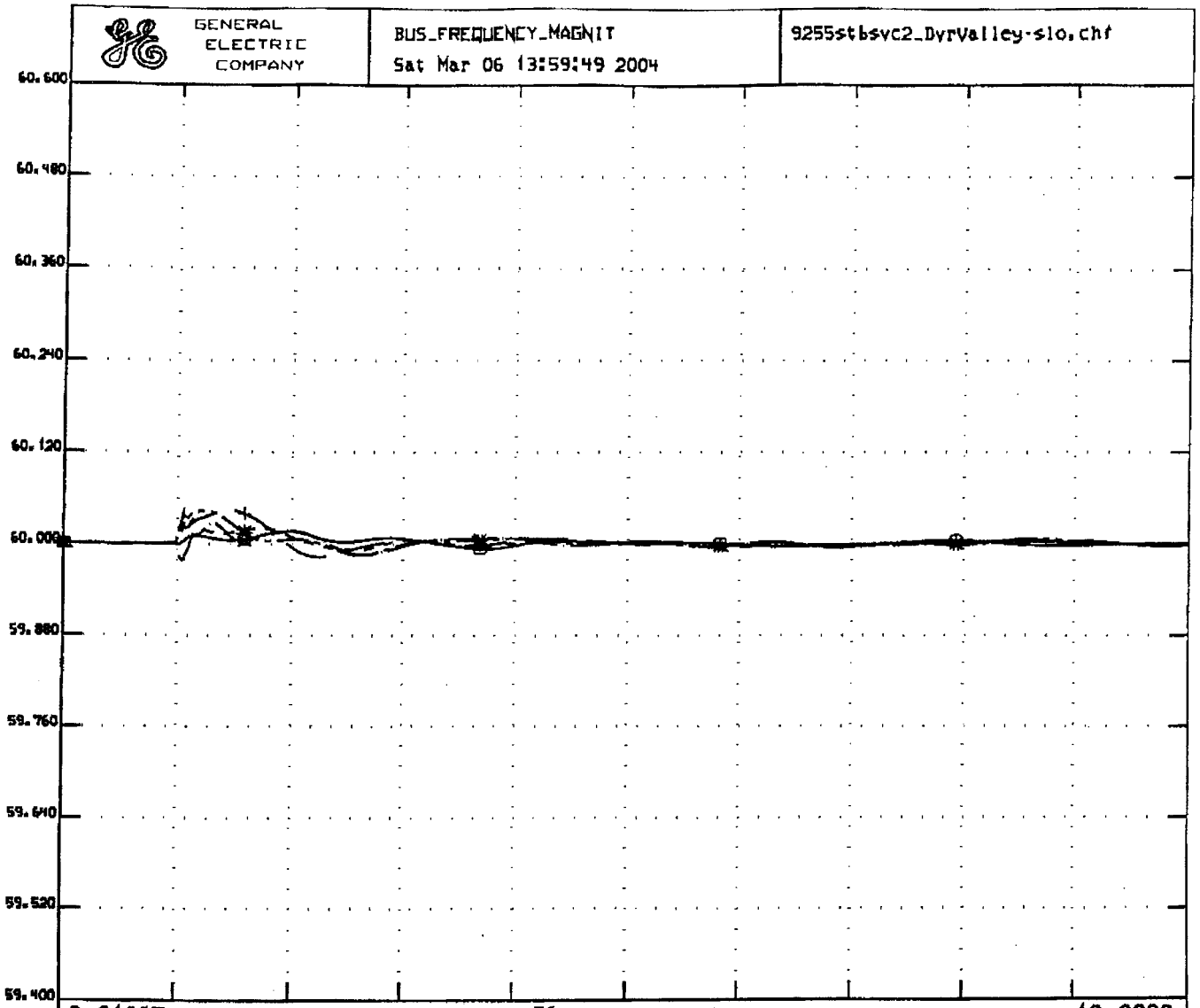
59.400	- - - - - - - - -	*	fbus	40585	500.0	JOHN DAY	1	1 y	60.600
59.400	—-·—-·—-·	#	fbus	30040	500.0	TESLA	1	1 y	60.600
59.400	—·—·—	×	fbus	24801	500.0	DEVERS	1	1 y	60.600
59.400	—·—·—·	⊗	fbus	19037	345.0	MEAD	1	1 y	60.600

Case =9255stbsvc2_DvrValley-slo
Loadflow=c:\pslf\cases\dpv2\9255stbsvc2.sav
Dyd file=c:\pslf\cases\dpv2\9255svc7pct.dyd
Swt file=c:\pslf\cases\dpv2\DvrValley-slo.swt
Terminal output log is CASE.trm

ADDED MOUNTAINVIEW GENERATION PROJECT (SCE)
STRESSED EOR BY DECREASING LOADLEVEL ACCORDING TO OSS MANUAL
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



Case =9255stbsvc2_DyrValley-slo
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Swt file=c:\pslf\cases\dpv2\DyrValley-slo.swt
Terminal output log is CASE.trm

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Gens fine tuned for dynamic runs
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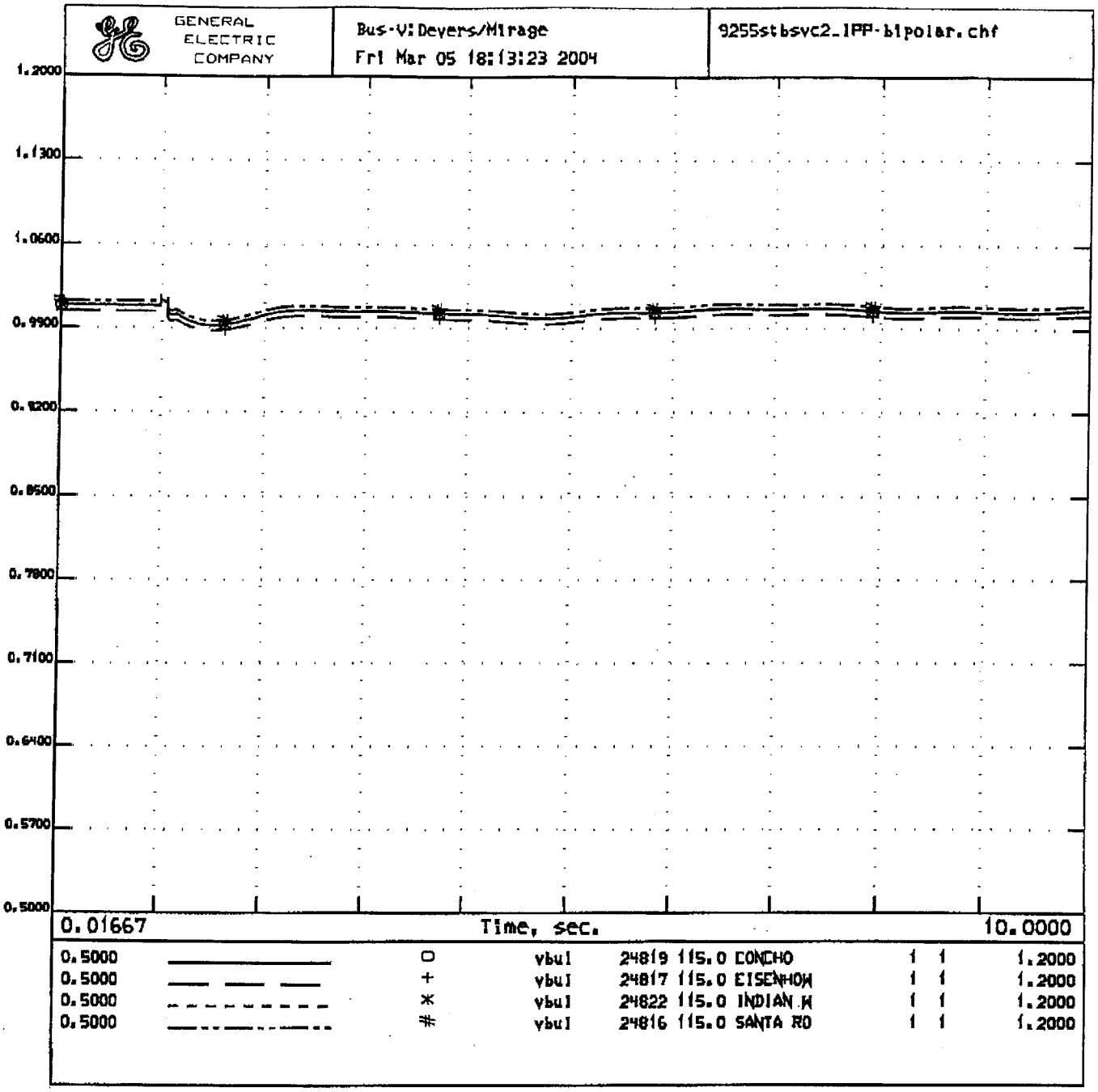
Transient Stability Study Plots - 8

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Bi-polar**
CONTINGENCY:	**N-2**
OUTAGE:	**Intermountain Power Project (IPP) DC Line**
EOR MARGIN:	**None**
NOTES:	



Case =9255stbsvc2_IPP-bipolar
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Terminal output log is CASE.trm

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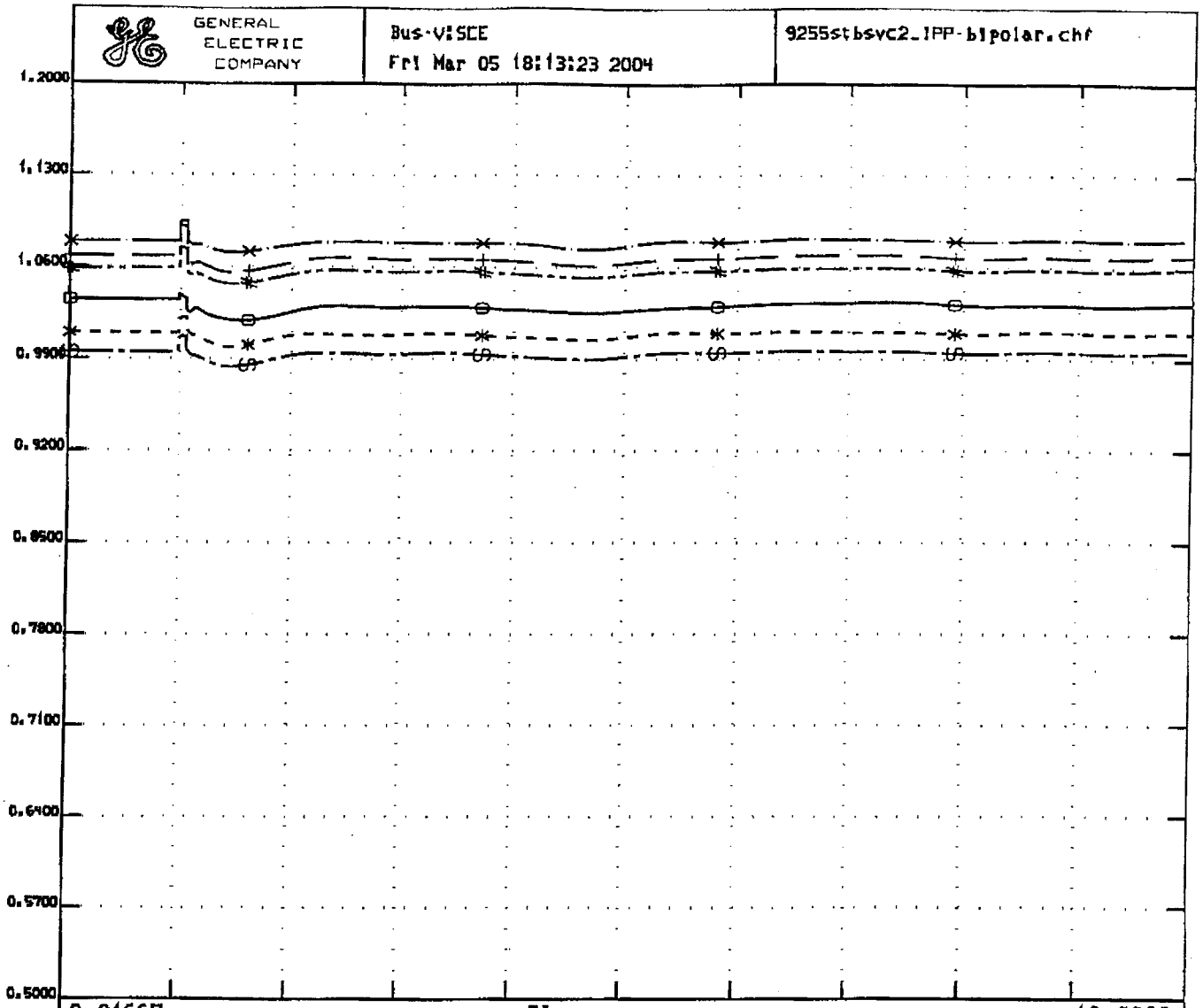

0.5000	———	○	vbus	24801	500.0	DEVERS	1	1 y	1.2000
0.5000	— — —	+	vbus	24086	500.0	LUGO	1	1 y	1.2000
0.5000	- - - - -	*	vbus	24091	230.0	MESA CAL	1	1 y	1.2000
0.5000	—-—-—	#	vbus	24138	500.0	SERRANO	1	1 y	1.2000
0.5000	—.—.—	×	vbus	24156	500.0	VINCENT	1	1 y	1.2000
0.5000	—..—..—	⊗	vbus	24158	230.0	WALNUT	1	1 y	1.2000

Case *9255stbsvc2_IPP-bipolar
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Dyd file=c:\pslf\cases\dpv2\9255svc7pct.dyd
Swt file=c:\pslf\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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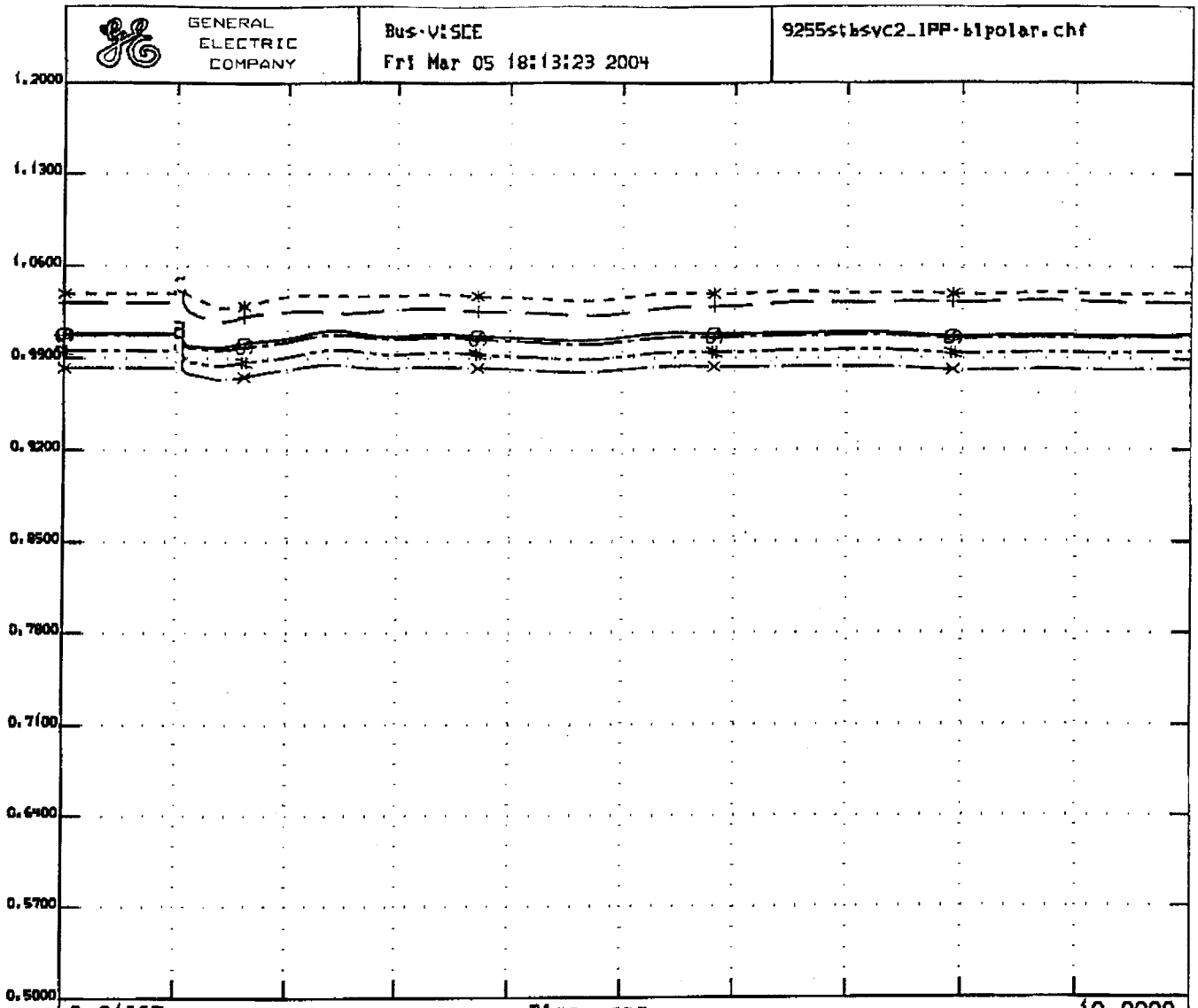

0.5000	———	○	vbul	24702	115.0	KRAMER	1	1 y	1.2000
0.5000	— — —	+	vbul	24098	66.0	MOORPARK	1	1 y	1.2000
0.5000	- - - - -	*	vbul	24213	66.0	RIOHONDO	1	1 y	1.2000
0.5000	—··—··—	#	vbul	24608	115.0	SAVAGE	1	1 y	1.2000
0.5000	—·—·—	×	vbul	24770	115.0	SOUTHBAS	1	1 y	1.2000
0.5000	—·—·—	⊕	vbul	24602	115.0	VICTOR	1	1 y	1.2000

Case =9255stbsvc2_IPP-bipolar
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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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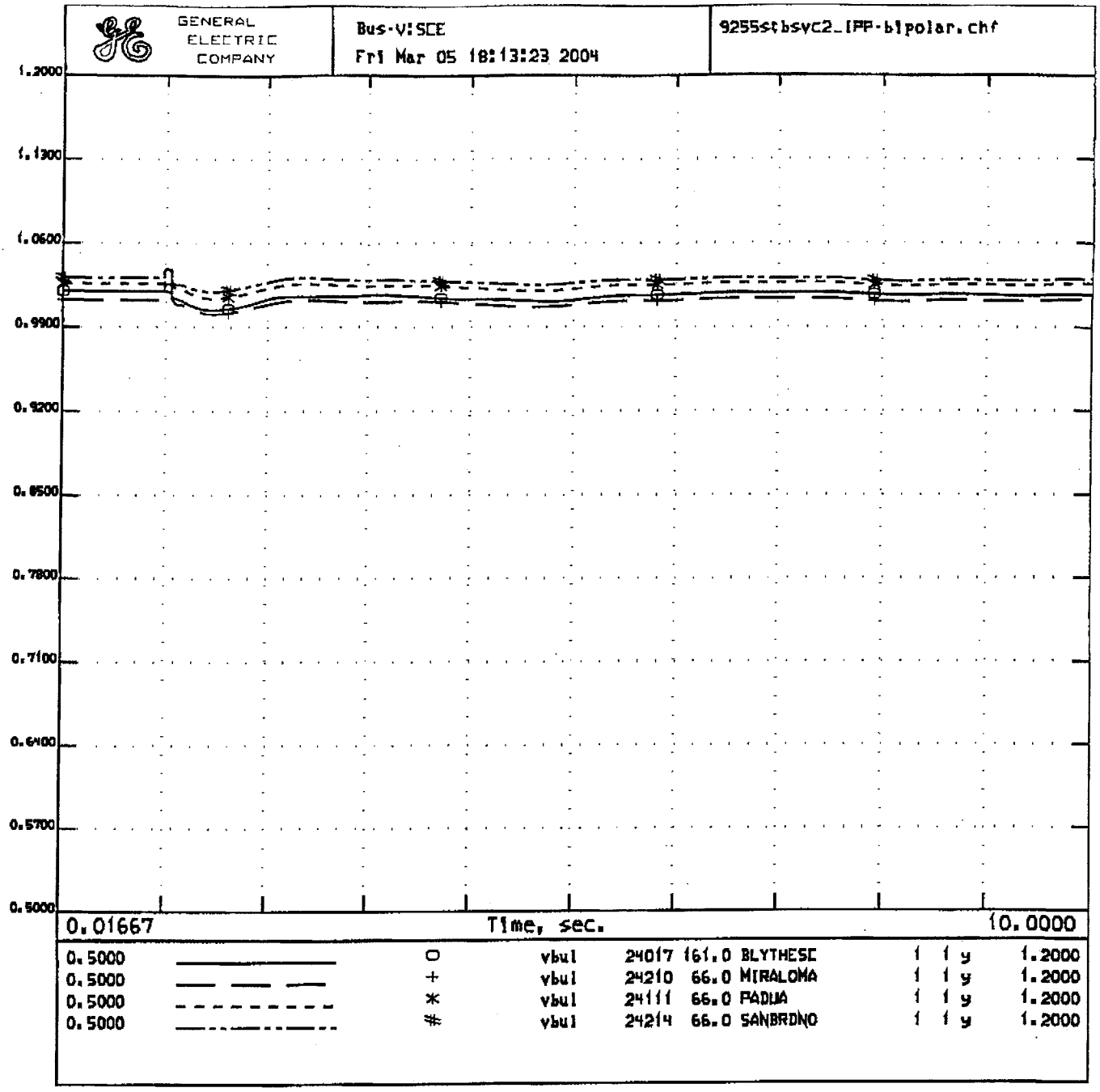

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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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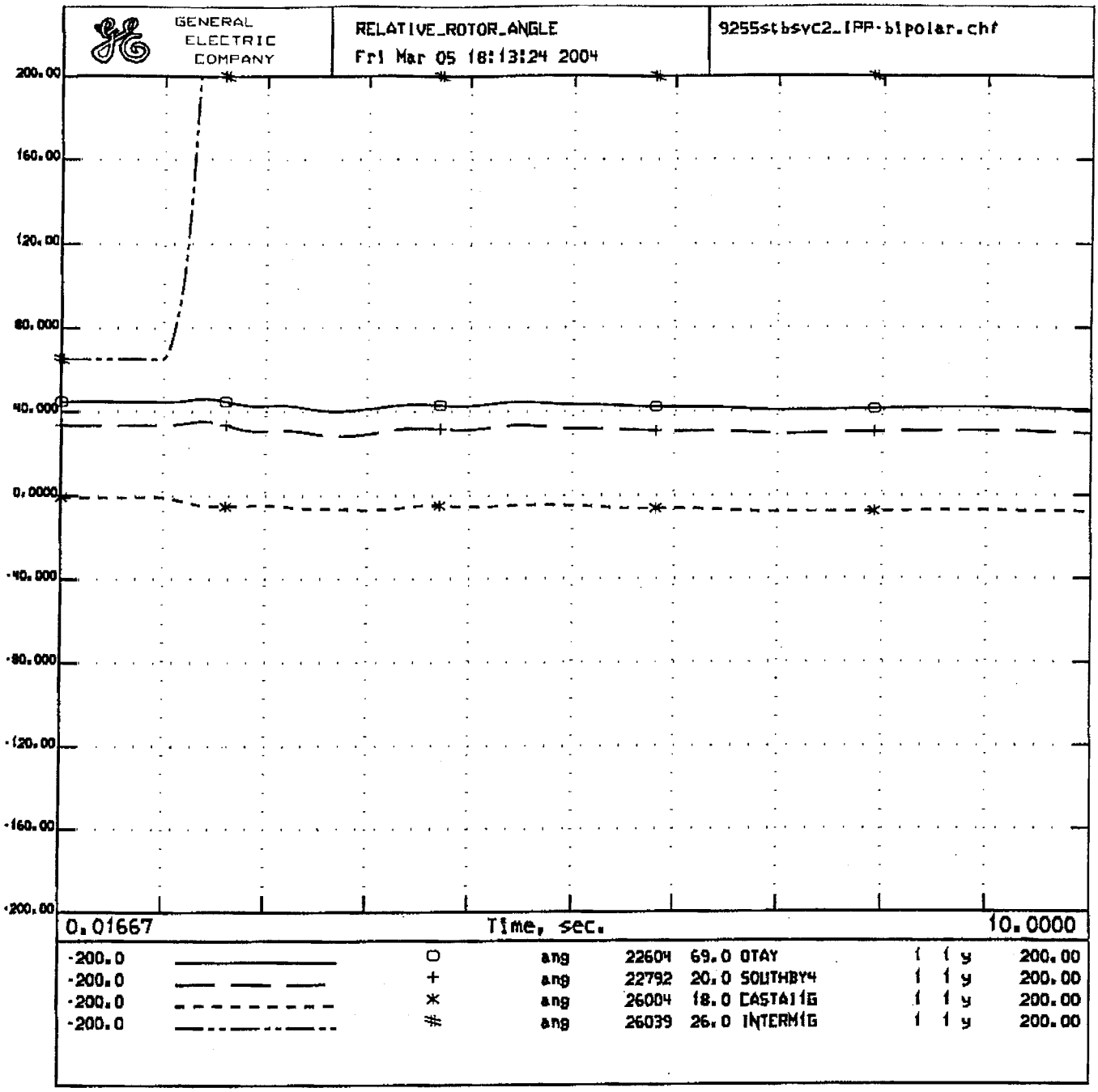

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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
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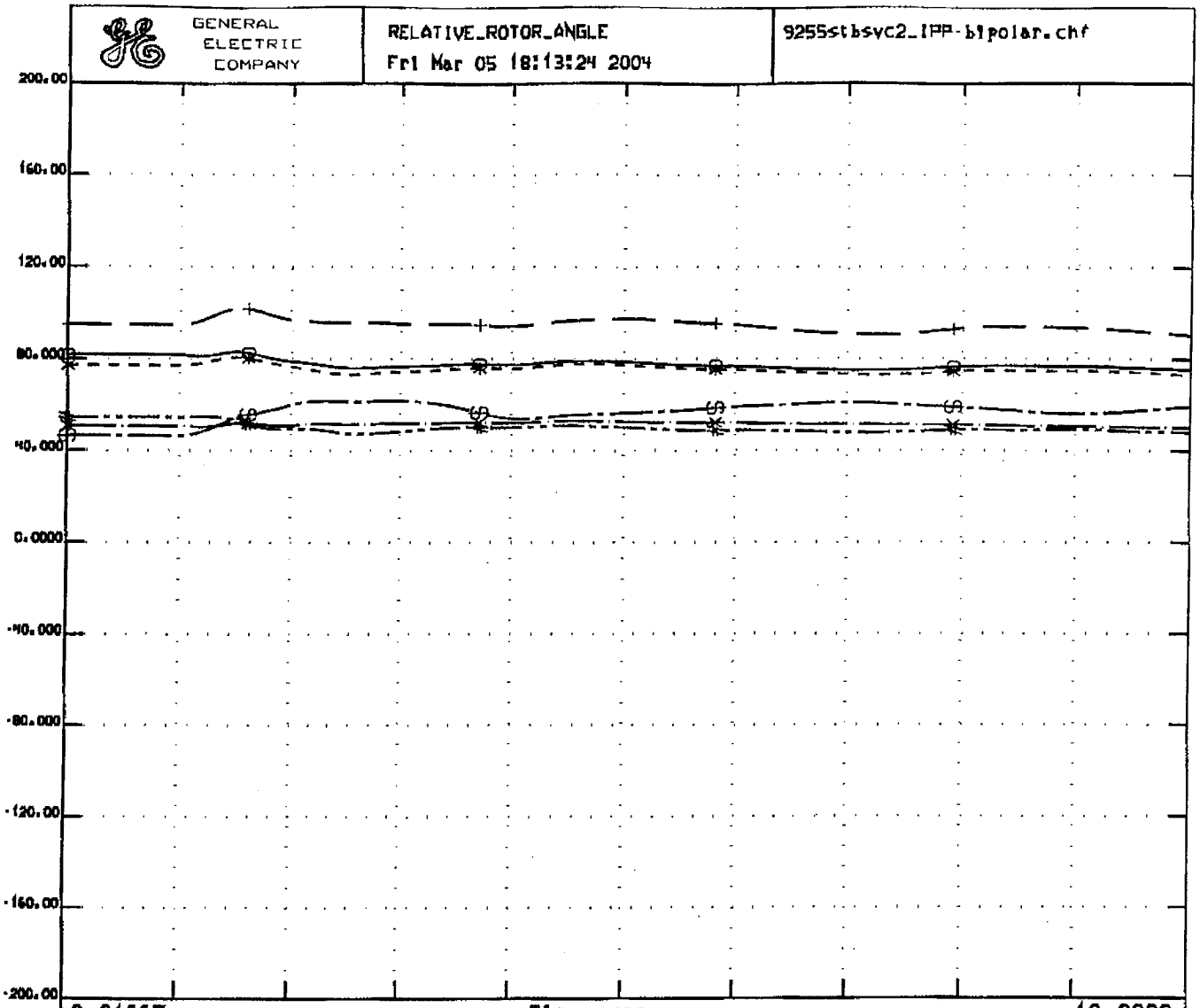

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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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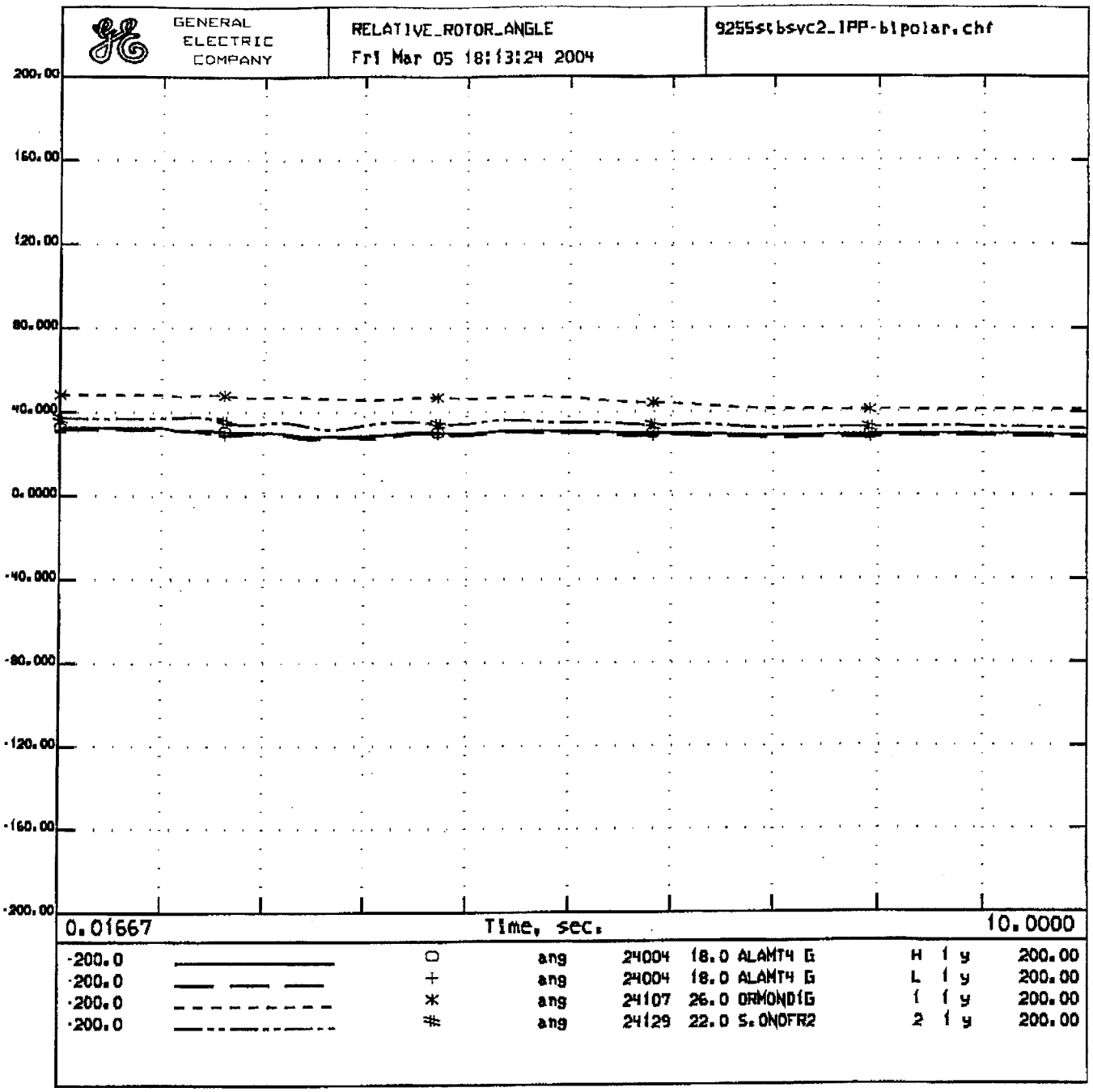

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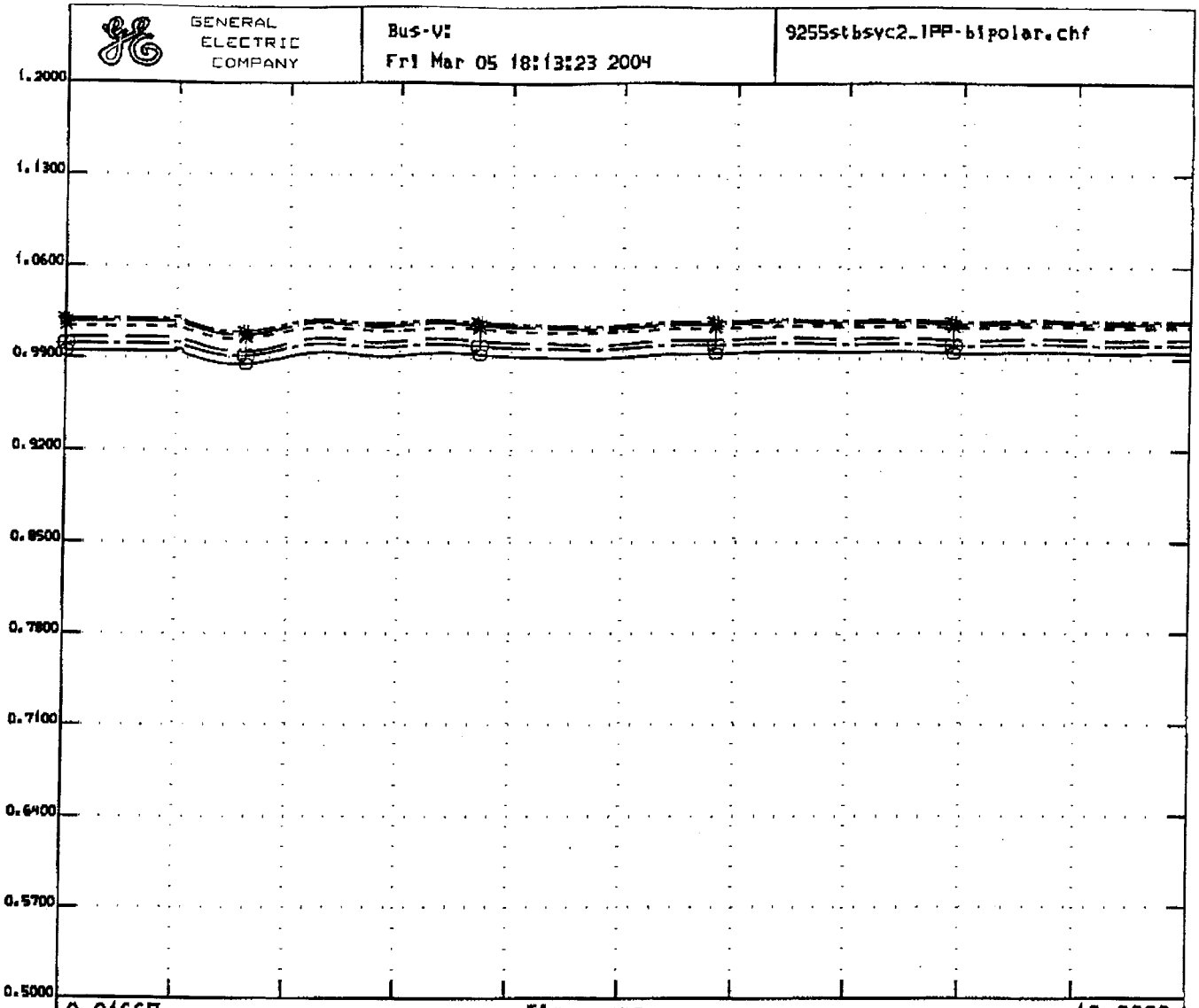

0.5000	———	○	vbul	22056	69.0	BERNARDO	1	1	y	1.2000
0.5000	— — —	+	vbul	22208	69.0	EL CAJON	1	1	y	1.2000
0.5000	- - - - - - - - -	*	vbul	22256	69.0	ESCNDIDO	1	1	y	1.2000
0.5000	—-—-—-—	#	vbul	22316	69.0	GENESEE	1	1	y	1.2000
0.5000	—.—.—	×	vbul	22496	69.0	MISSION	1	1	y	1.2000
0.5000	—-—-—	⊕	vbul	22592	69.0	OLD TOWN	1	1	y	1.2000

Case =9255stbsvc2_IPP-bipolar
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Swt file=c:\pslf\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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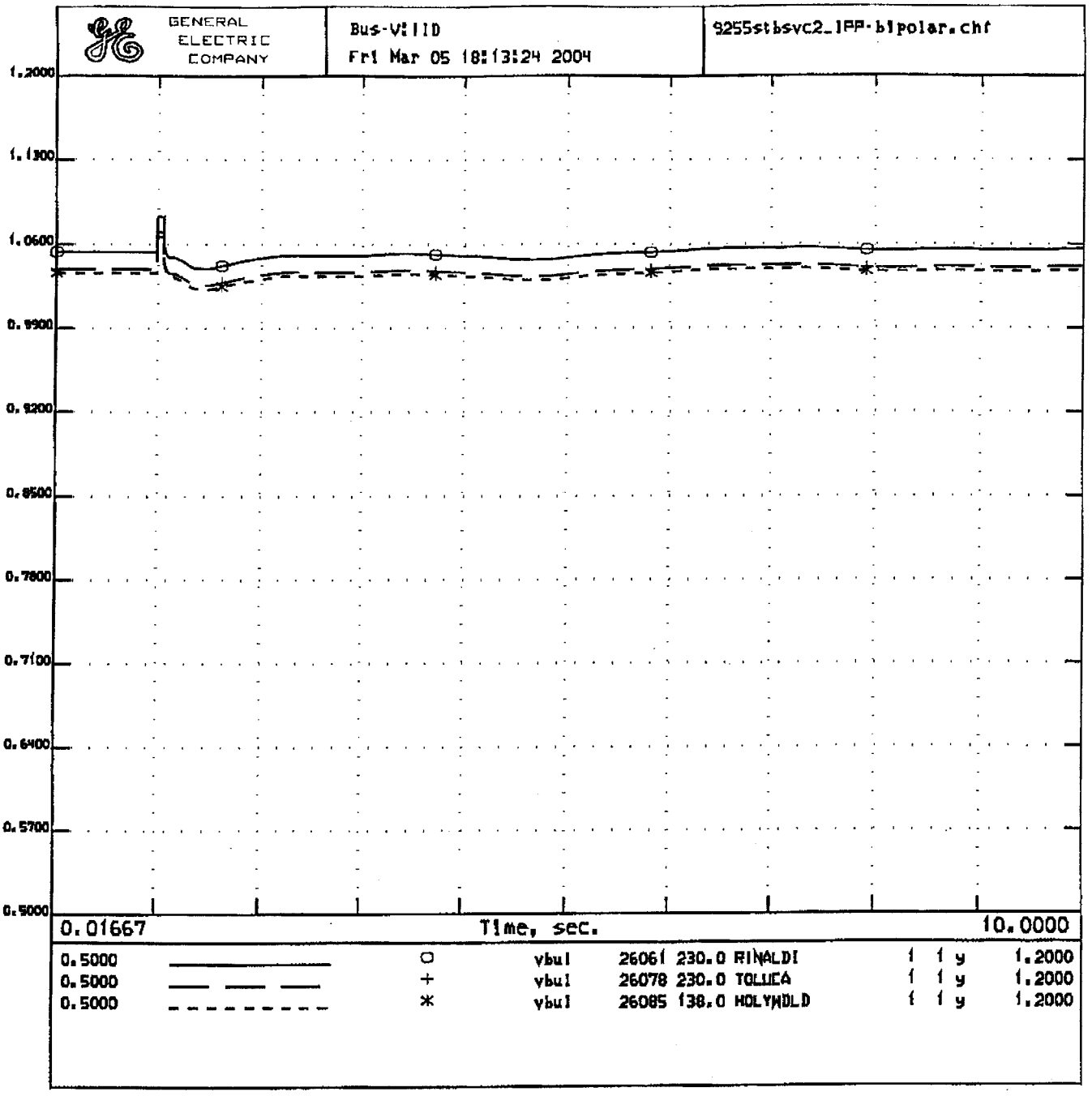

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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
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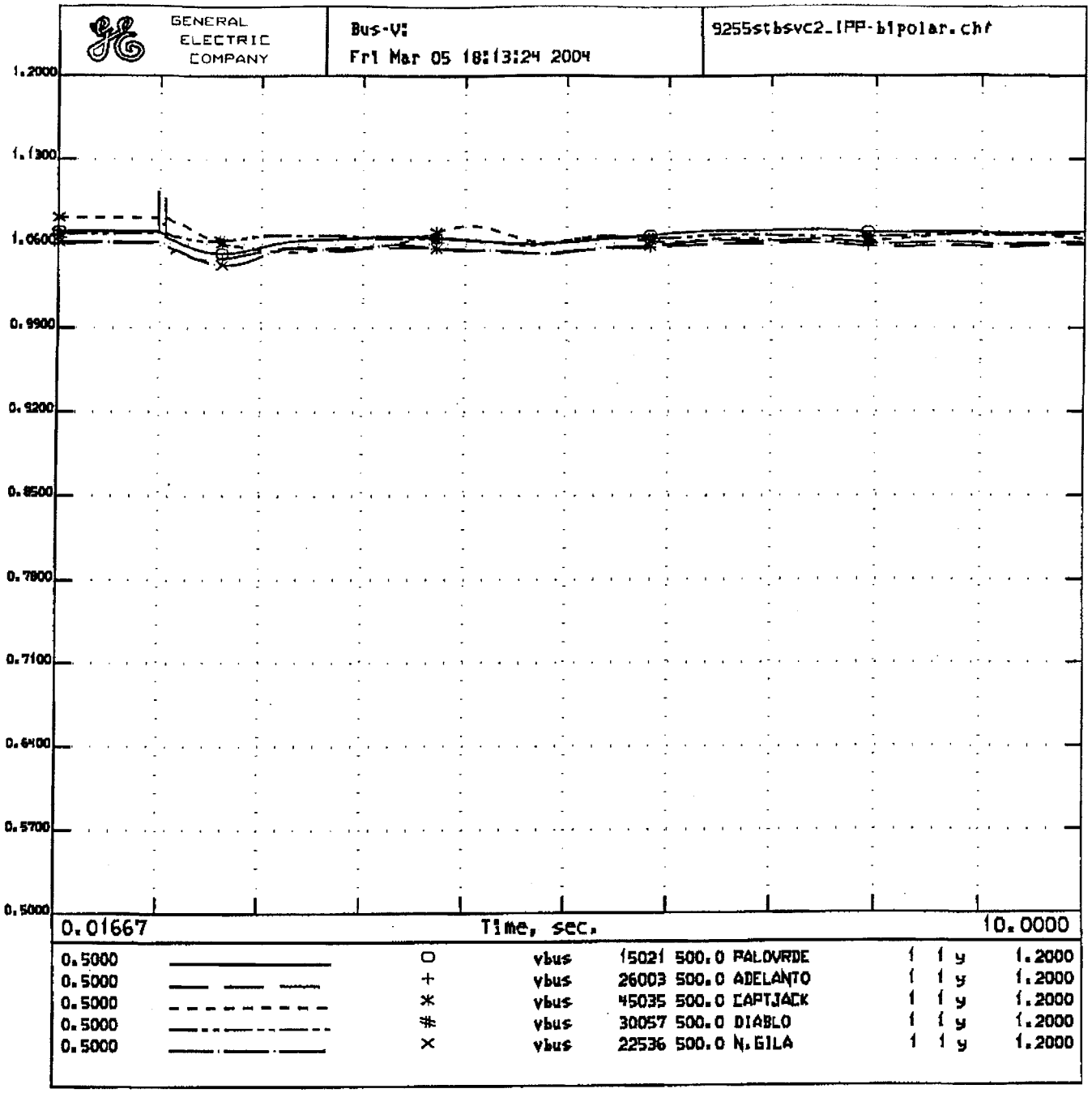

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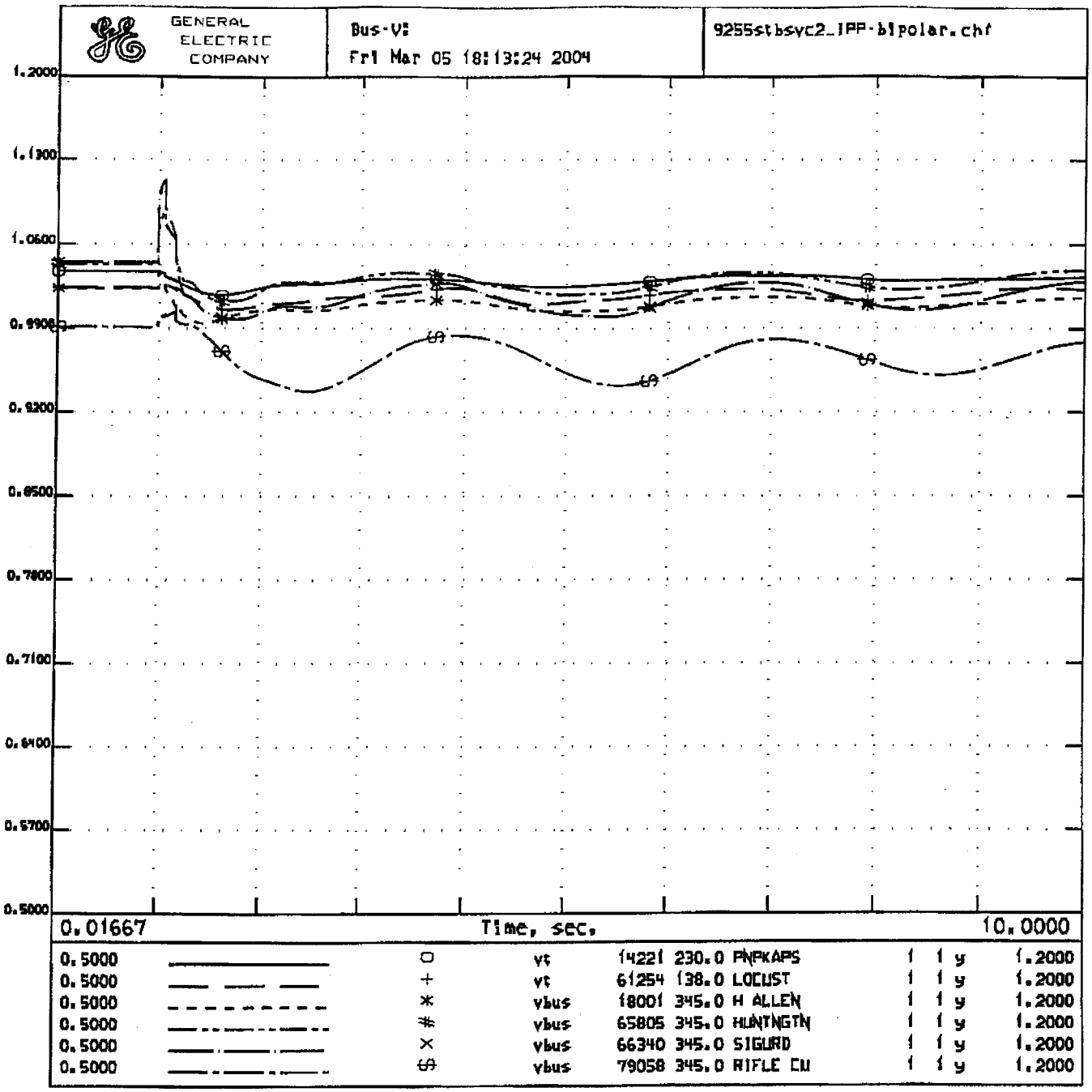

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Terminal output log is CASE.trm

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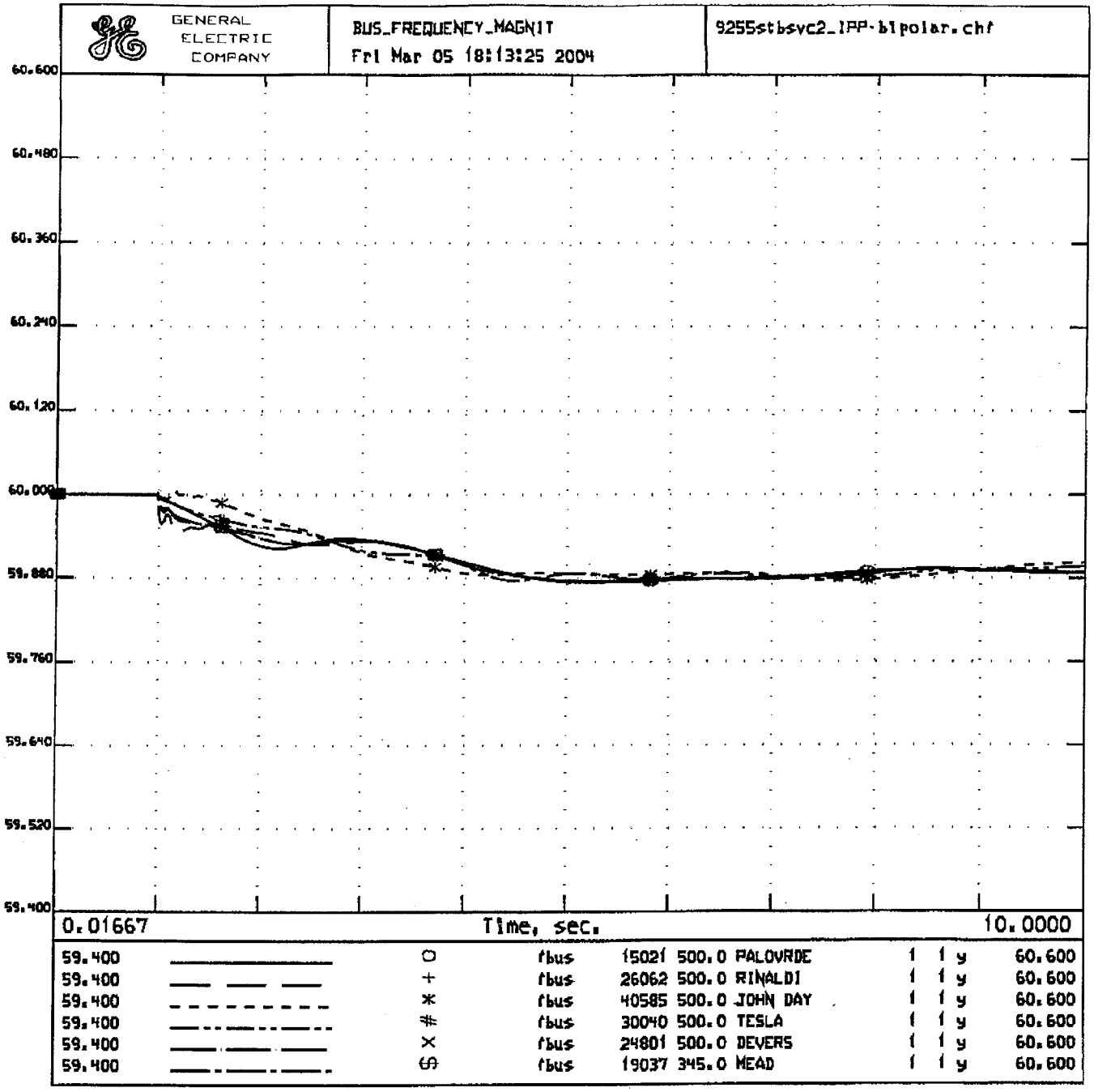

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Swt file=c:\psif\cases\dpv2\IPP-bipolar.swt
Terminal output log is CASE.trm

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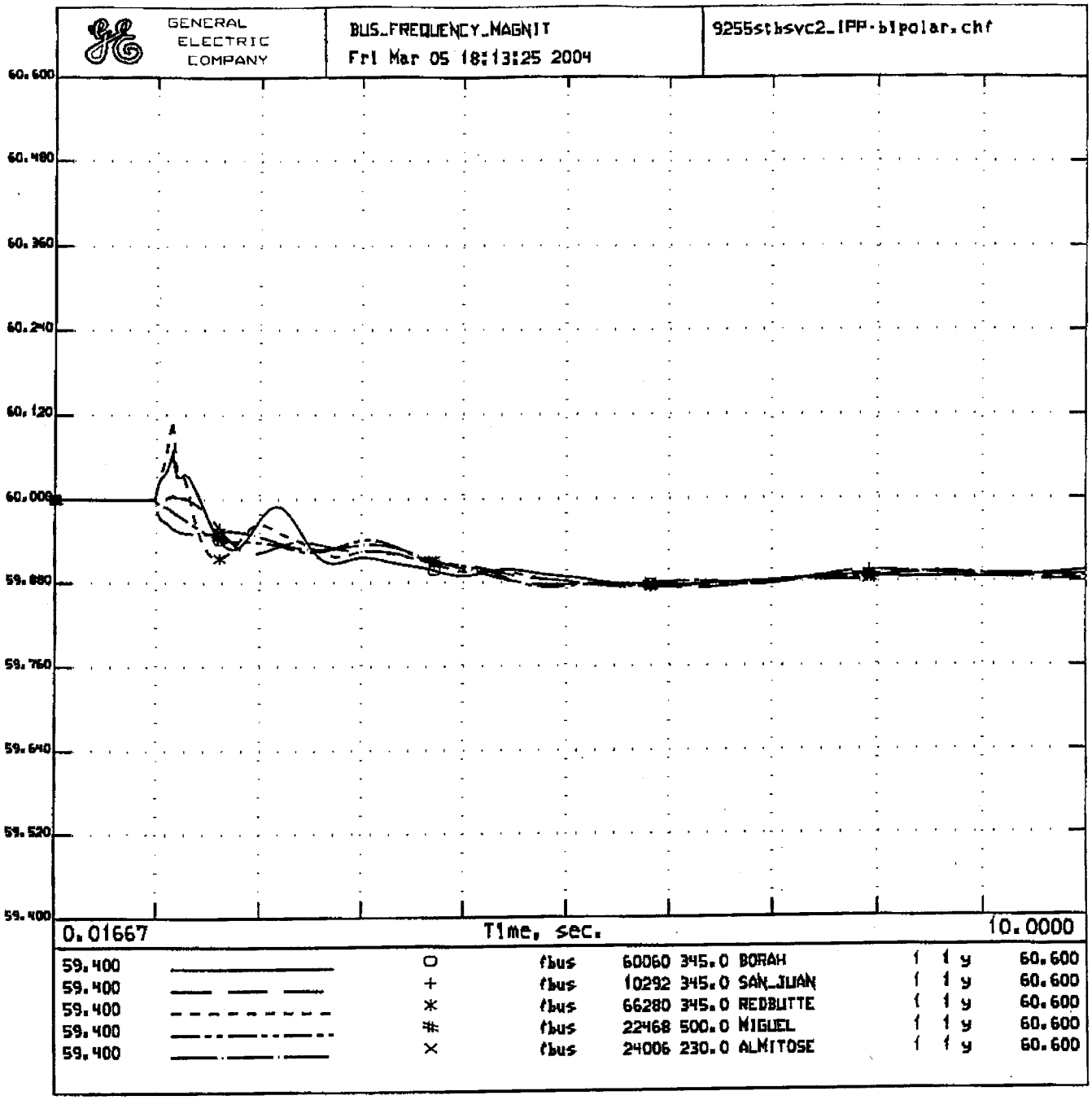

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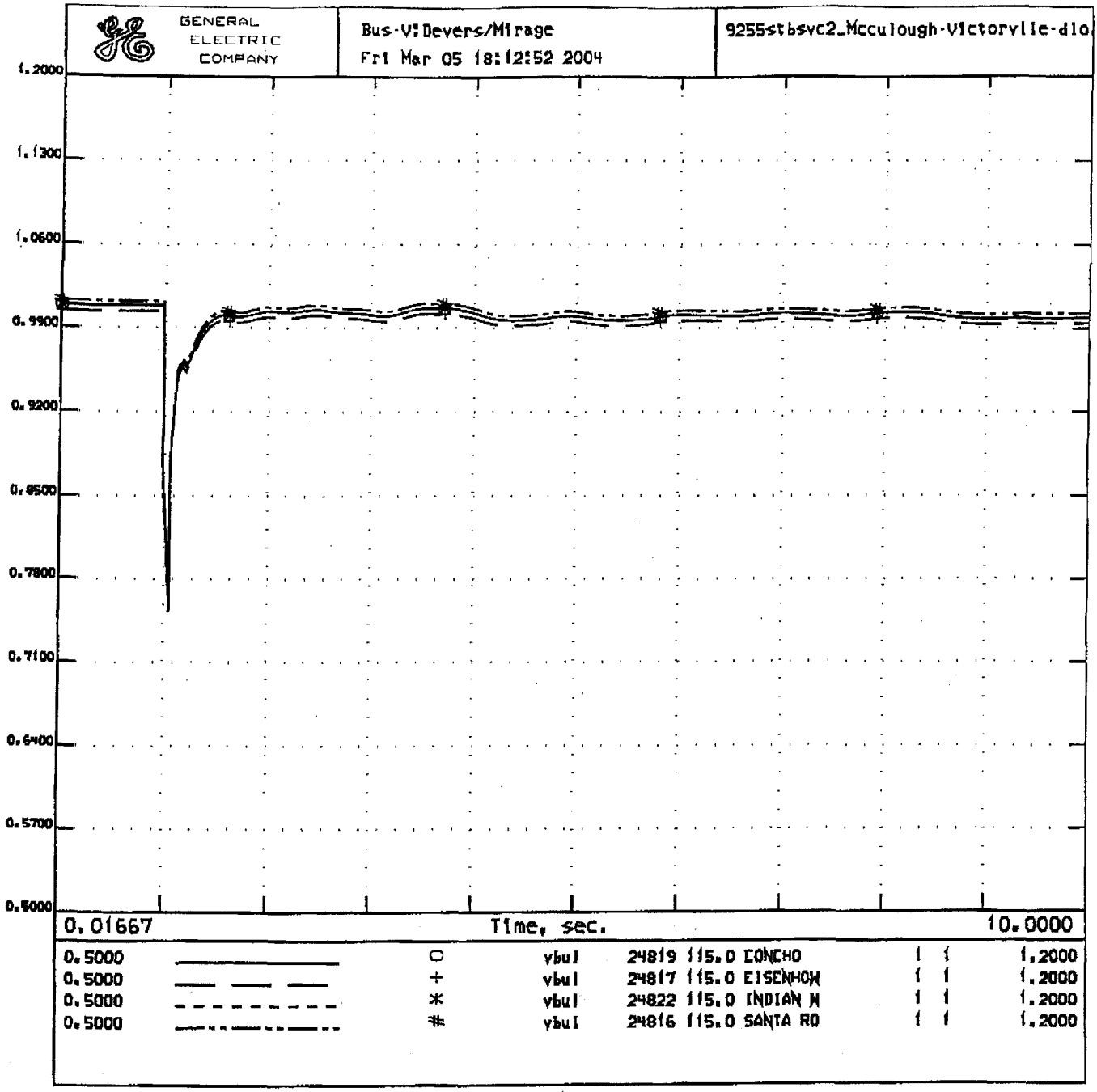
Transient Stability Study Plots - 9

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-2**
OUTAGE:	**McCullough-Victorville 500 kV No. 1 Line & McCullough-Victorville 500 kV No. 2 Line**
EOR MARGIN:	**None**
NOTES:	



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Terminal output log is CASE.trm

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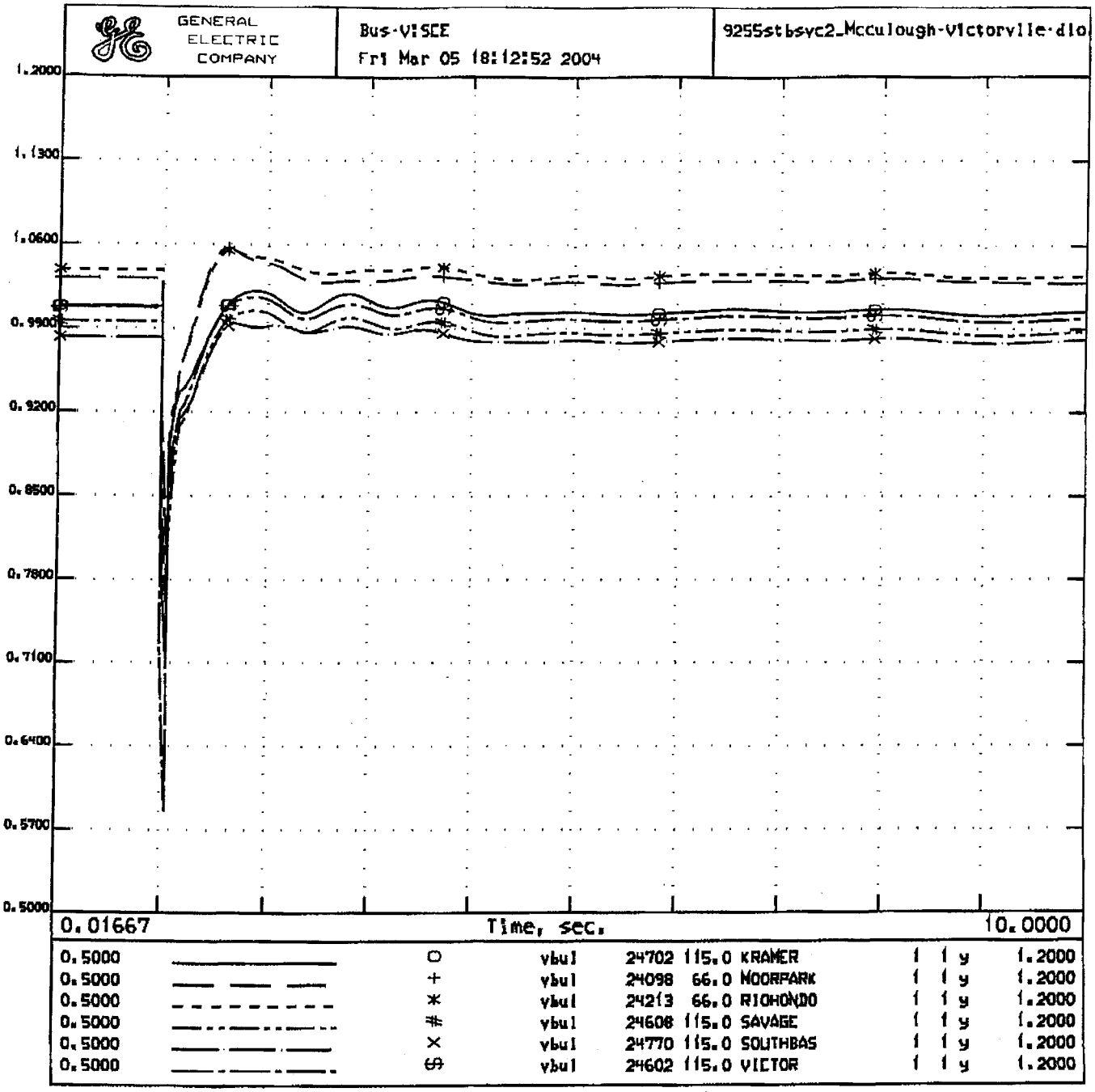

Case =9255stbsvc2_Mcculough-Victorvlle-dlo
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Terminal output log is CASE.trm

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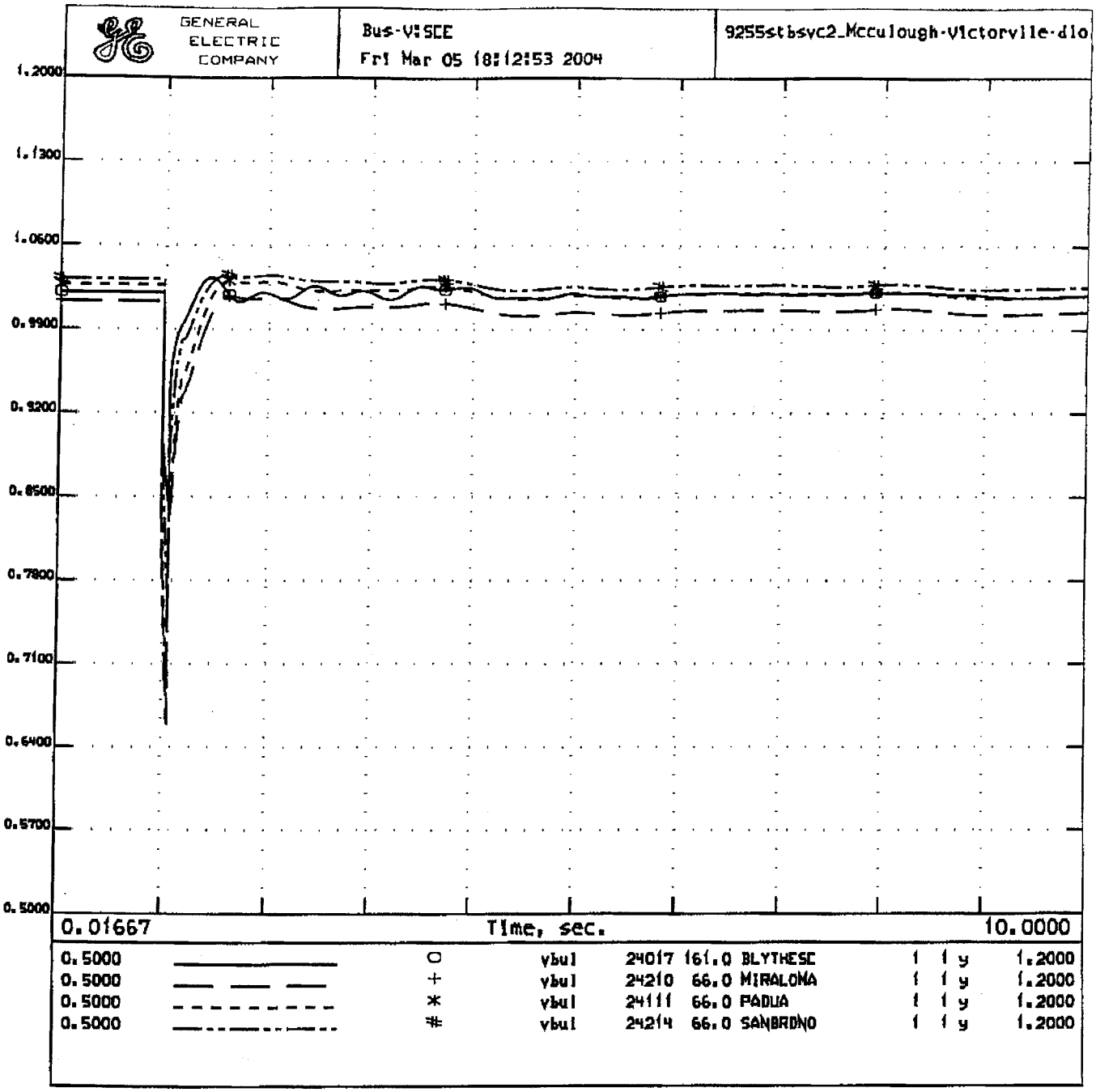

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Swt file=c:\pslf\cases\dpv2\Mcculough-Victorville-dlo.swt
Terminal output log is CASE.trm

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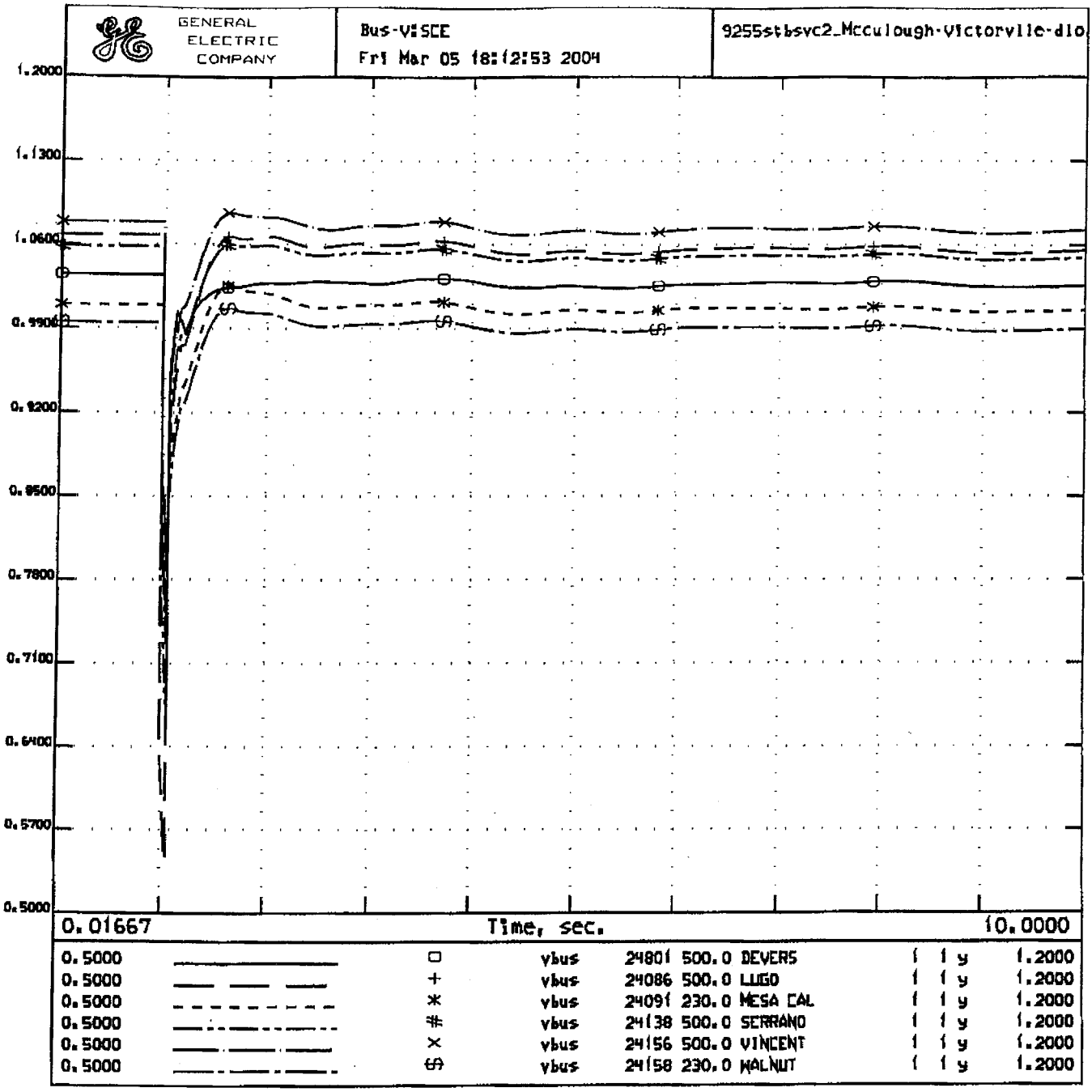

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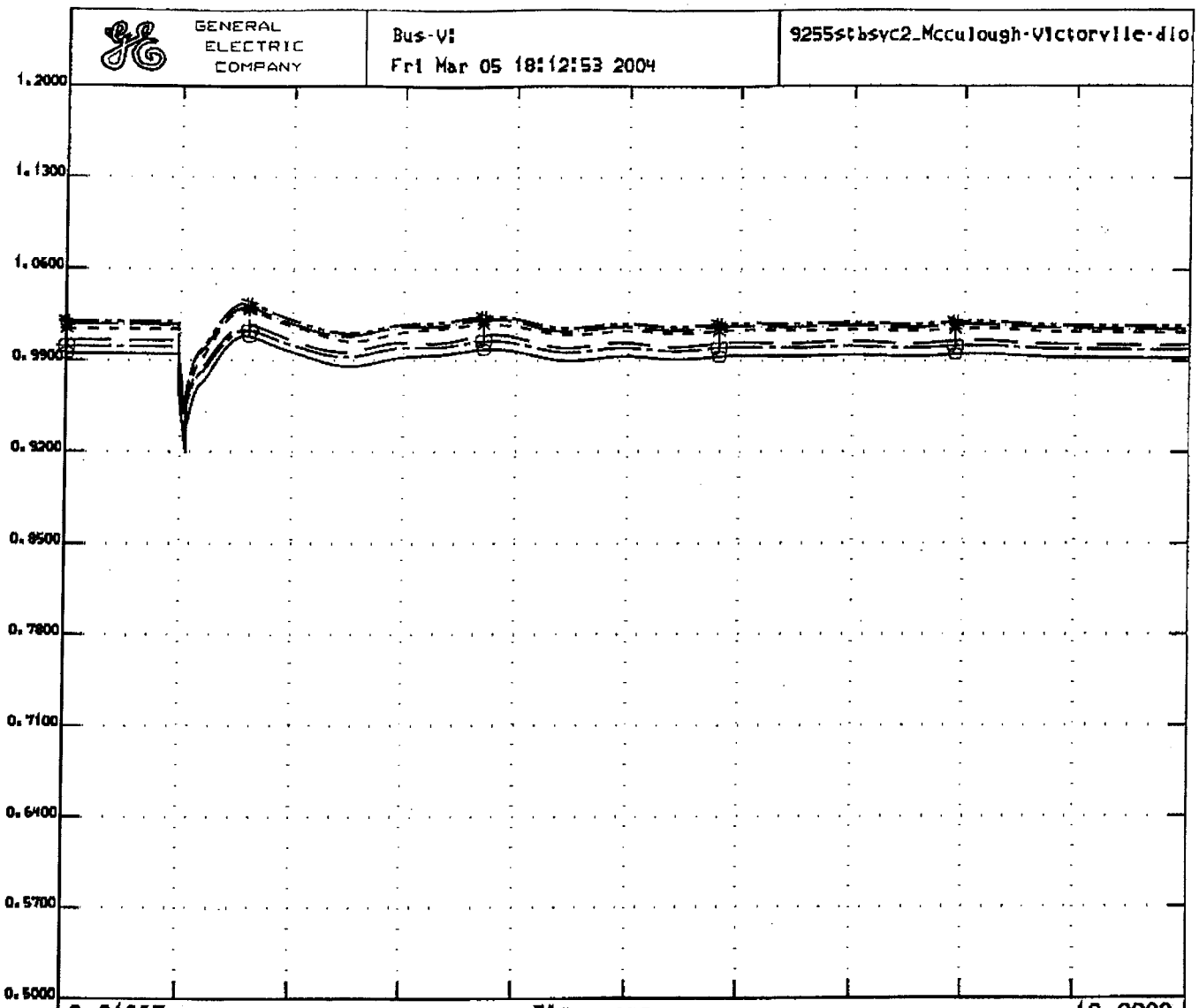

0.5000	———	○	vbul	22056	69.0	BERNARDO	1	1	y	1.2000
0.5000	— — —	+	vbul	22208	69.0	EL CAJON	1	1	y	1.2000
0.5000	- - - - - - - -	*	vbul	22256	69.0	ESCNDIDO	1	1	y	1.2000
0.5000	—-—-—-—	#	vbul	22316	69.0	GENESEE	1	1	y	1.2000
0.5000	—·—·—	×	vbul	22496	69.0	MISSION	1	1	y	1.2000
0.5000	—-—-—	⊗	vbul	22592	69.0	OLD TOWN	1	1	y	1.2000

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Terminal output log is CASE.trm

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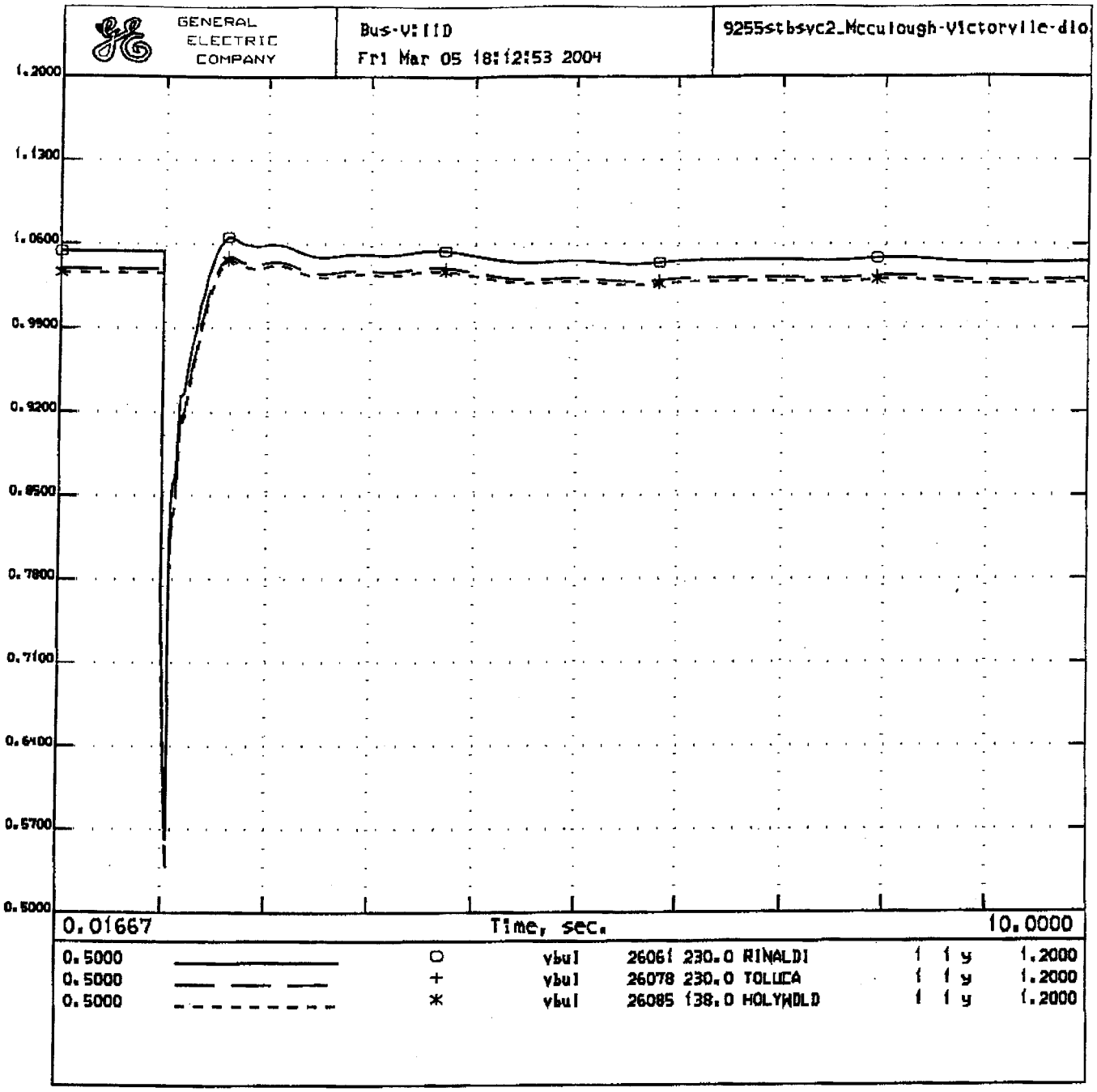
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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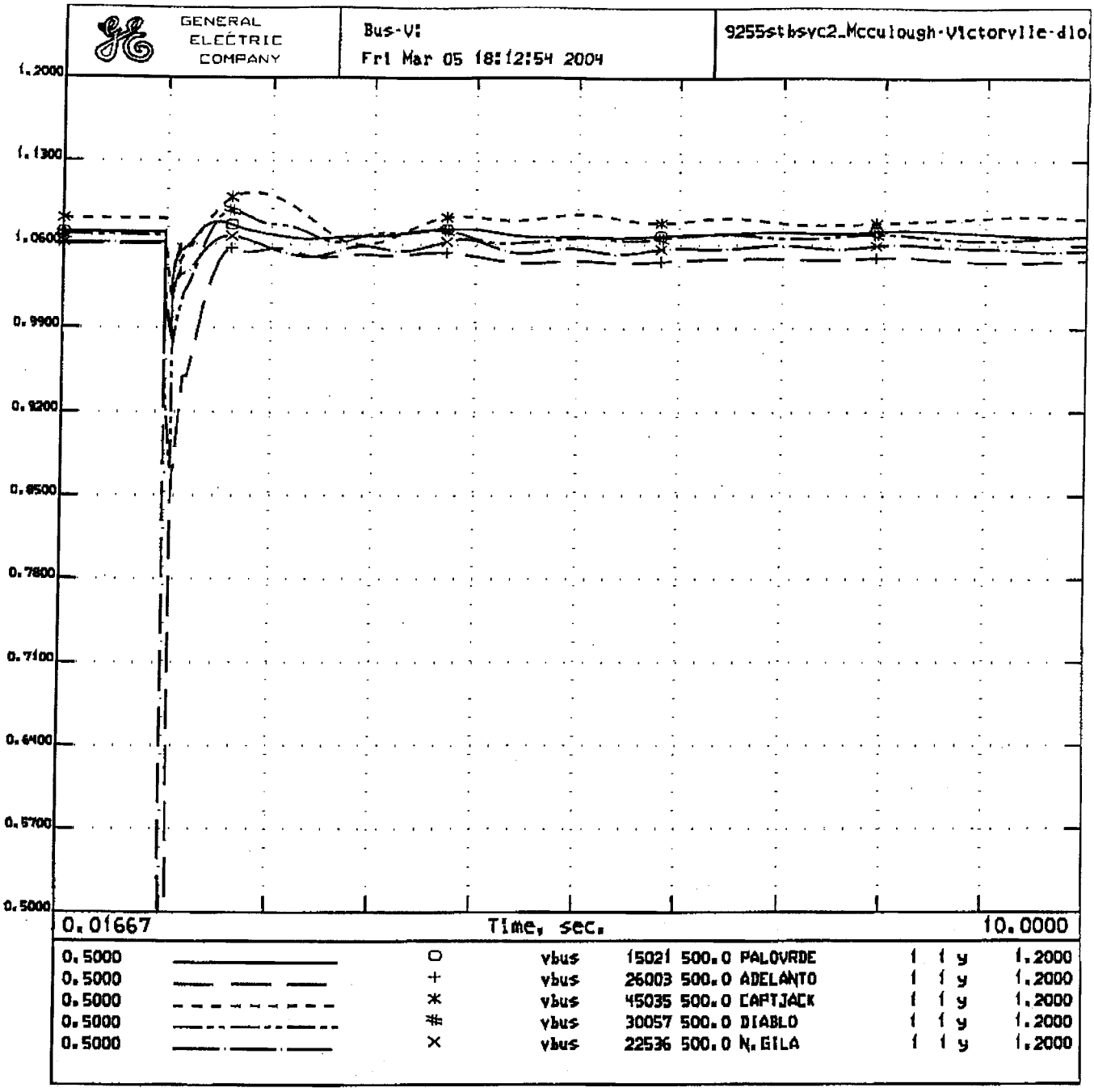

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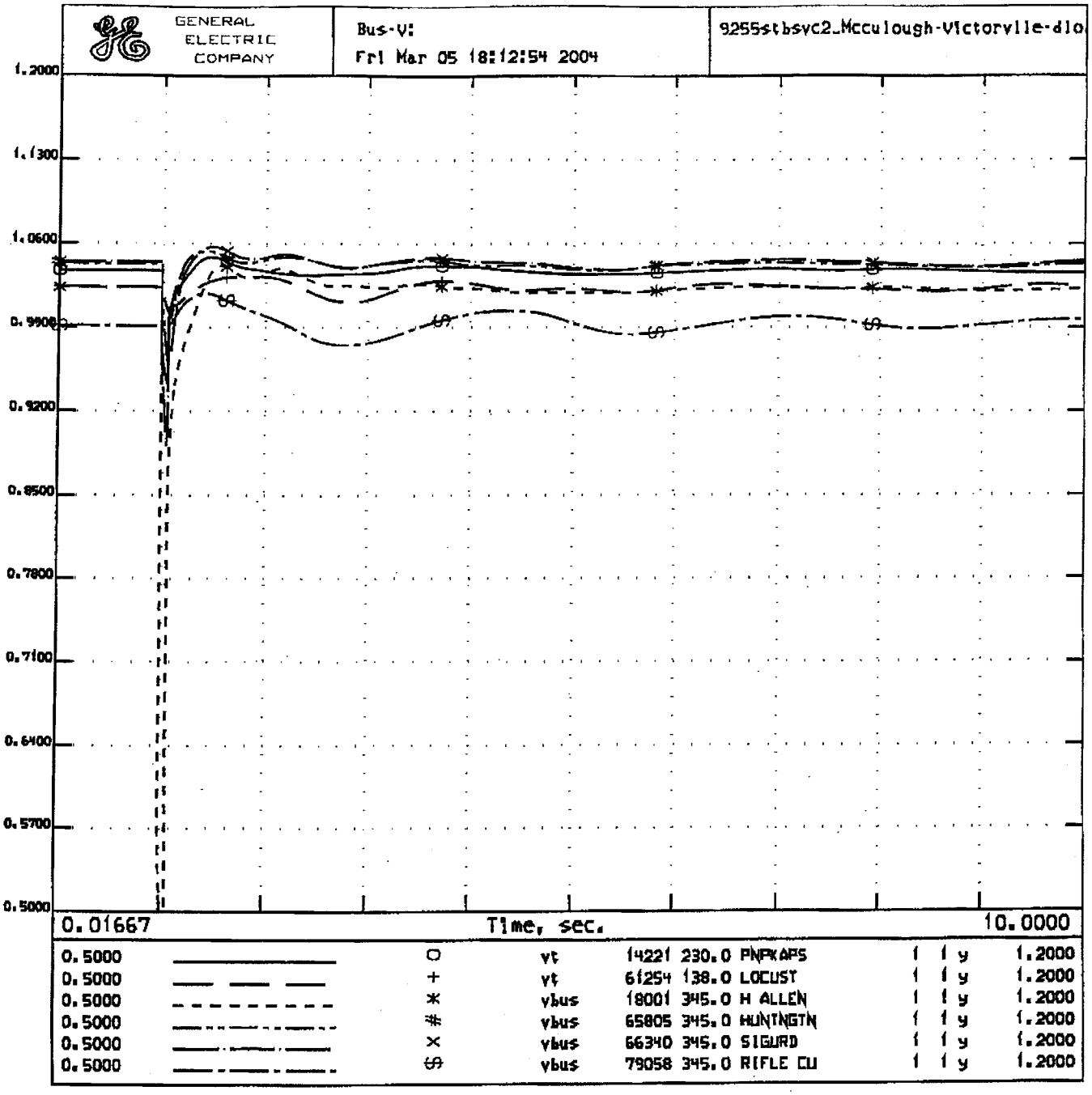

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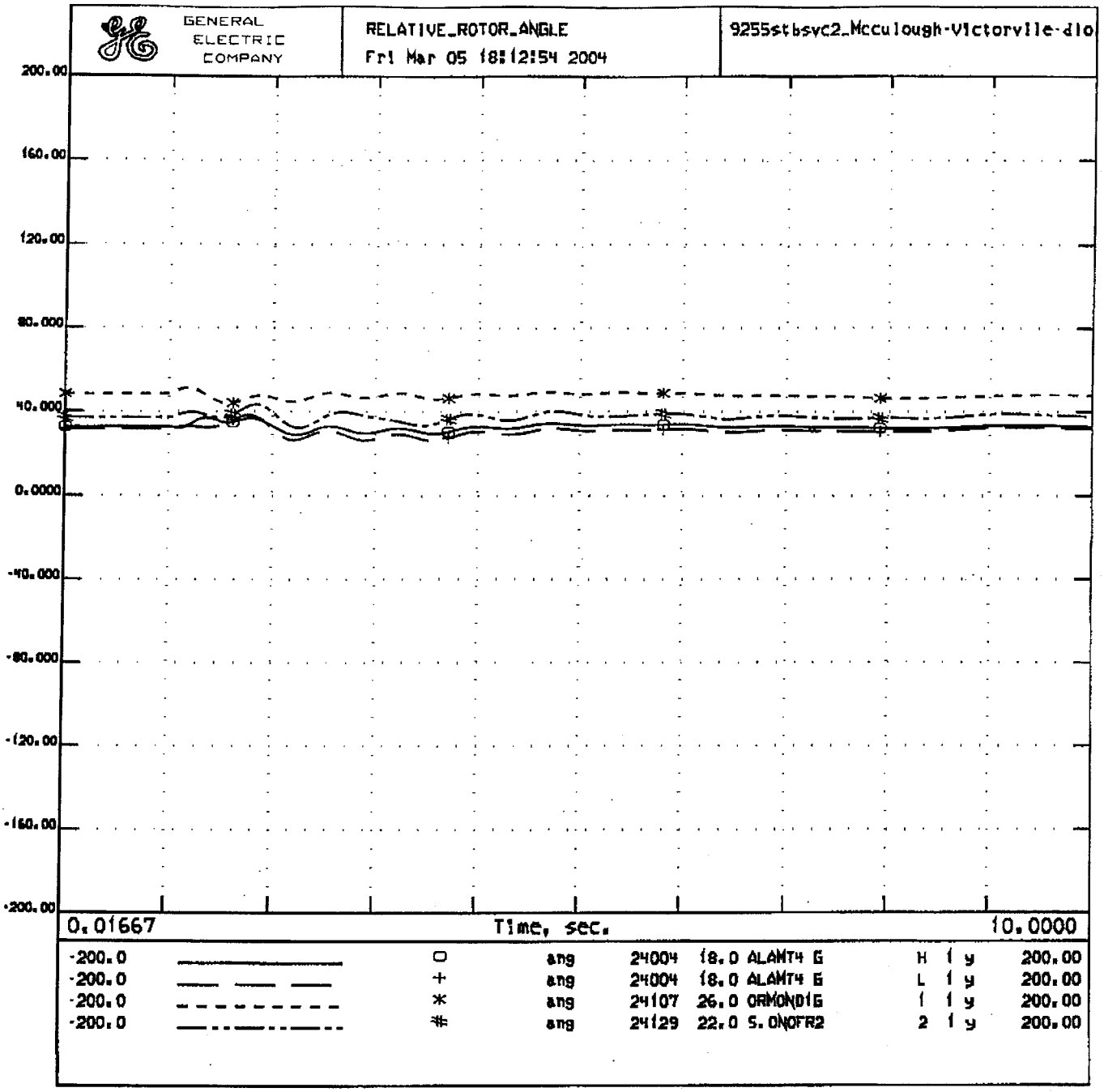

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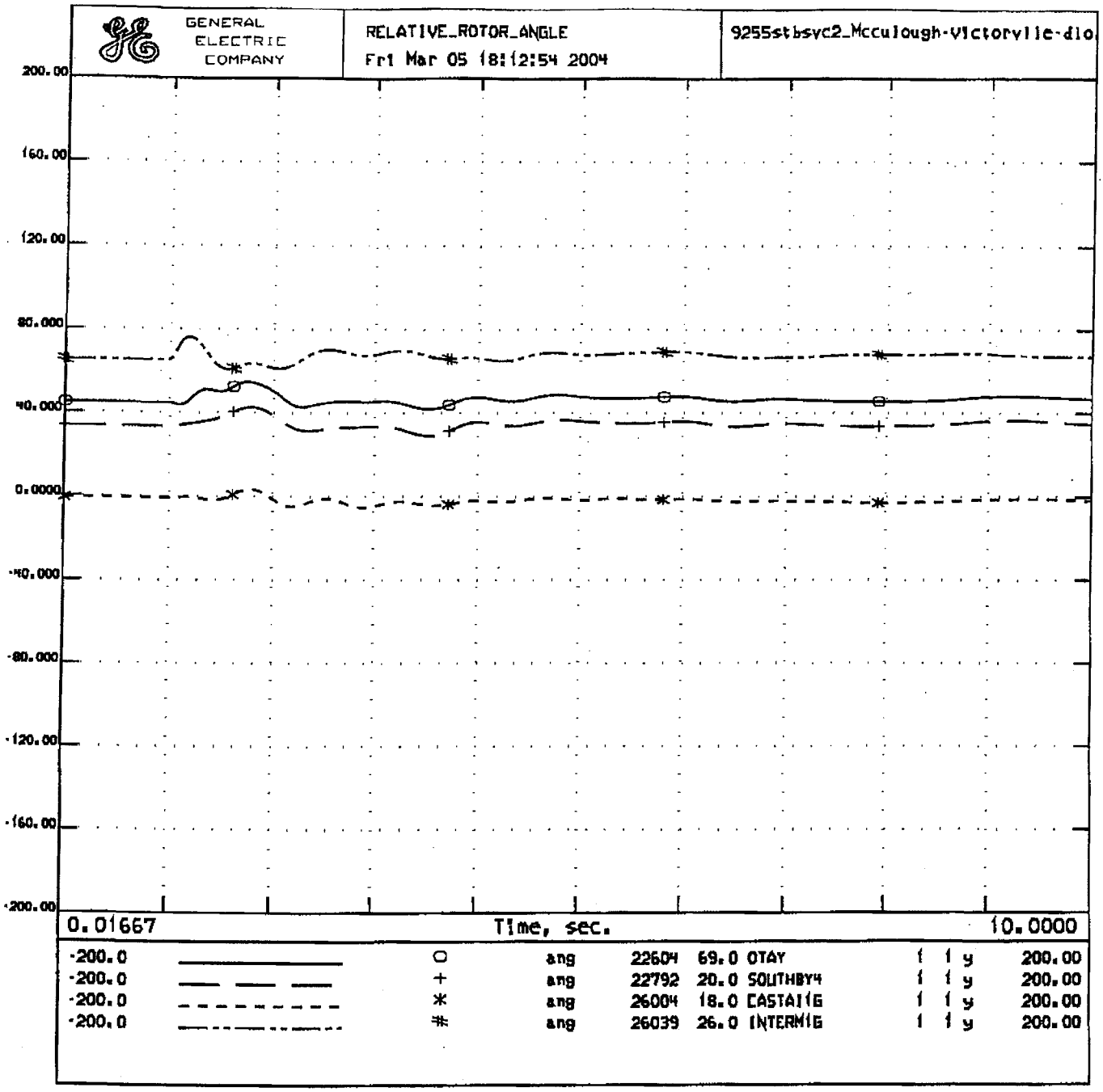

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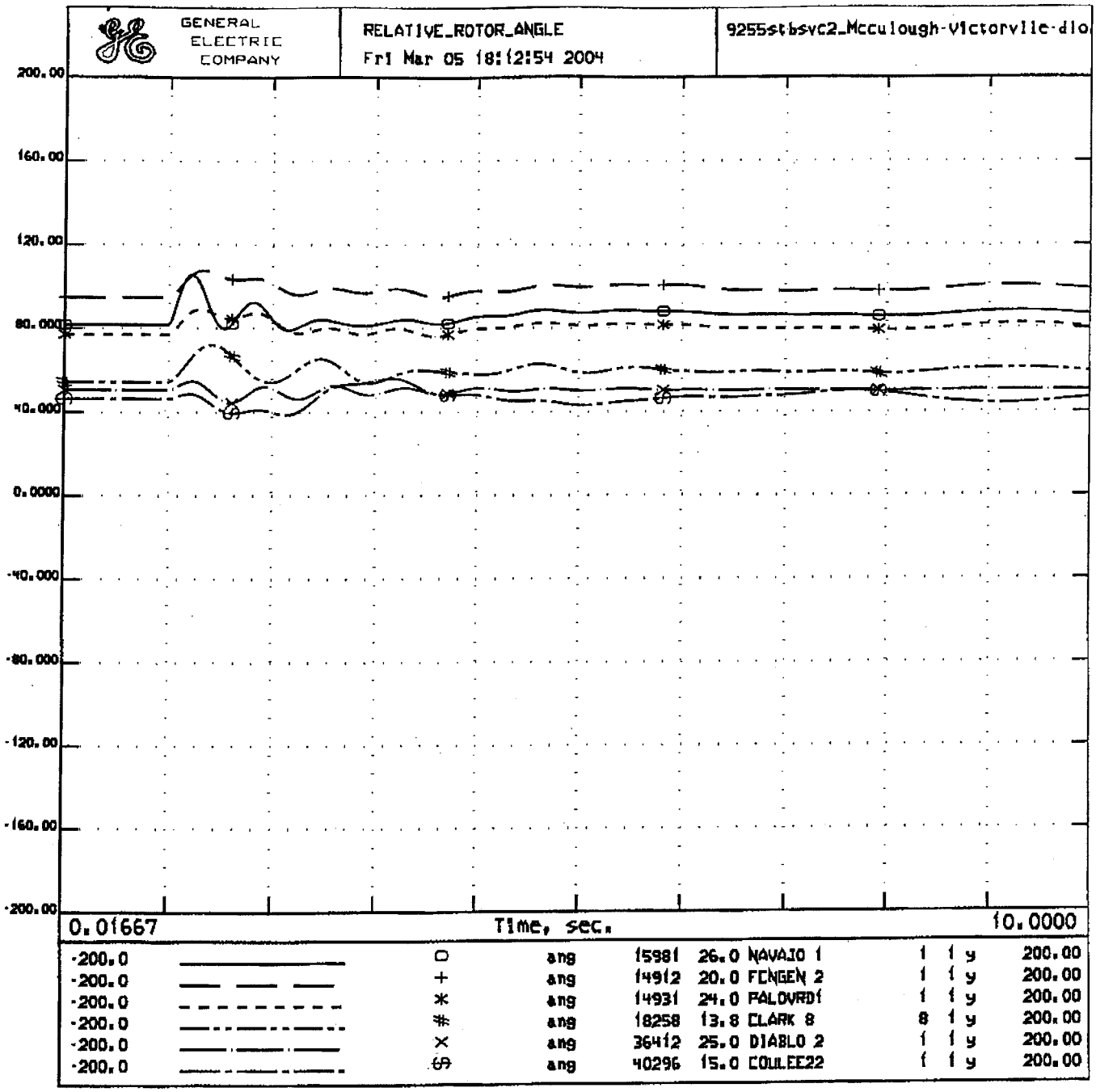

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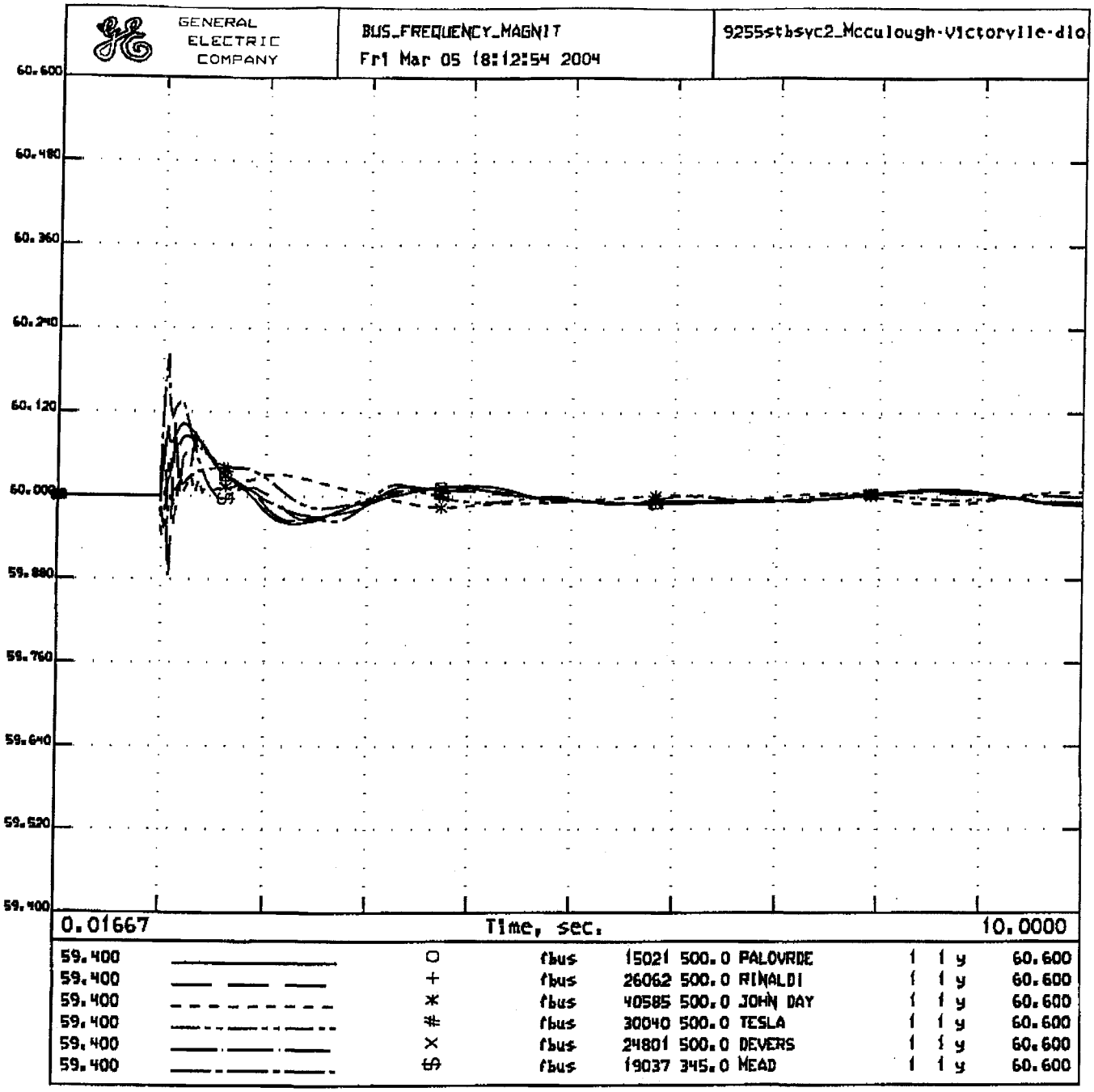

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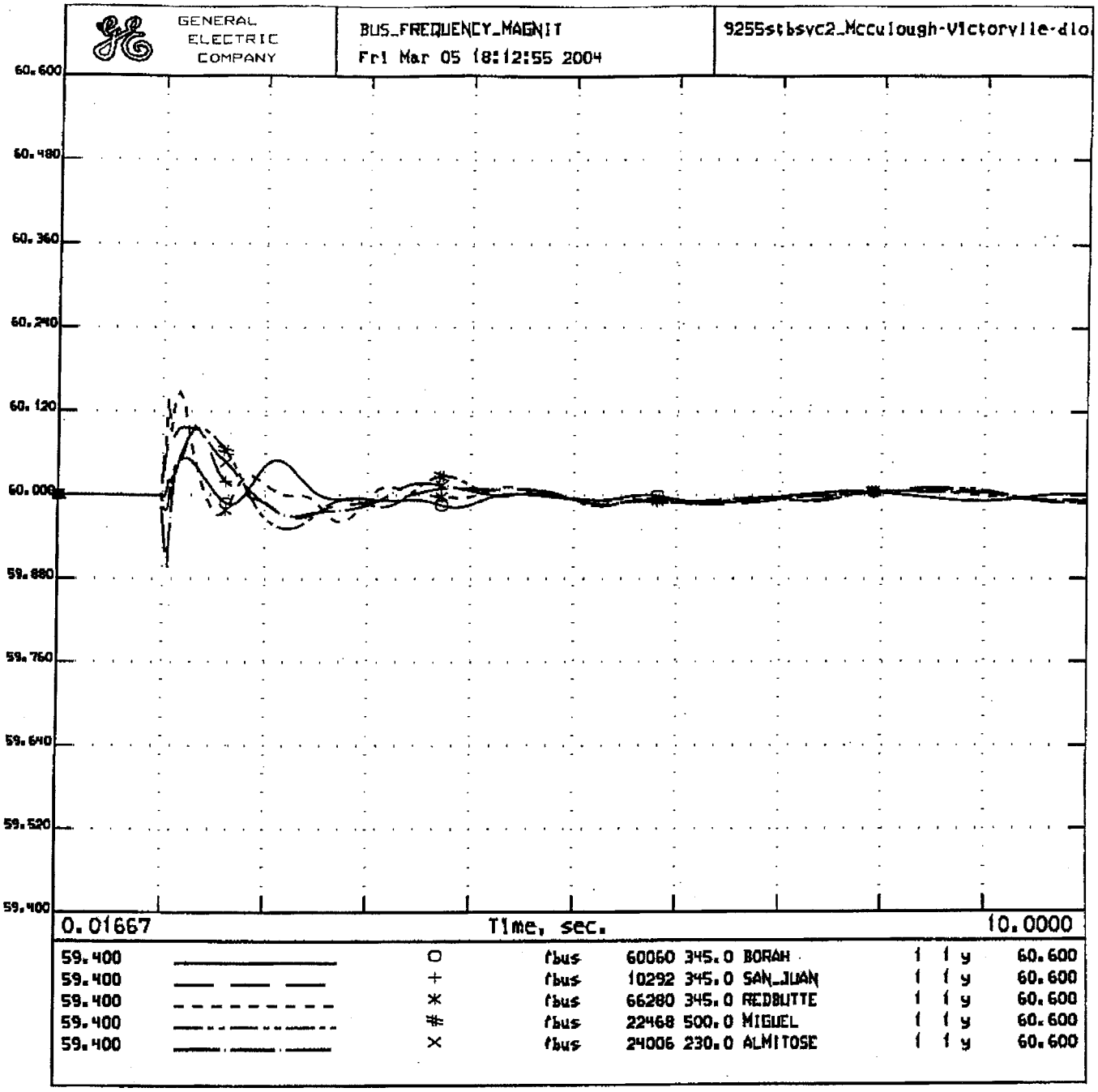

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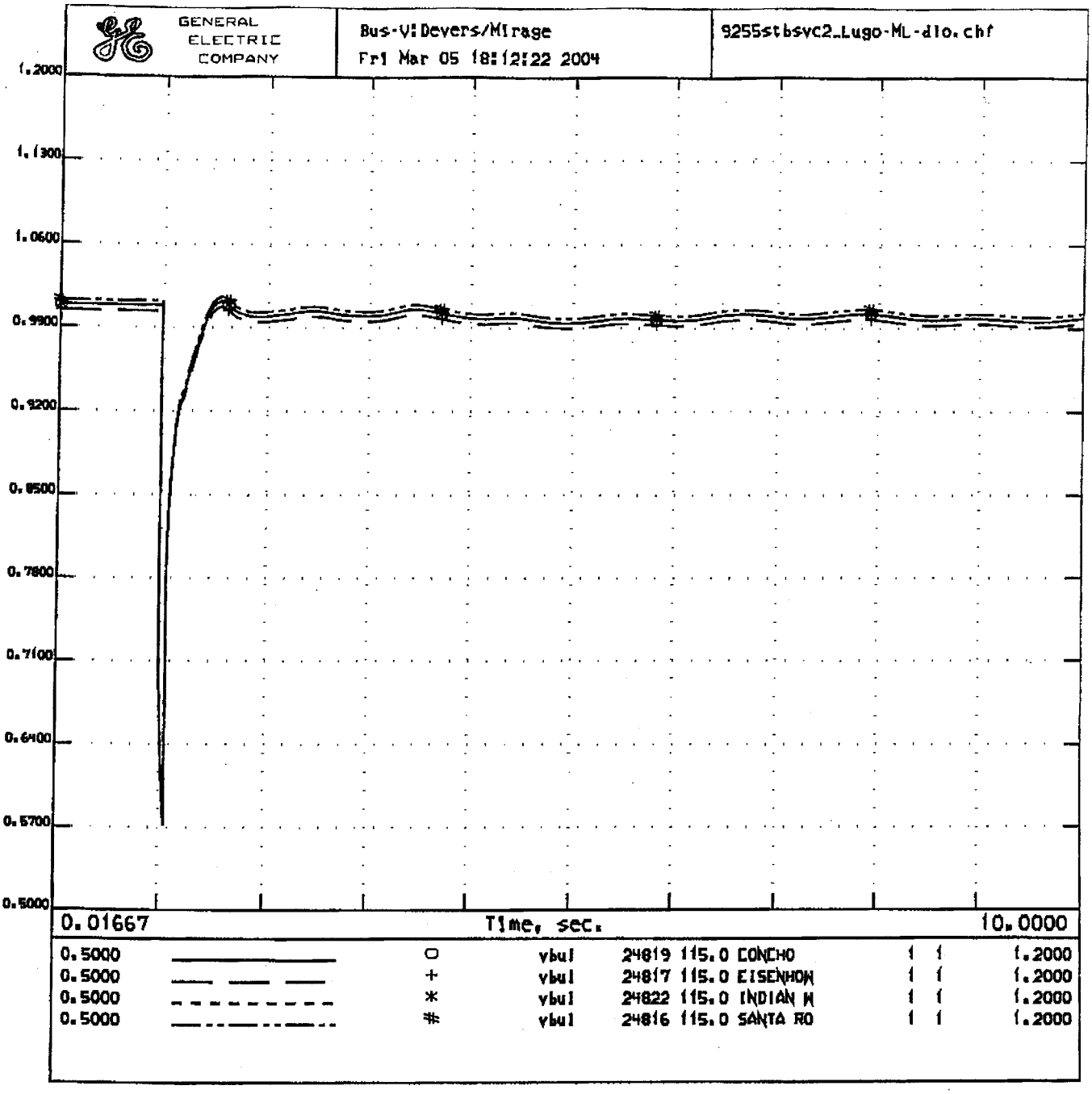
Transient Stability Study Plots - 10

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-2**
OUTAGE:	**Lugo-Mira Loma 500 kV No. 2 Line & Lugo-Mira Loma 500 kV No. 3 Line**
EOR MARGIN:	**None**
NOTES:	



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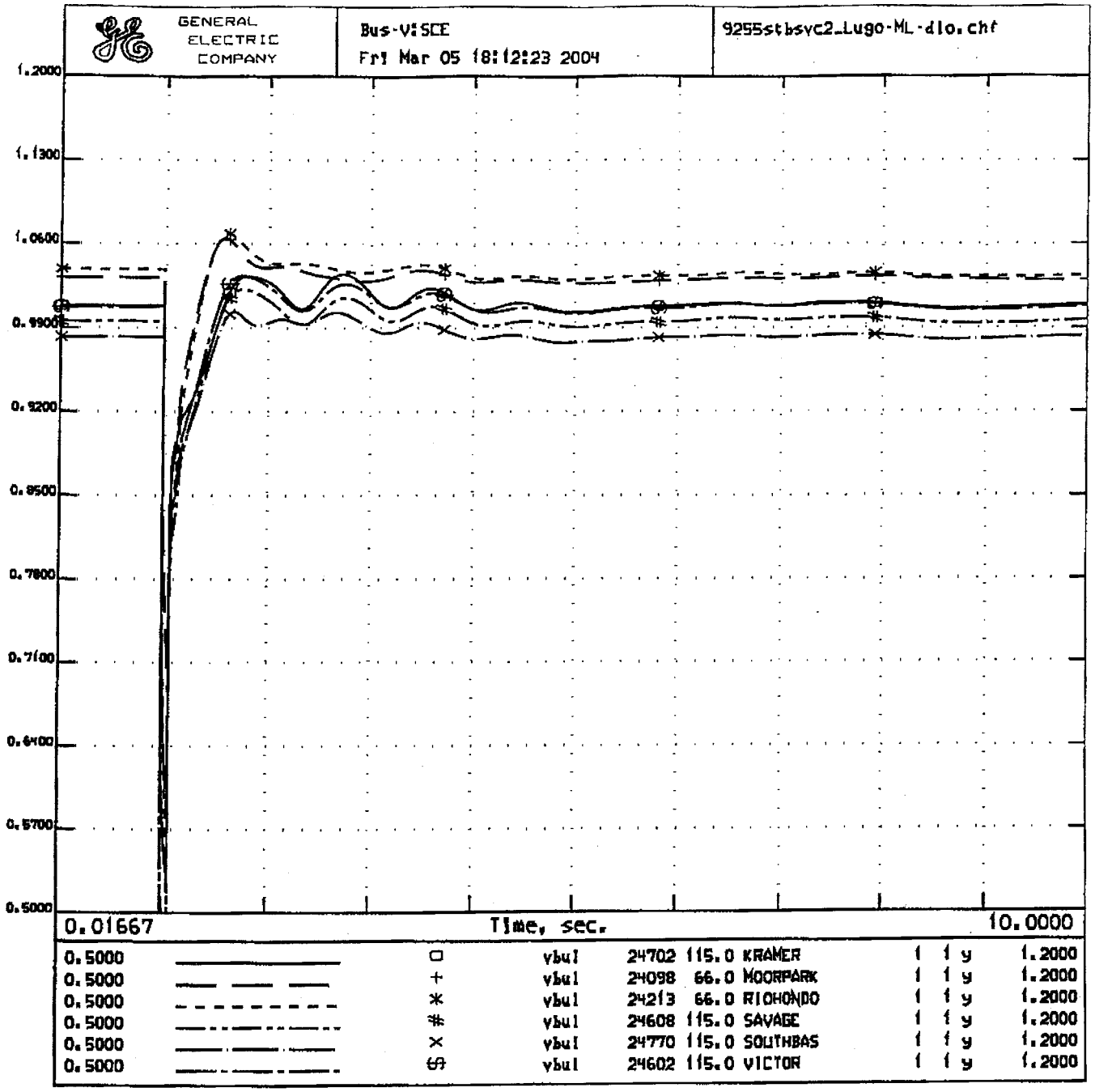

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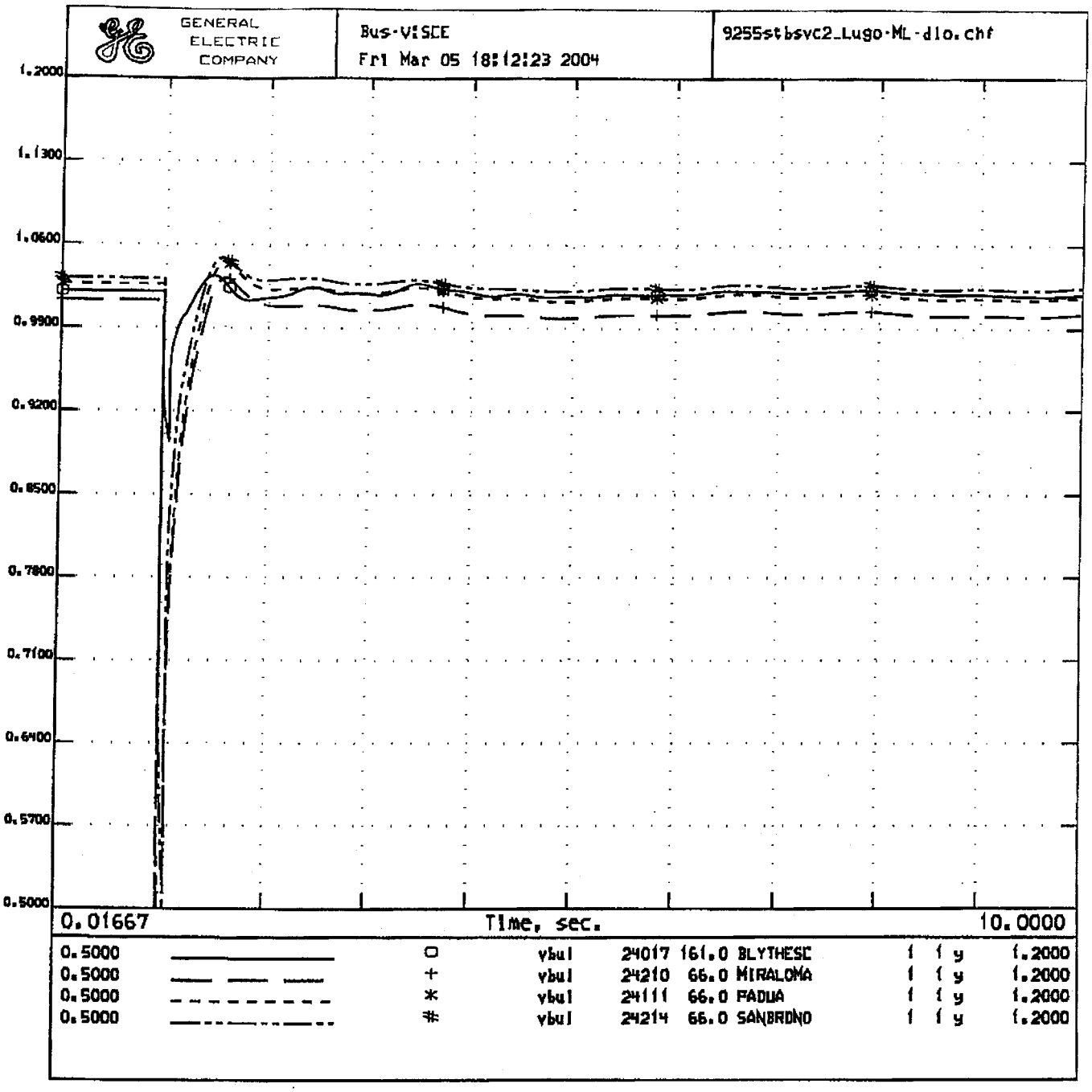

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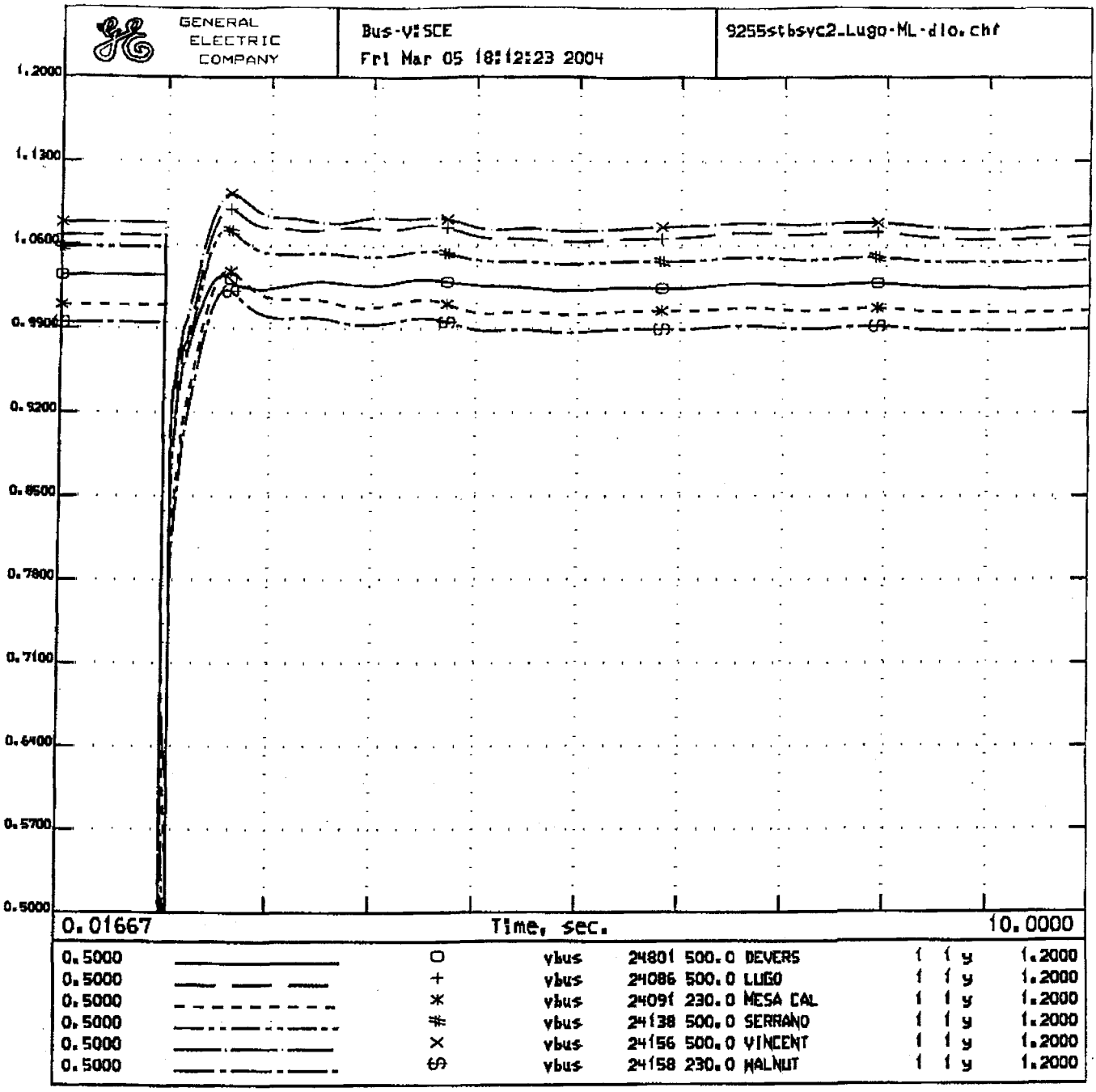

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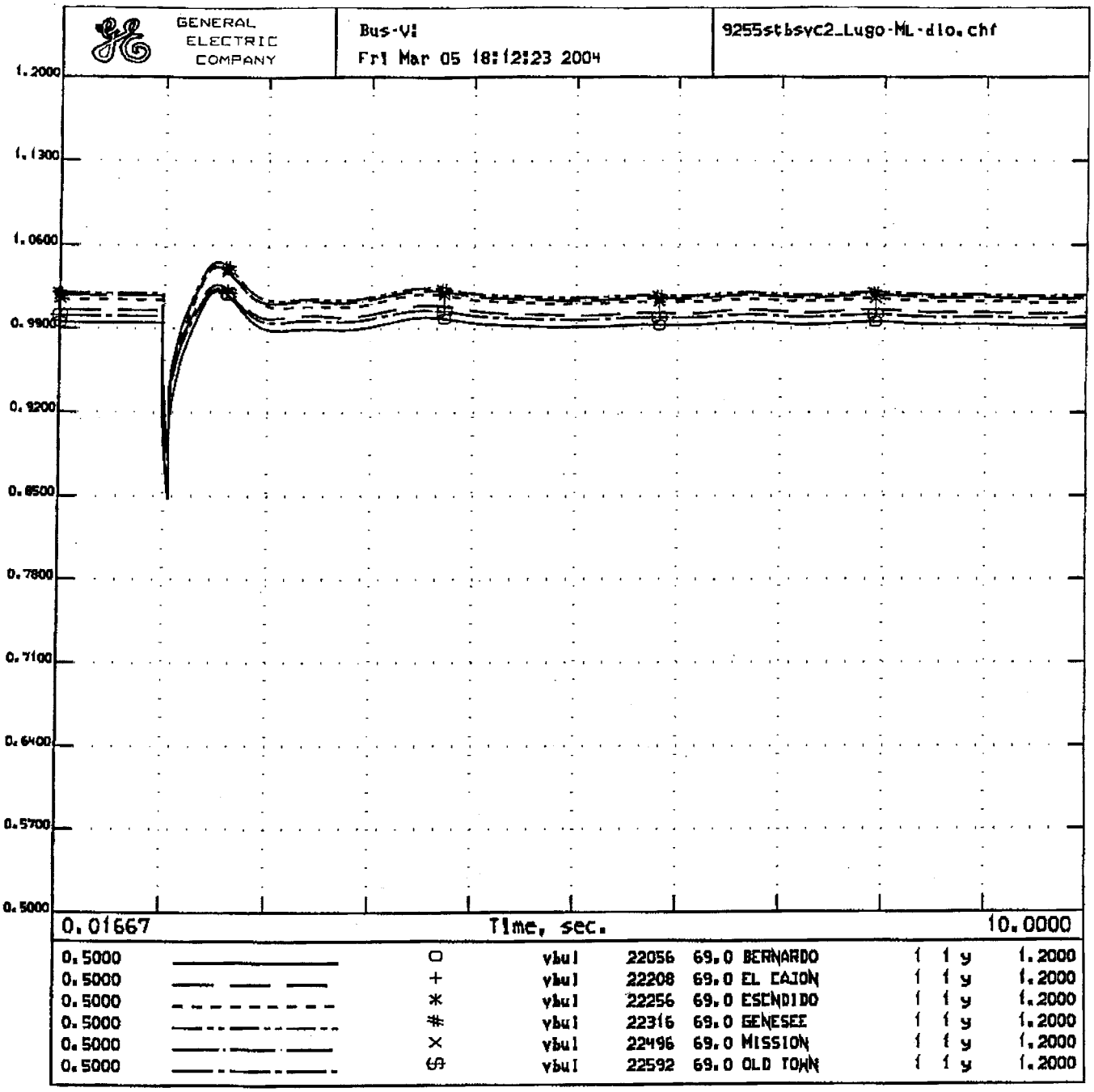

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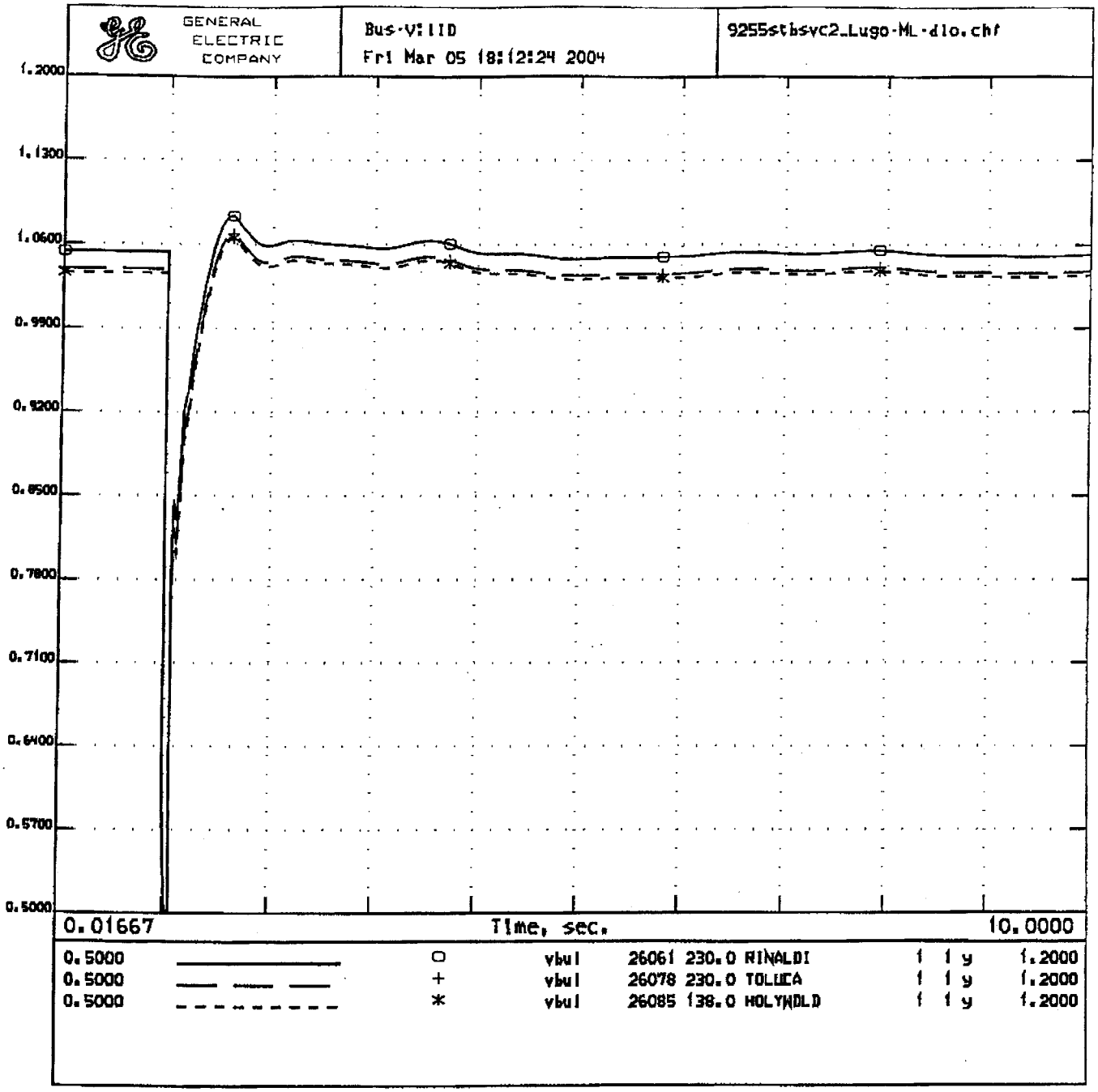

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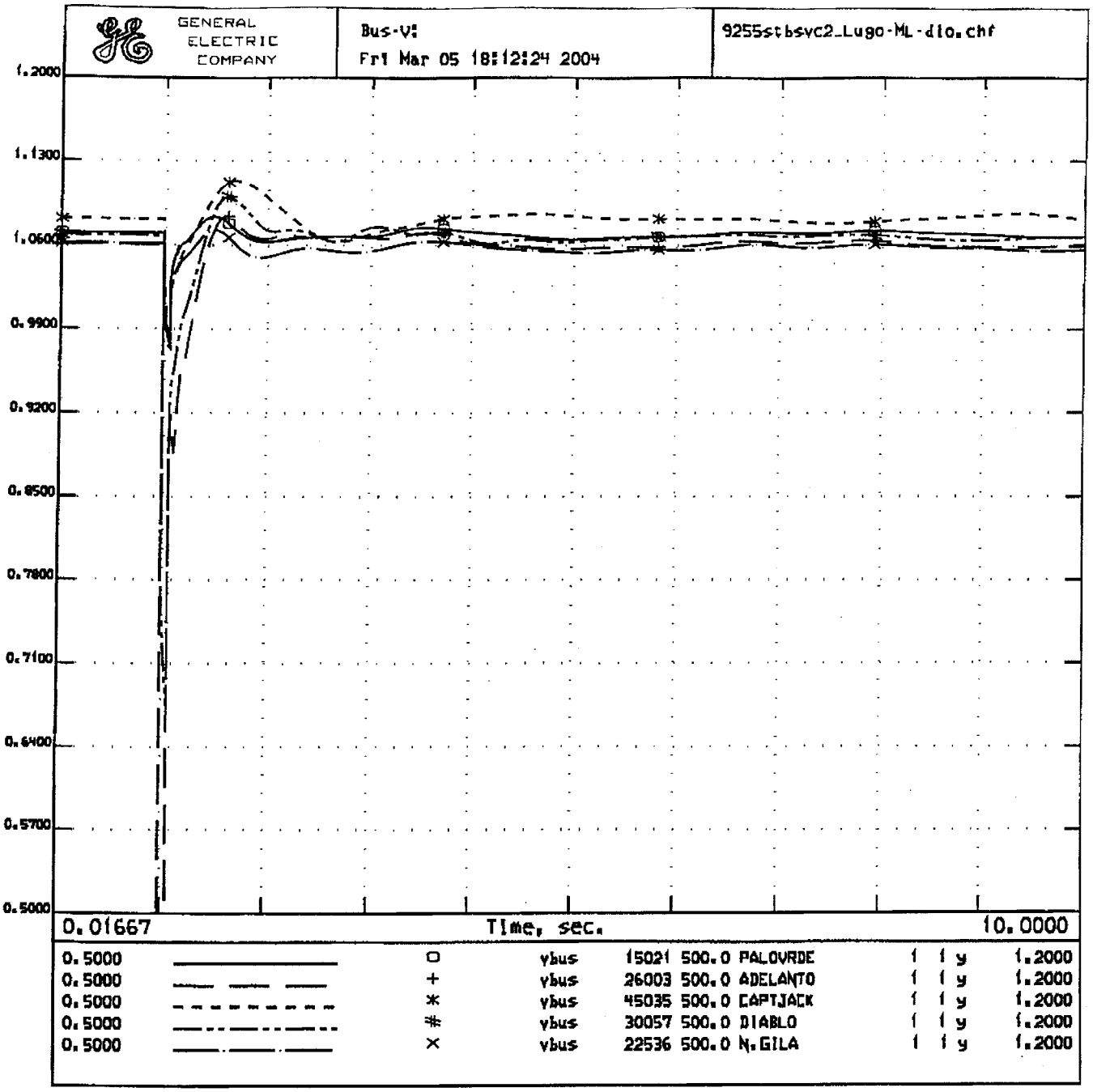

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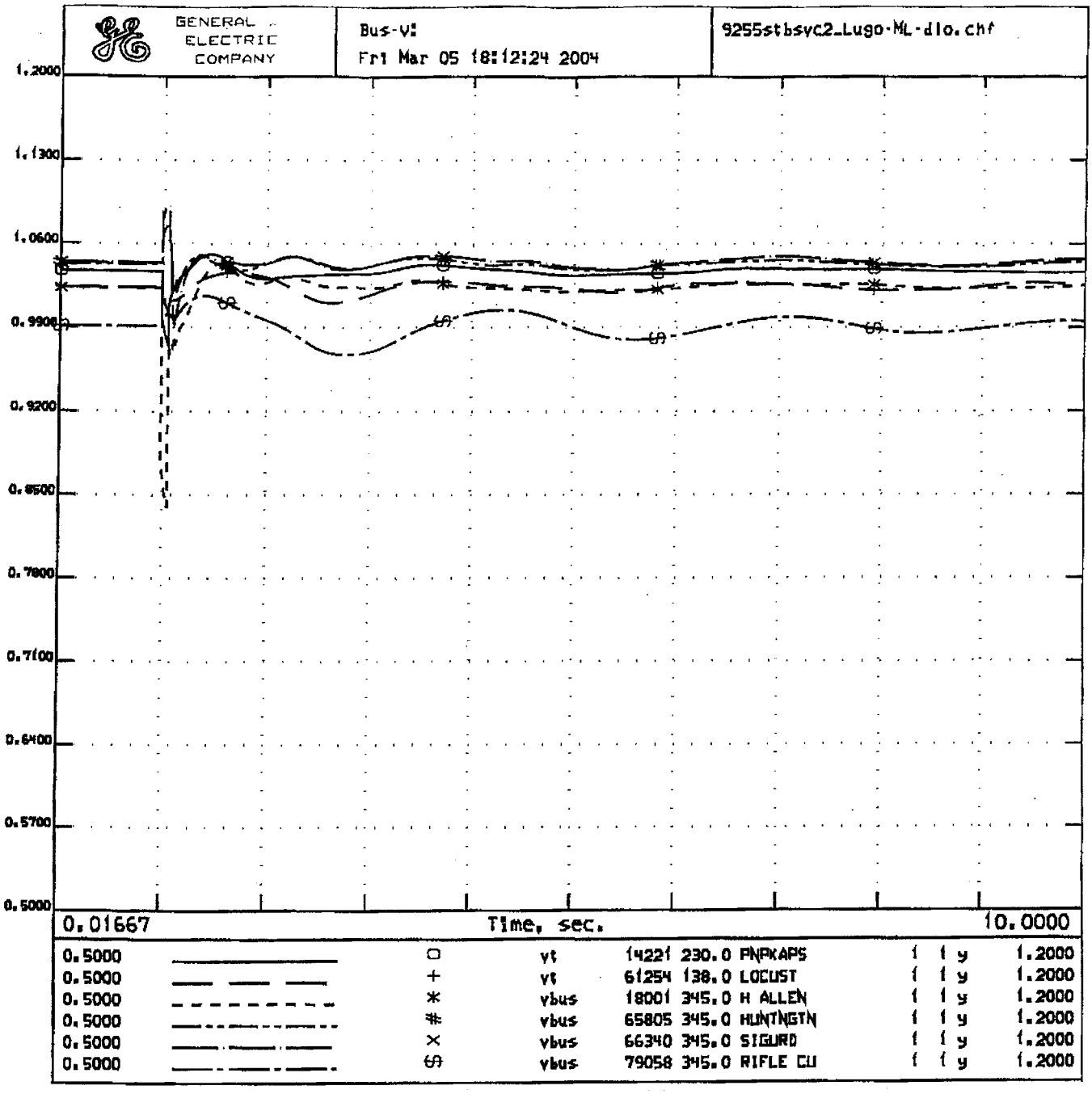

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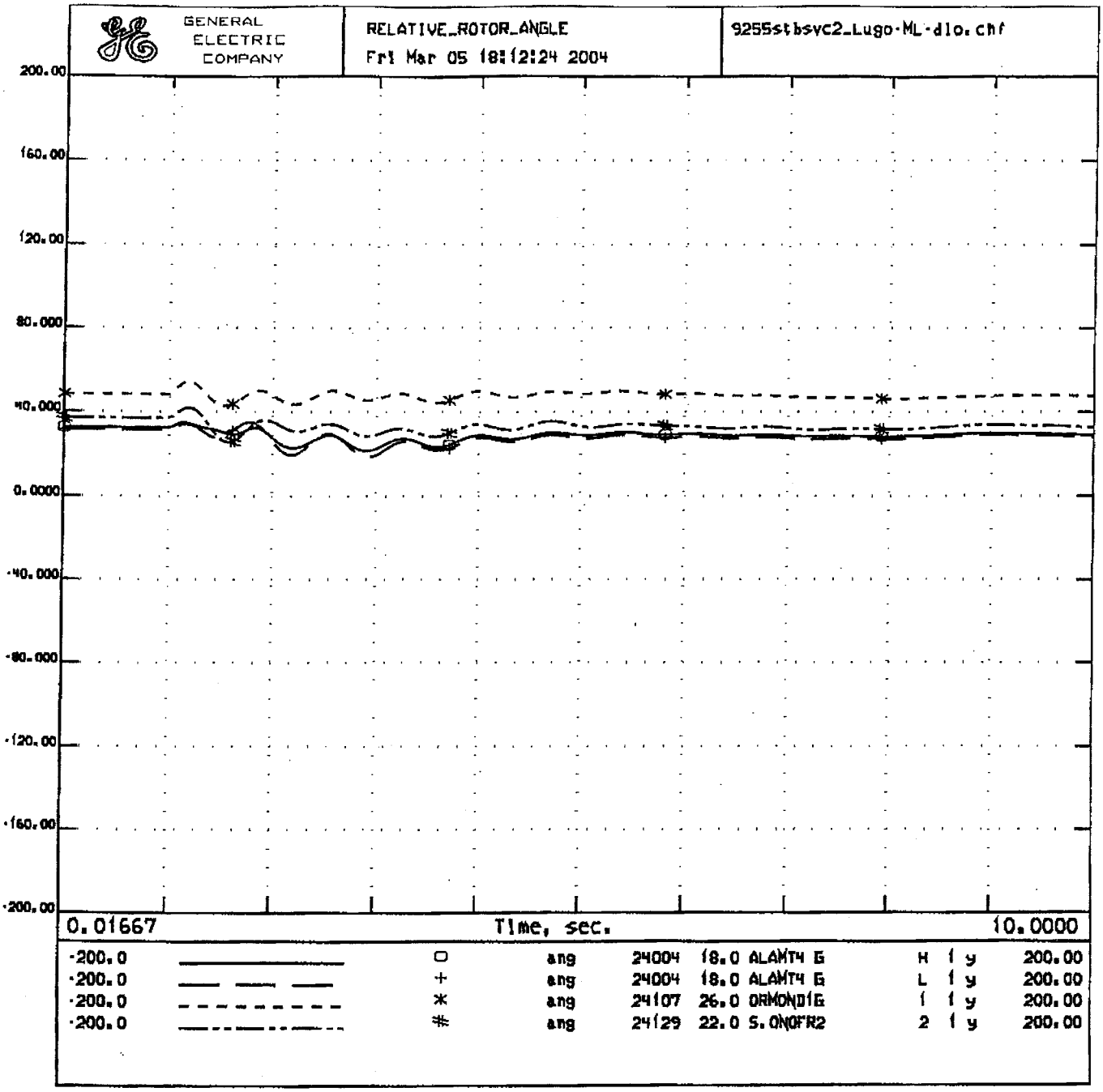

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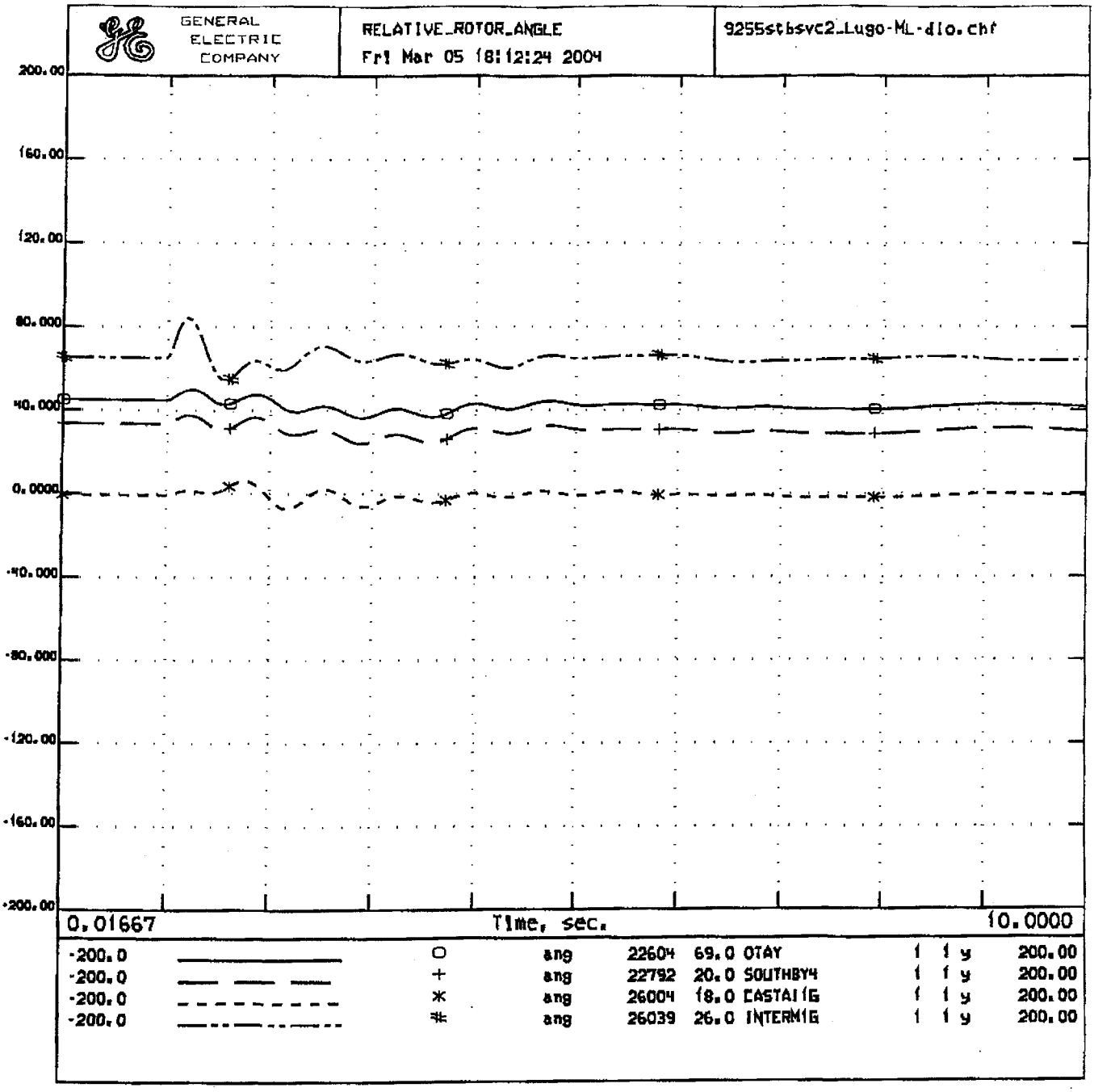

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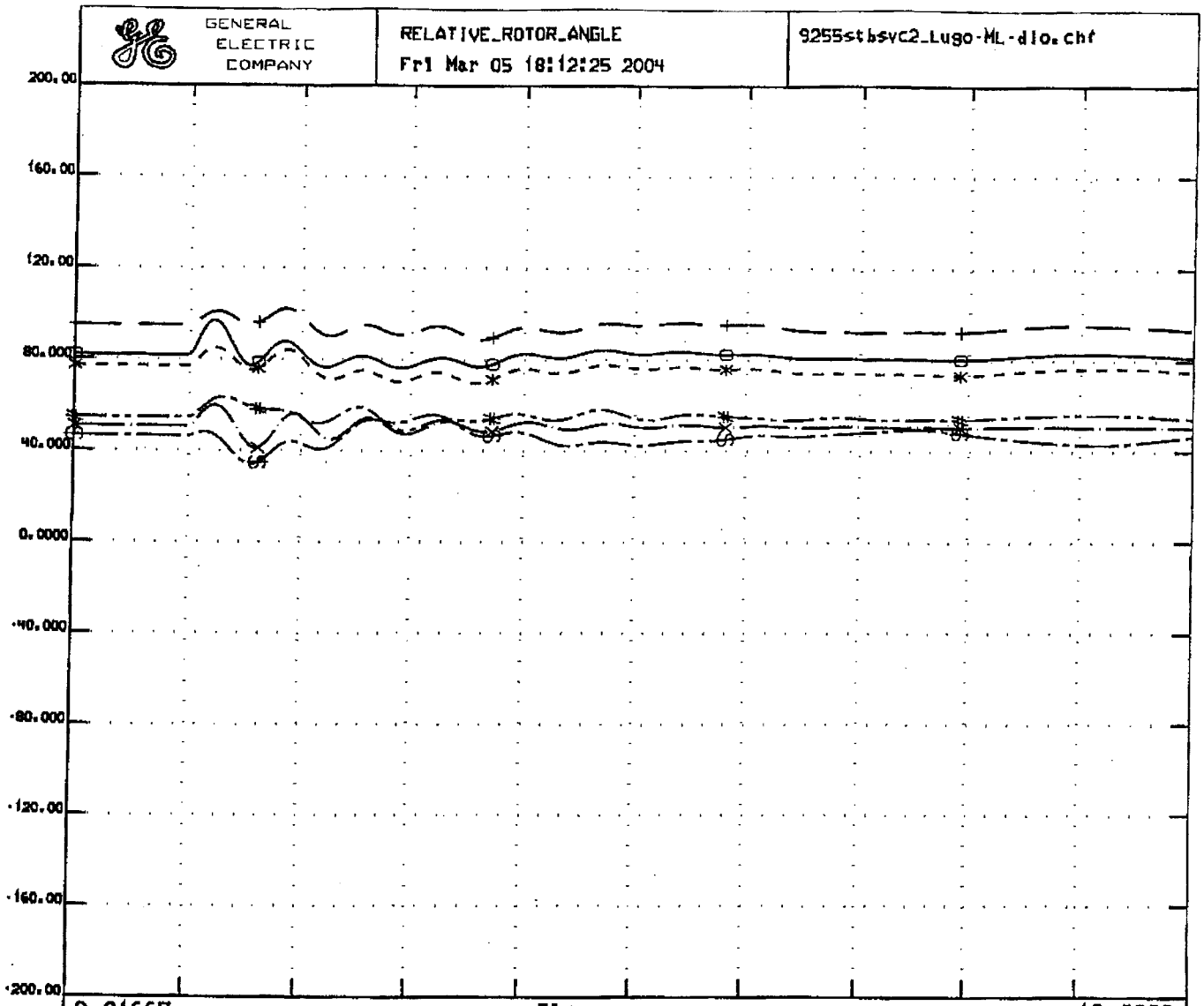

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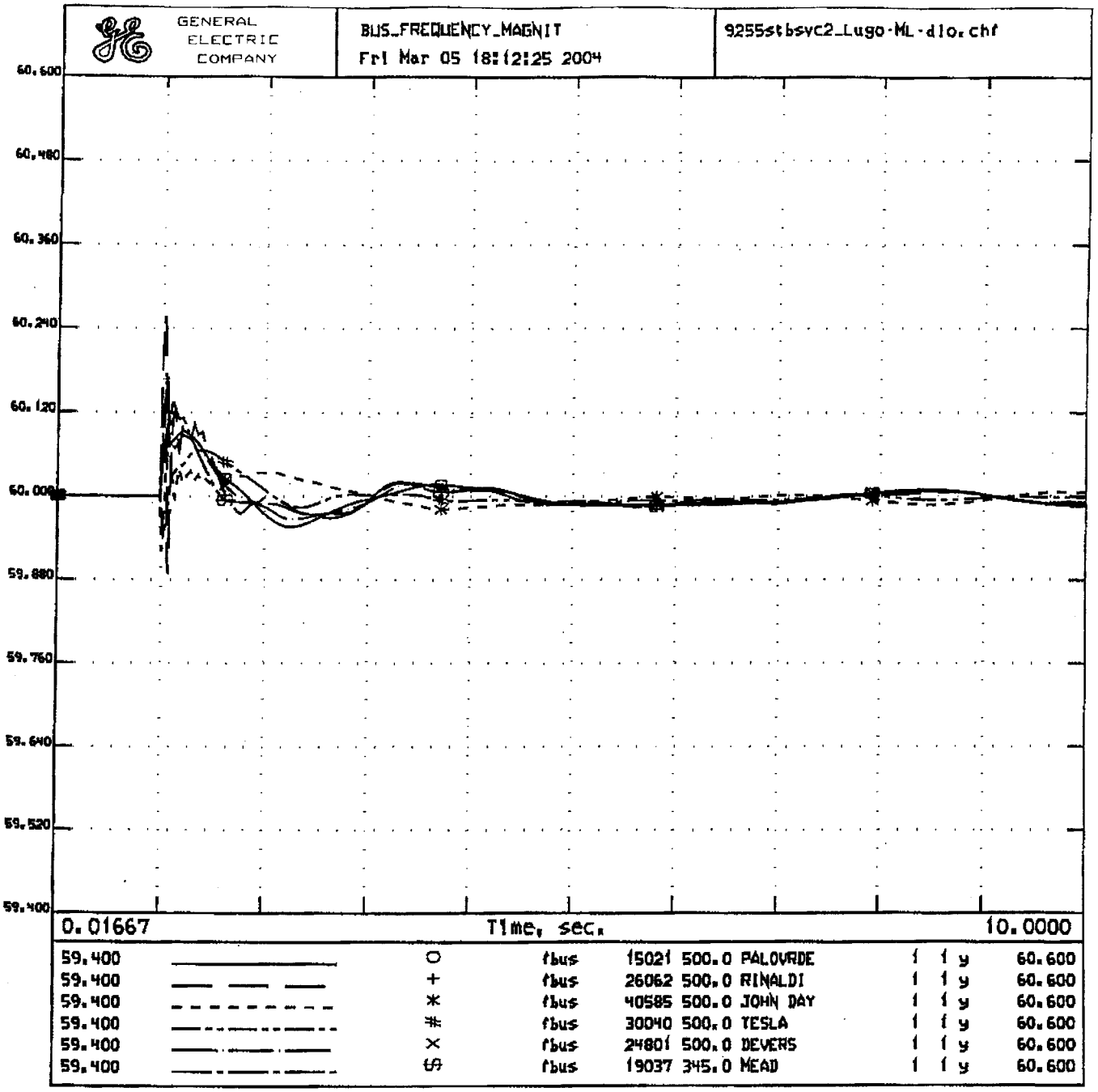

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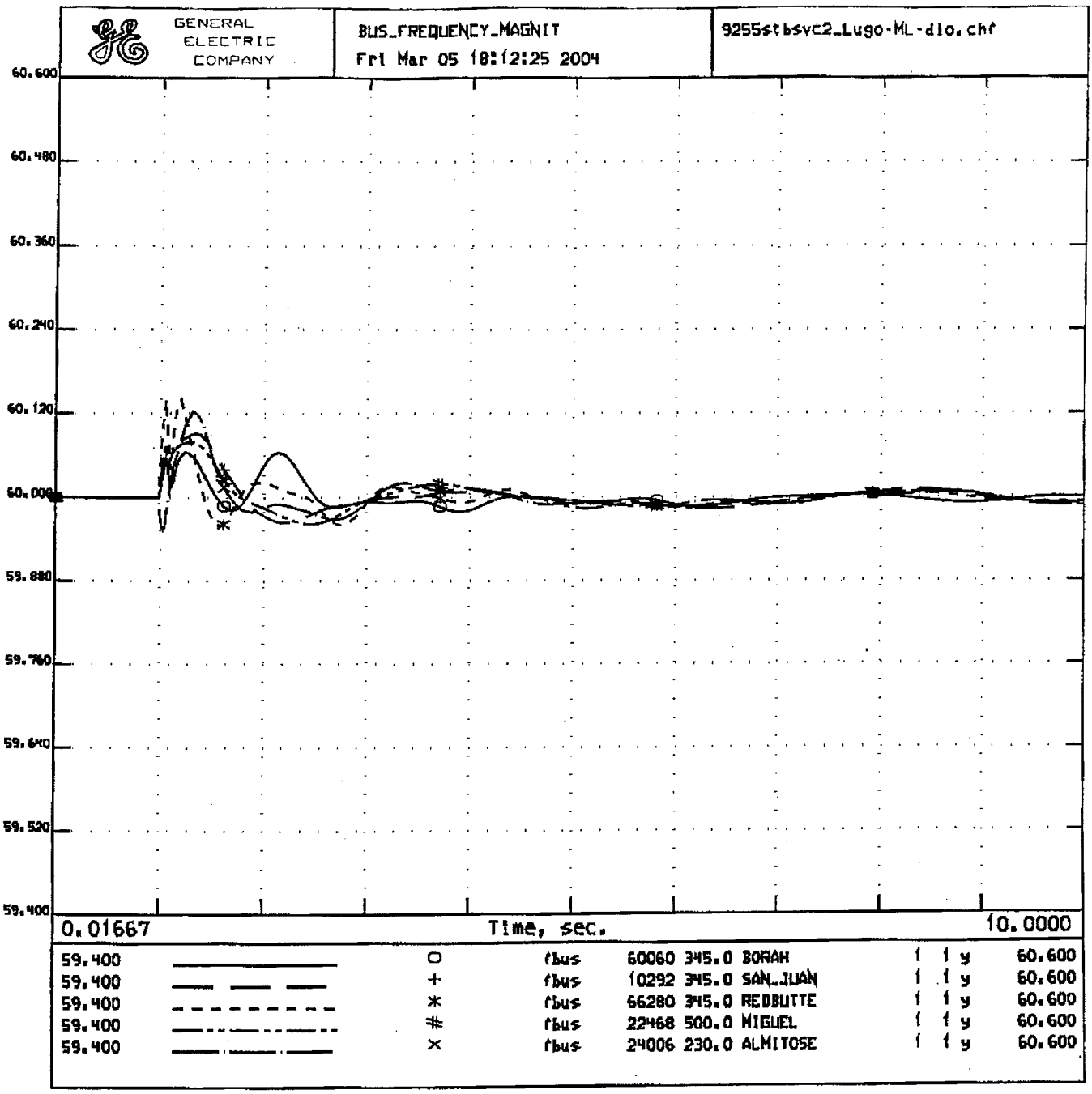

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Terminal output log is CASE.trm

ADDED MOUNTAINVIEW GENERATION PROJECT (SCE)
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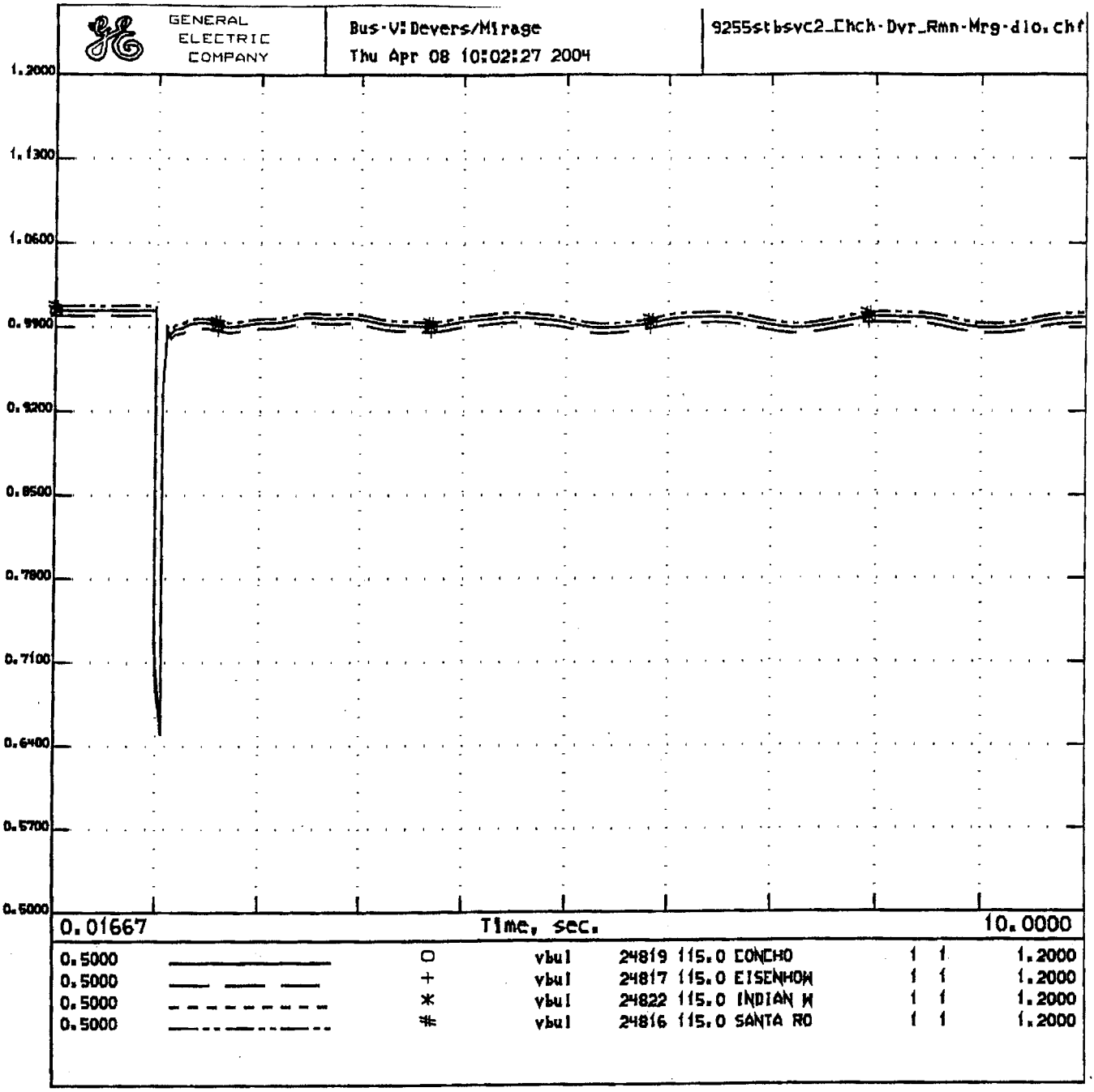
(DECREASED LOAD IN AREA 70 AND 65, REDUCED GENERATION IN S. CA
AT 55/30/15 RATIO (SCE/DWP/SDG&E)
Change impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations

Transient Stability Study Plots - 11

CASE:	**Post-DPV2 with Path 49 at 9,255 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-2**
OUTAGE:	**Devers-Coachella 230 kV Line & Mirage-Ramon 230 kV Line**
EOR MARGIN:	**None**
NOTES:	



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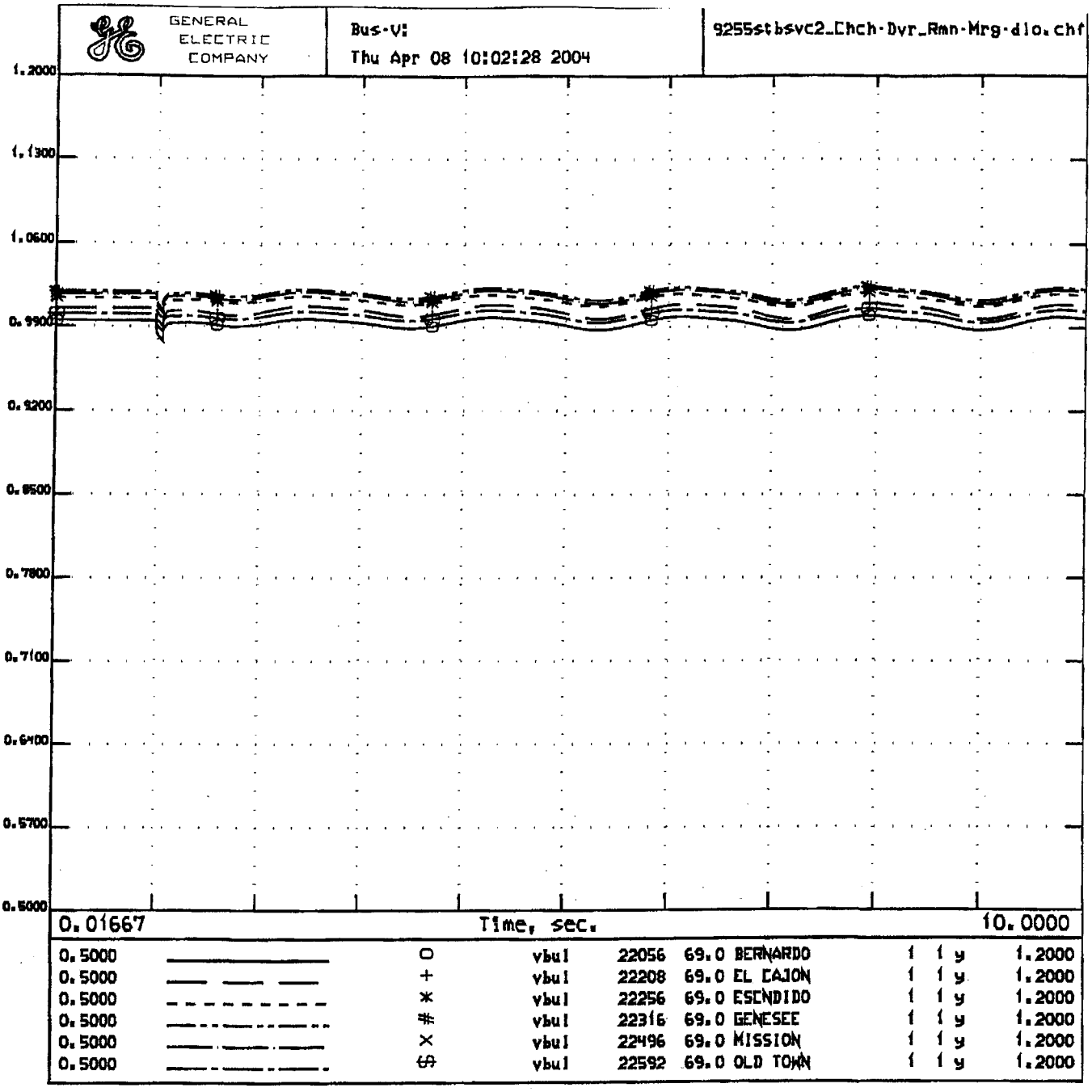

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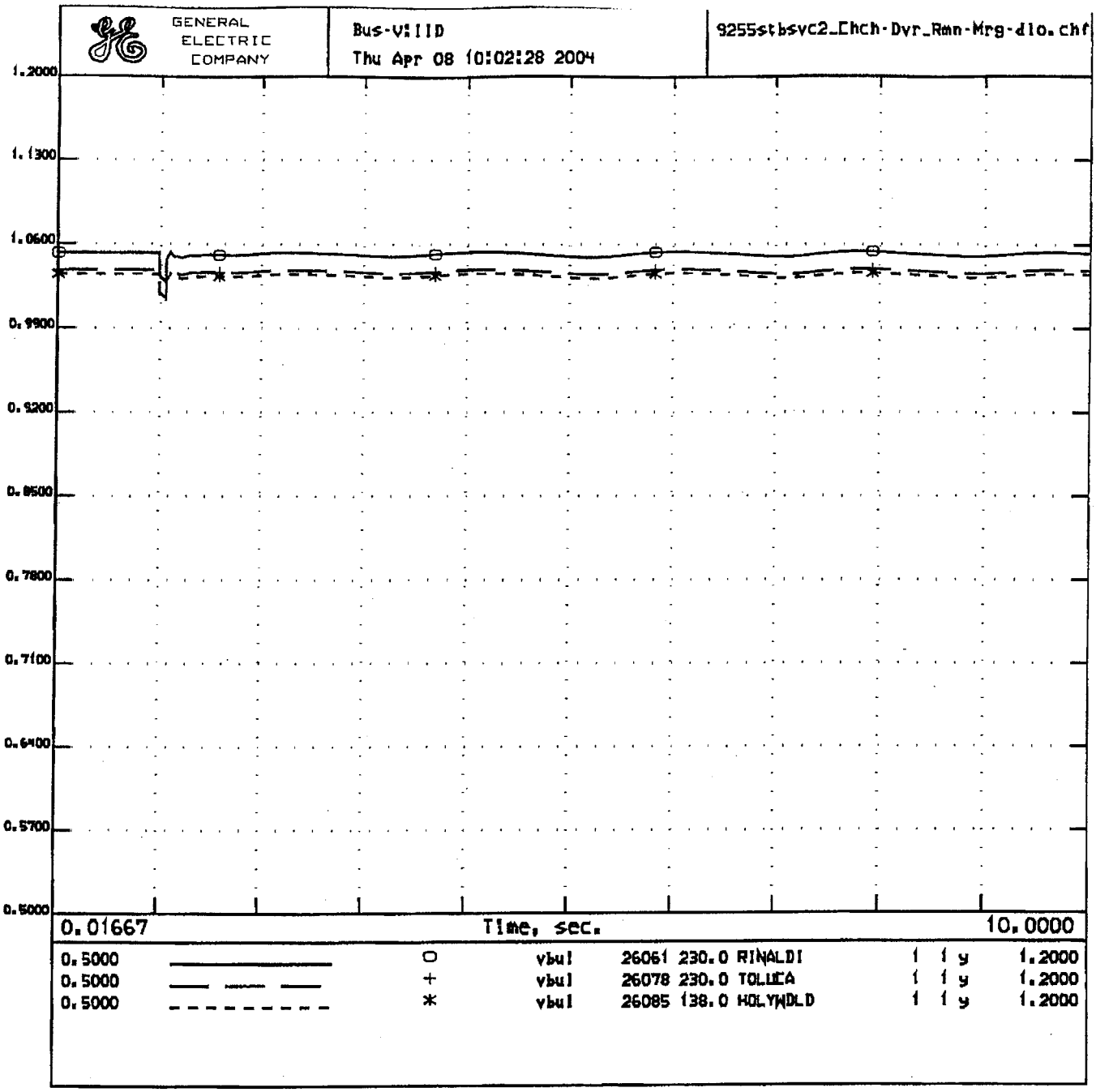

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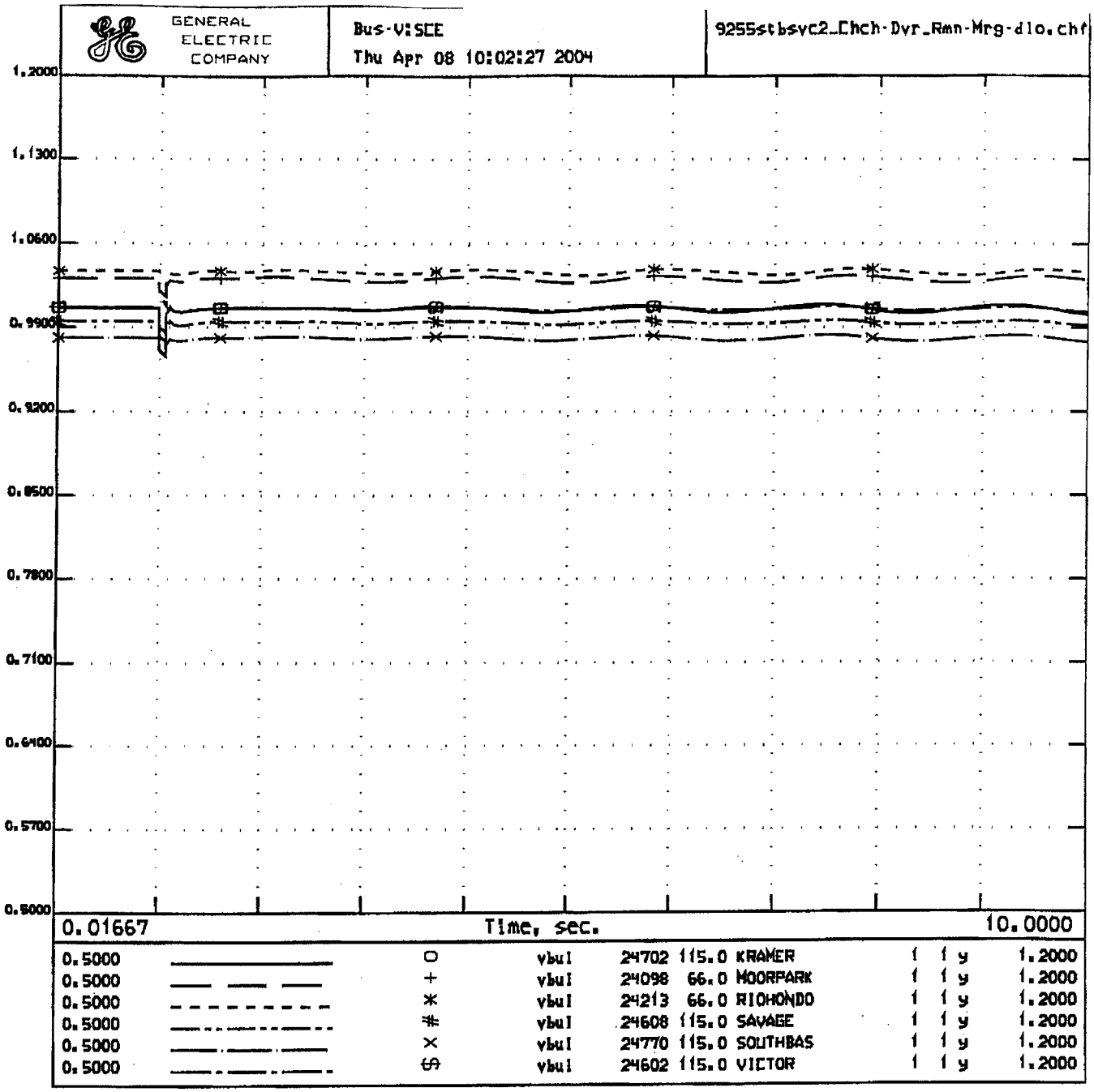

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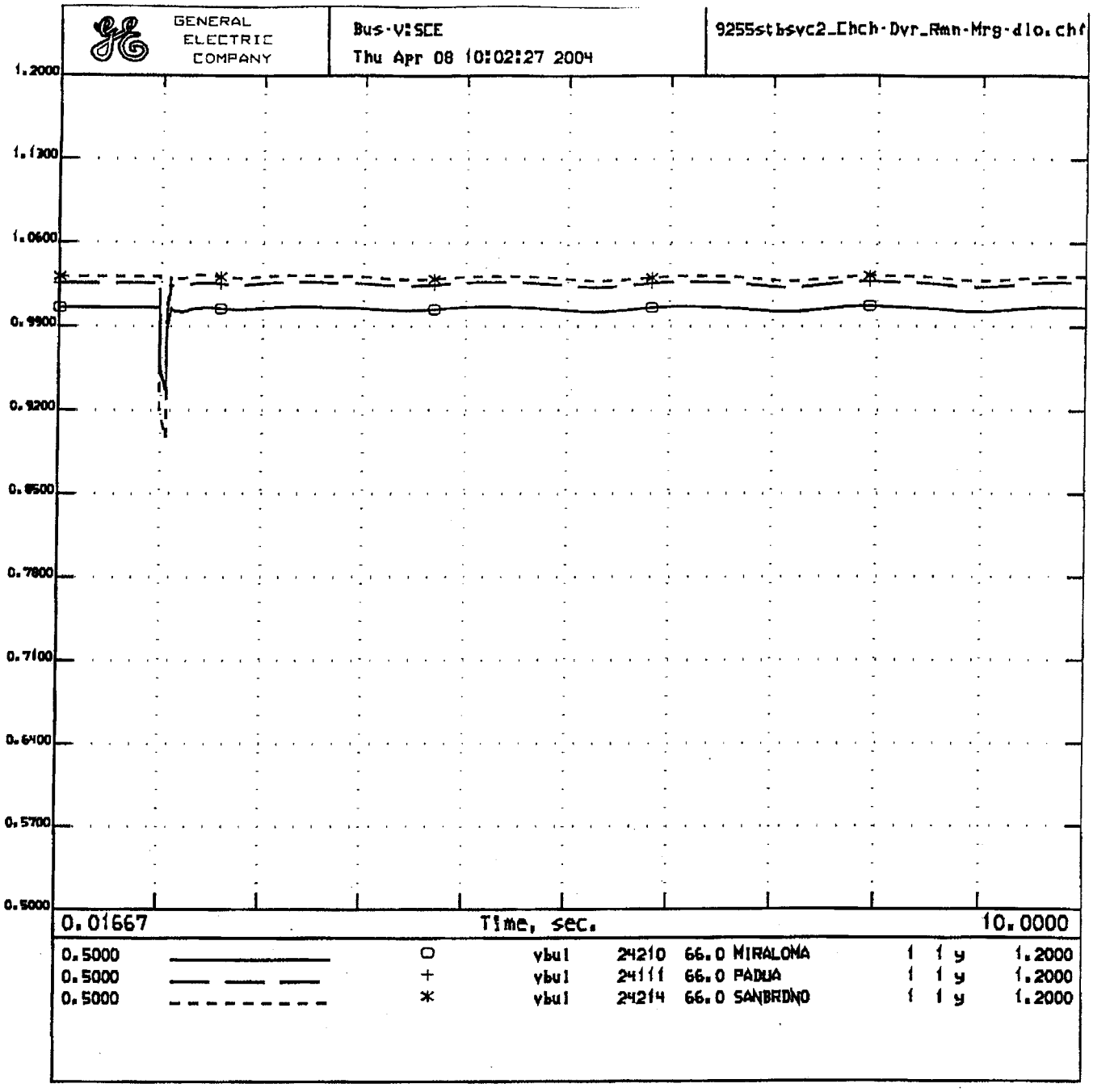

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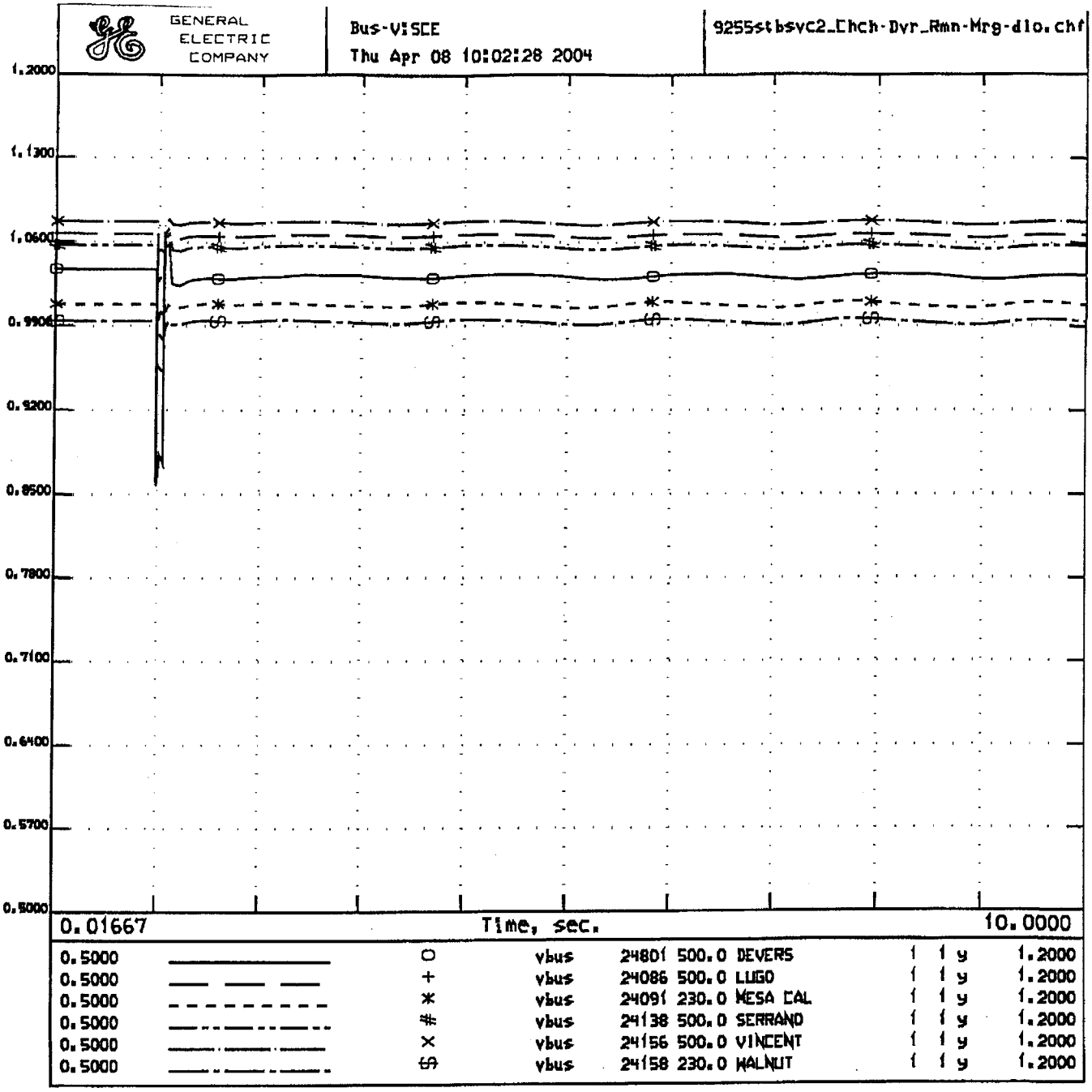

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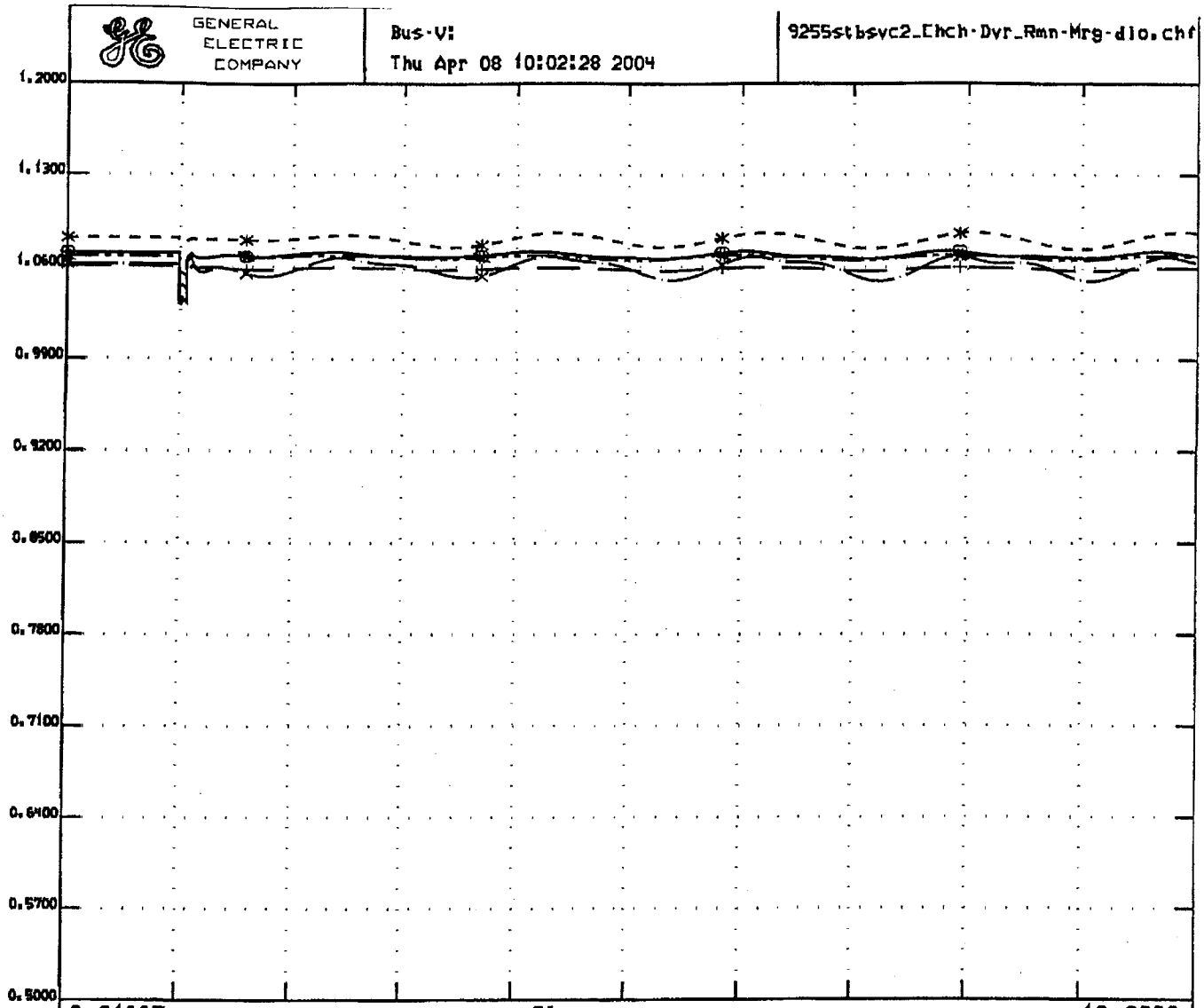

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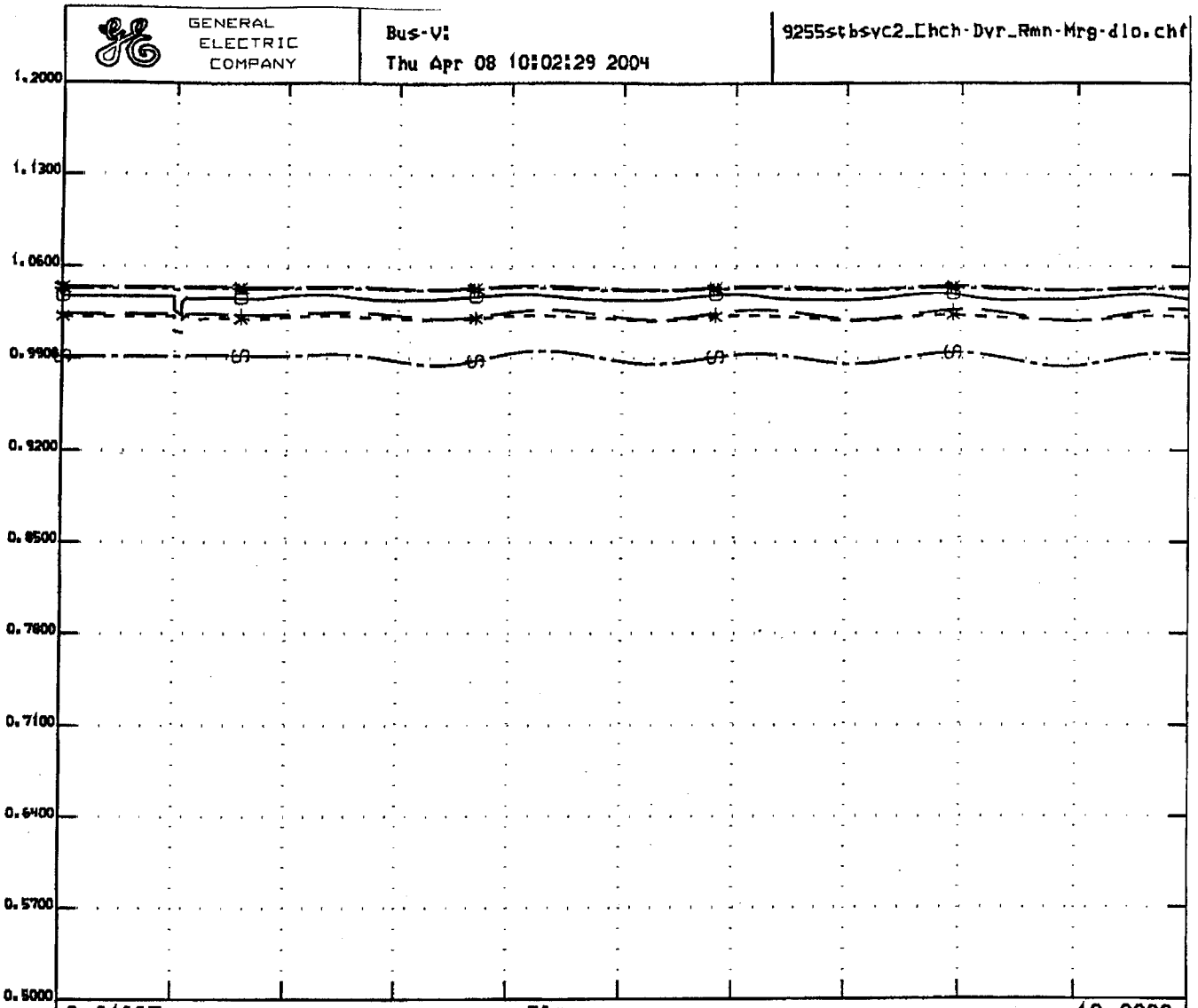

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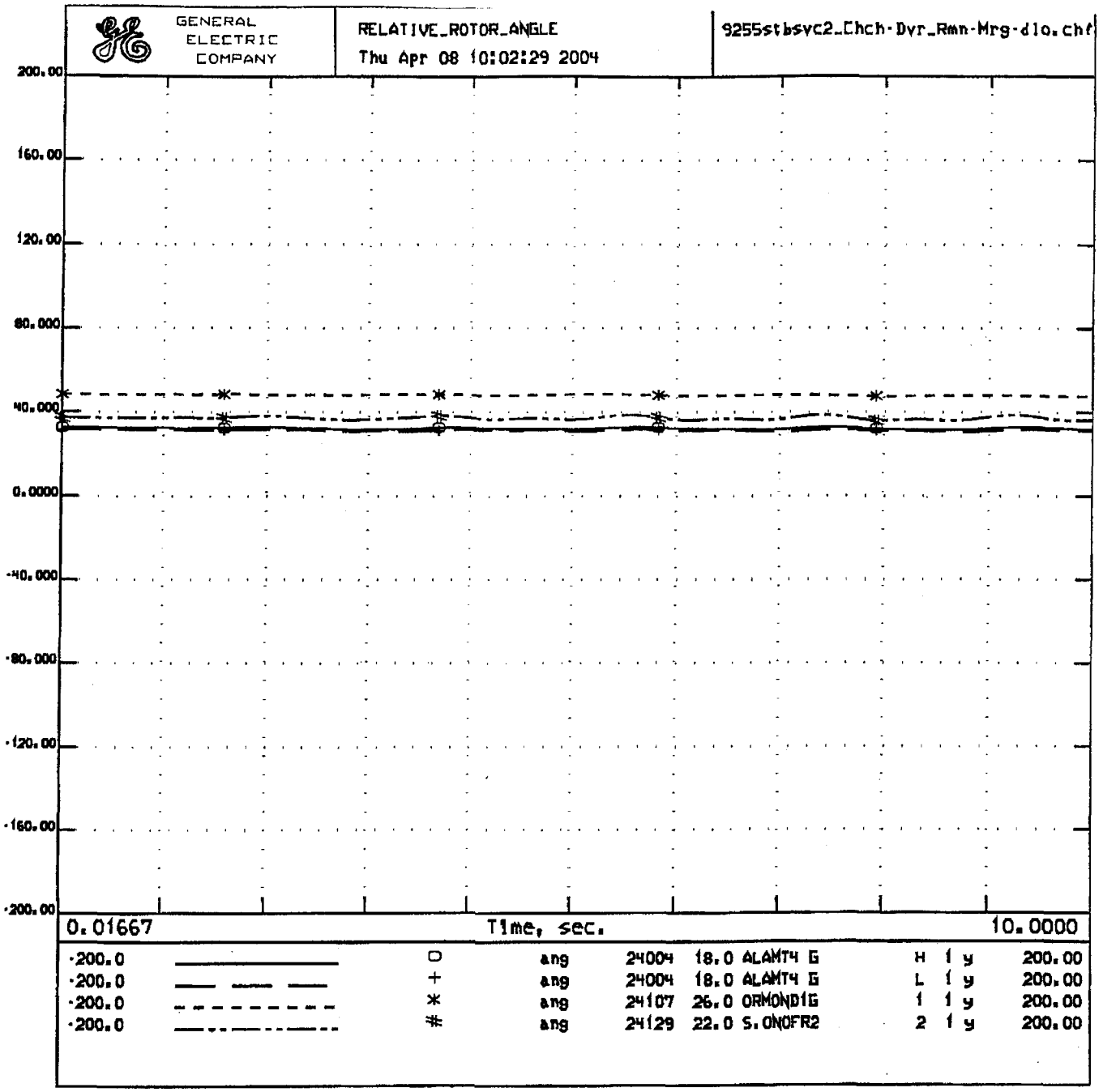

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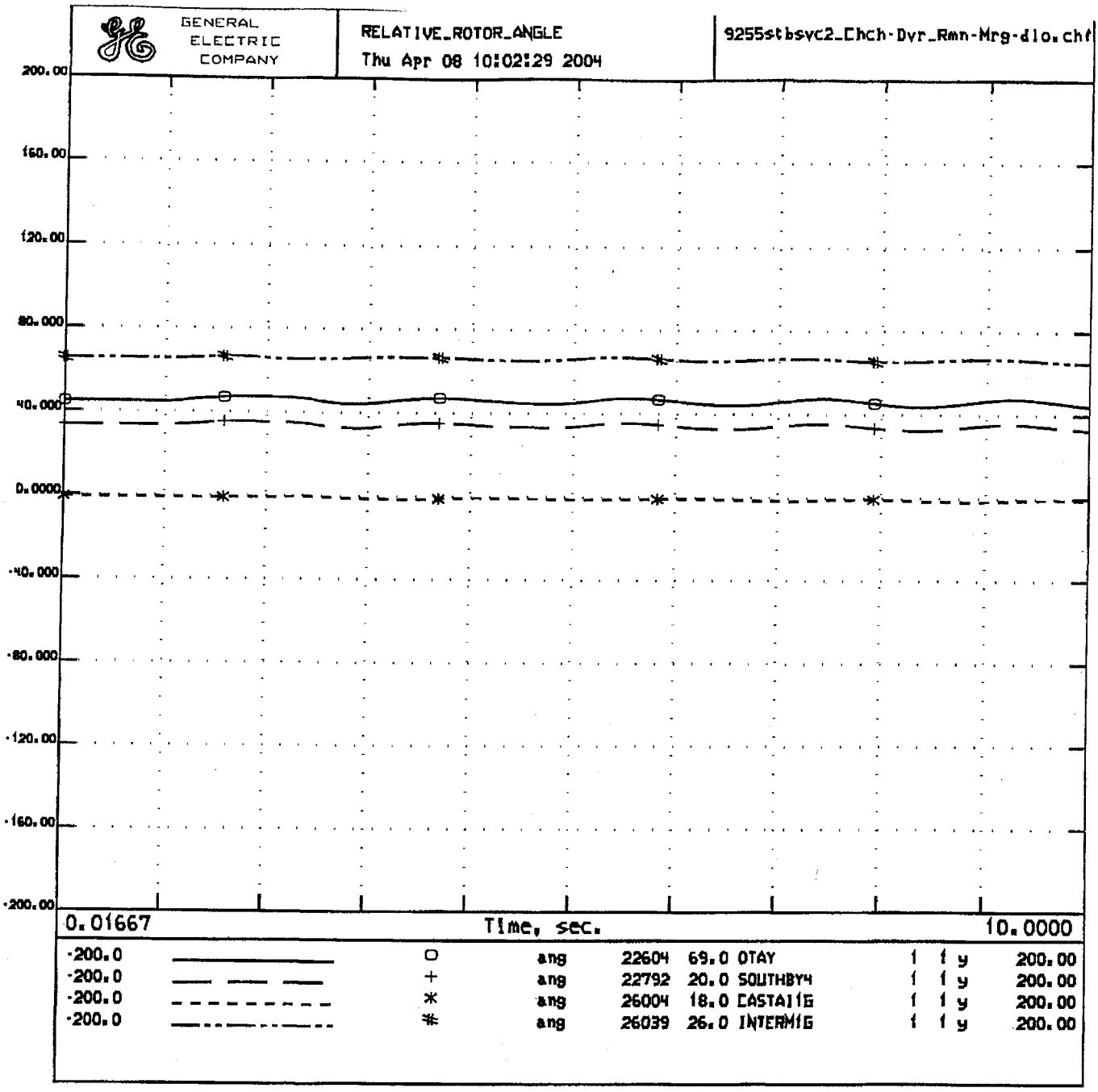

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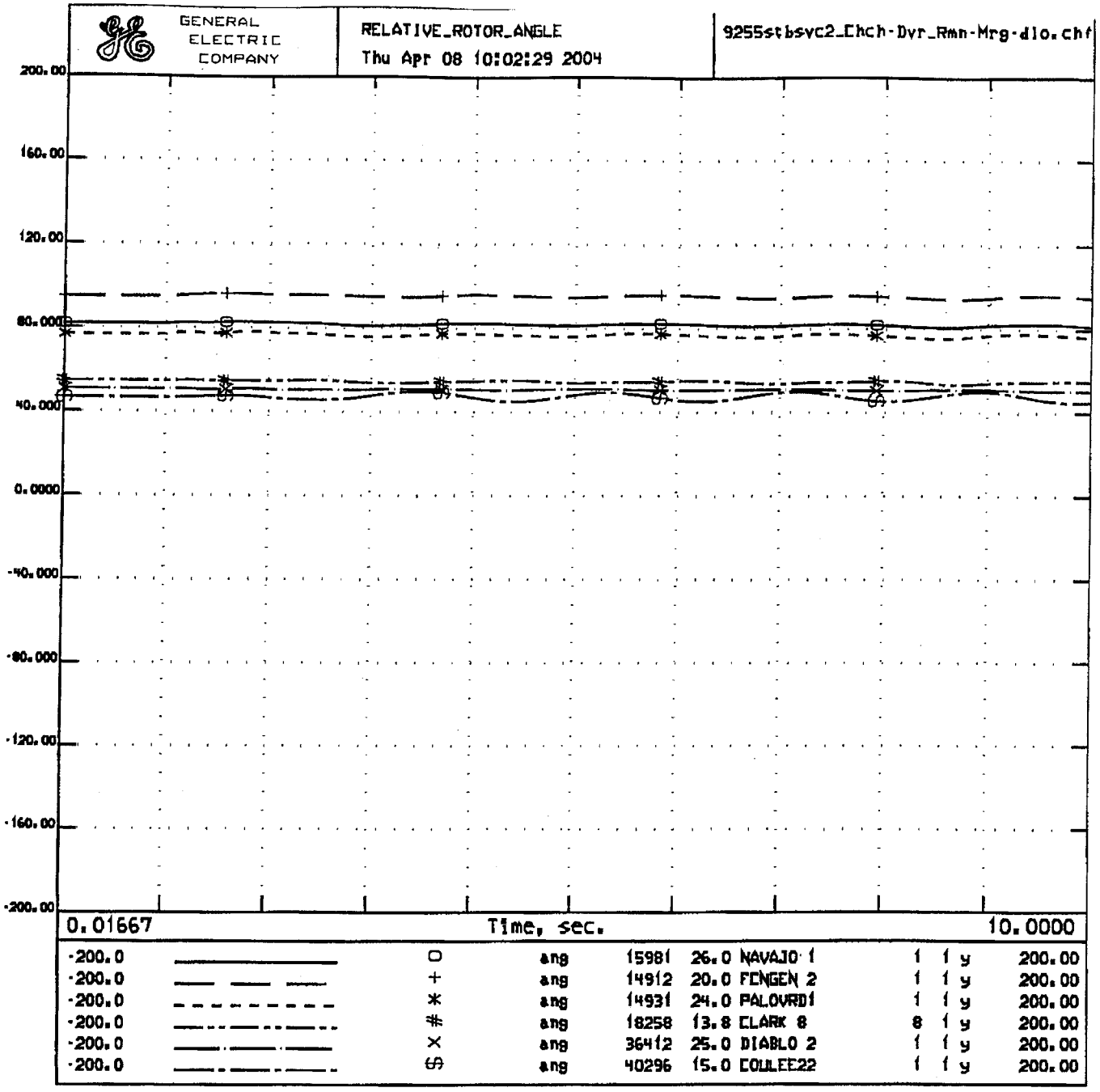

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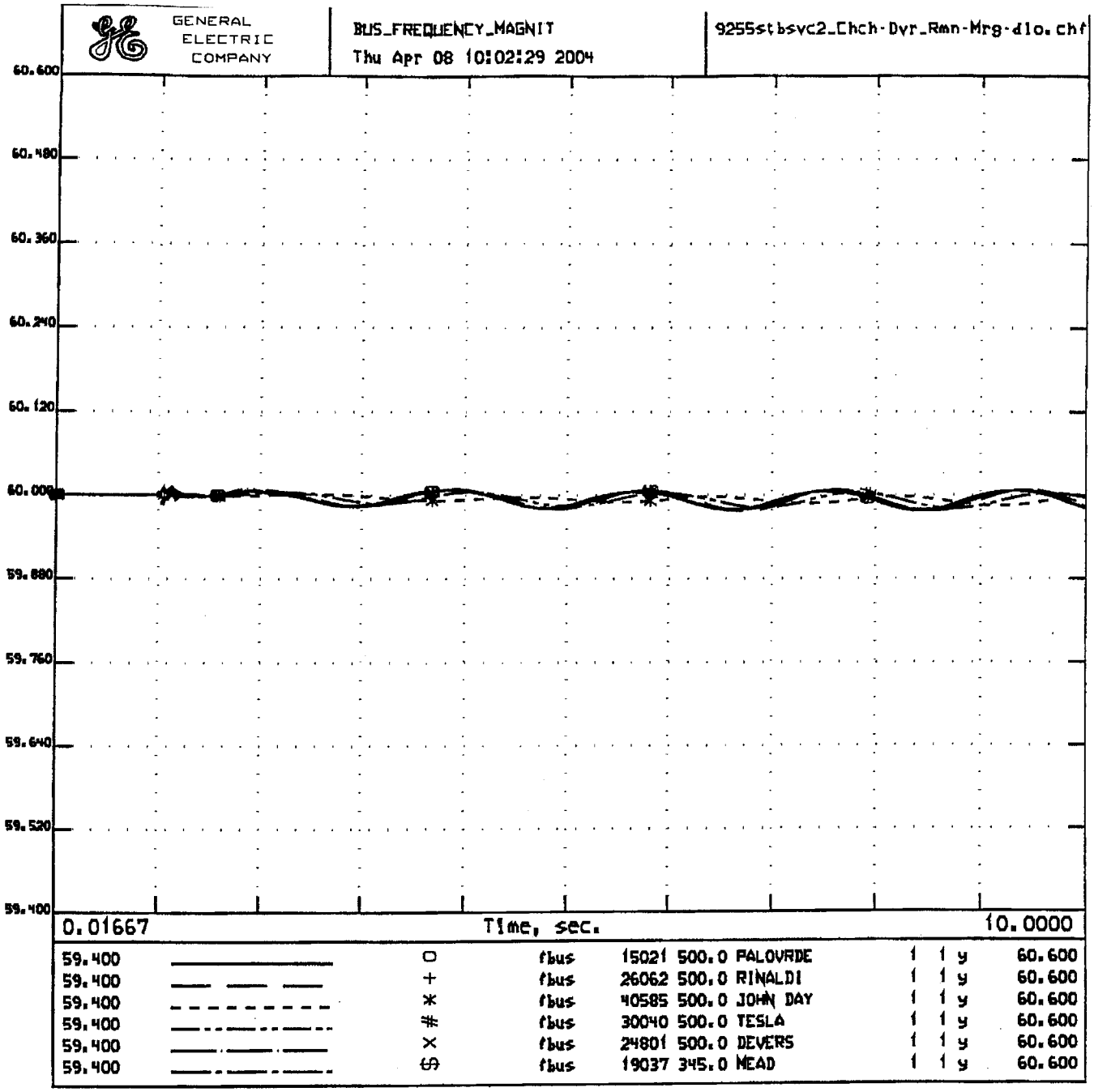

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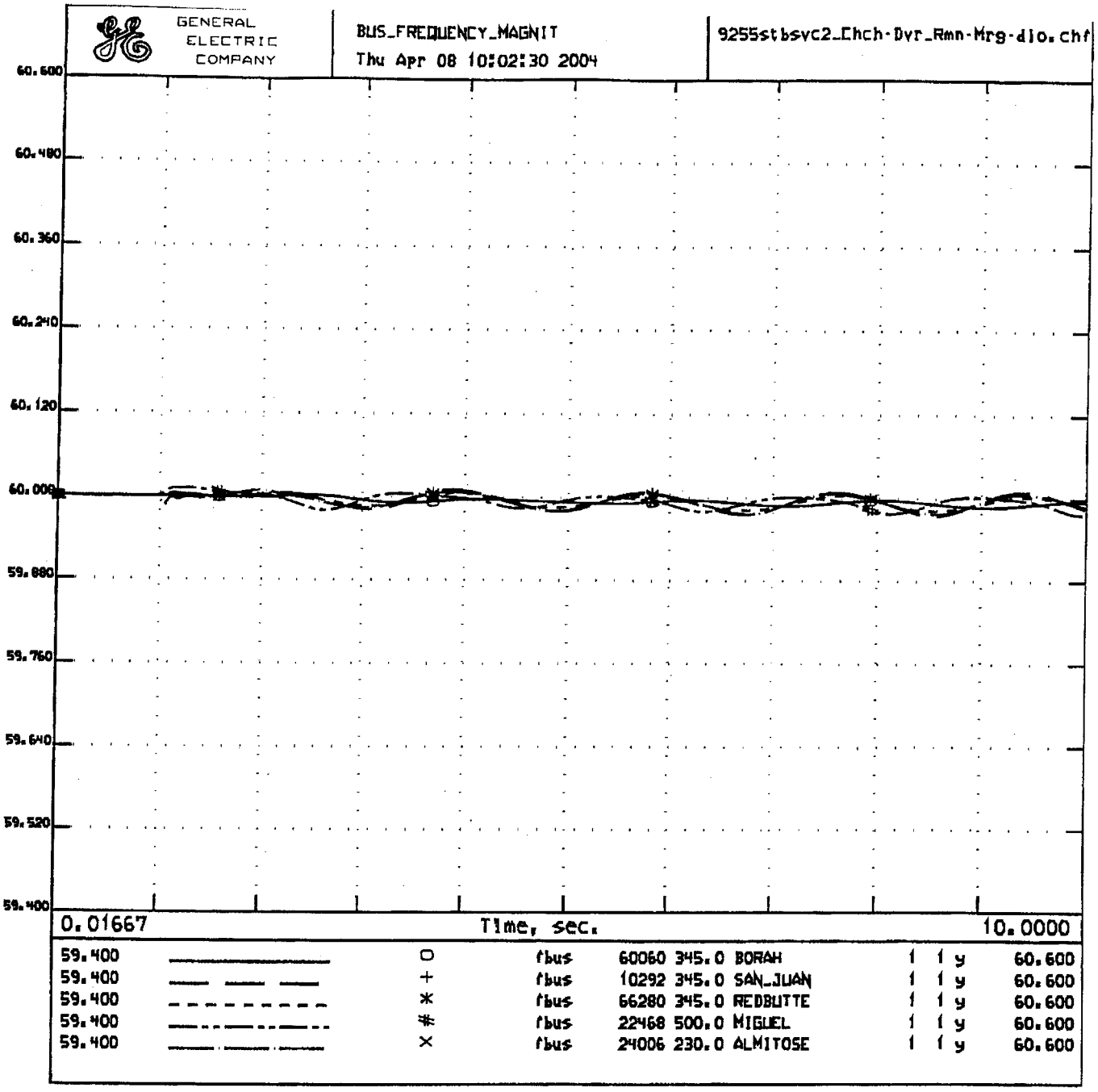

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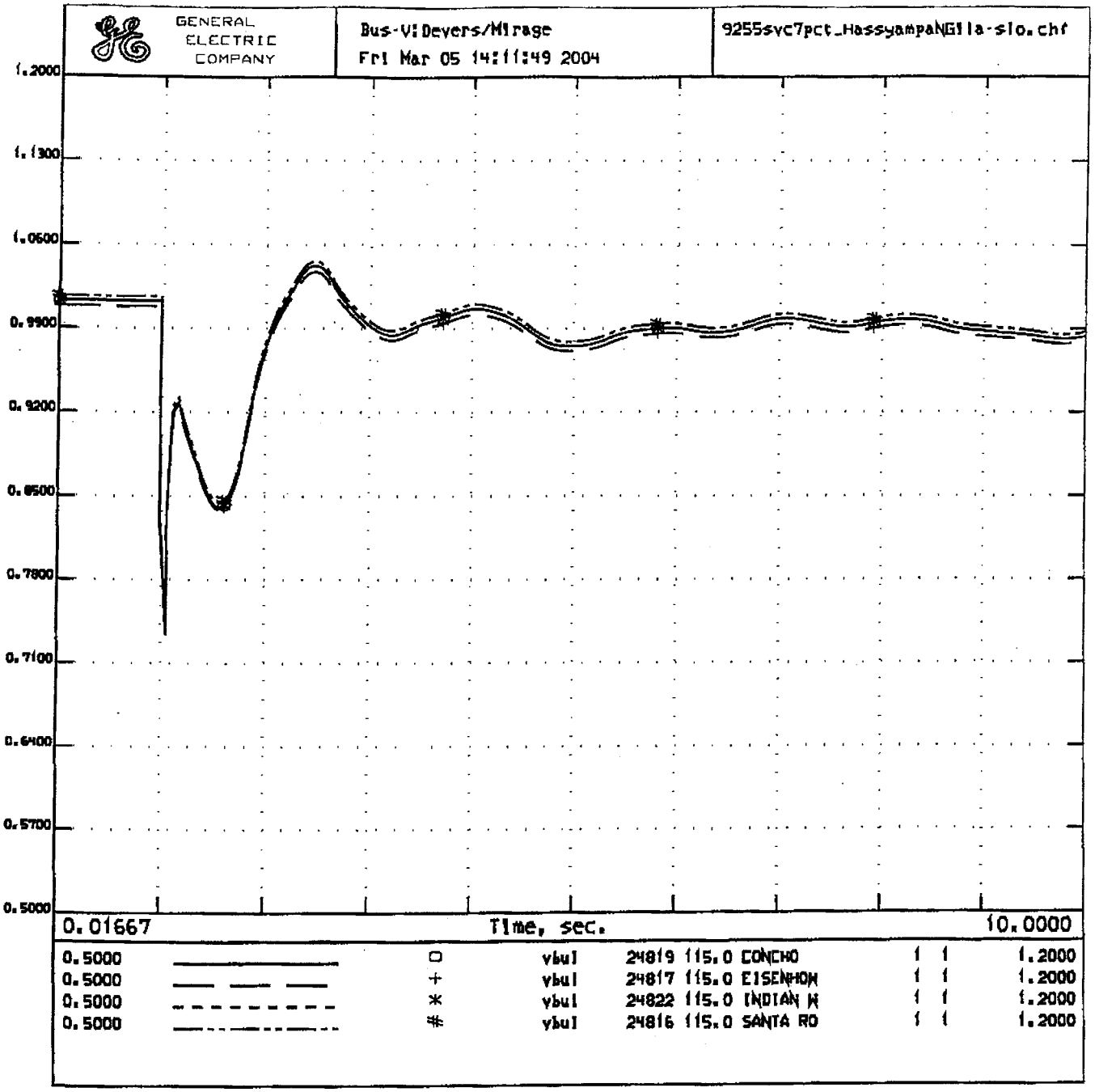
Transient Stability Study Plots - 12

CASE:	**Post-DPV2 with Path 49 at 9,903 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Hassayampa-North Gila 500 kV Line**
EOR MARGIN:	**7%**
NOTES:	



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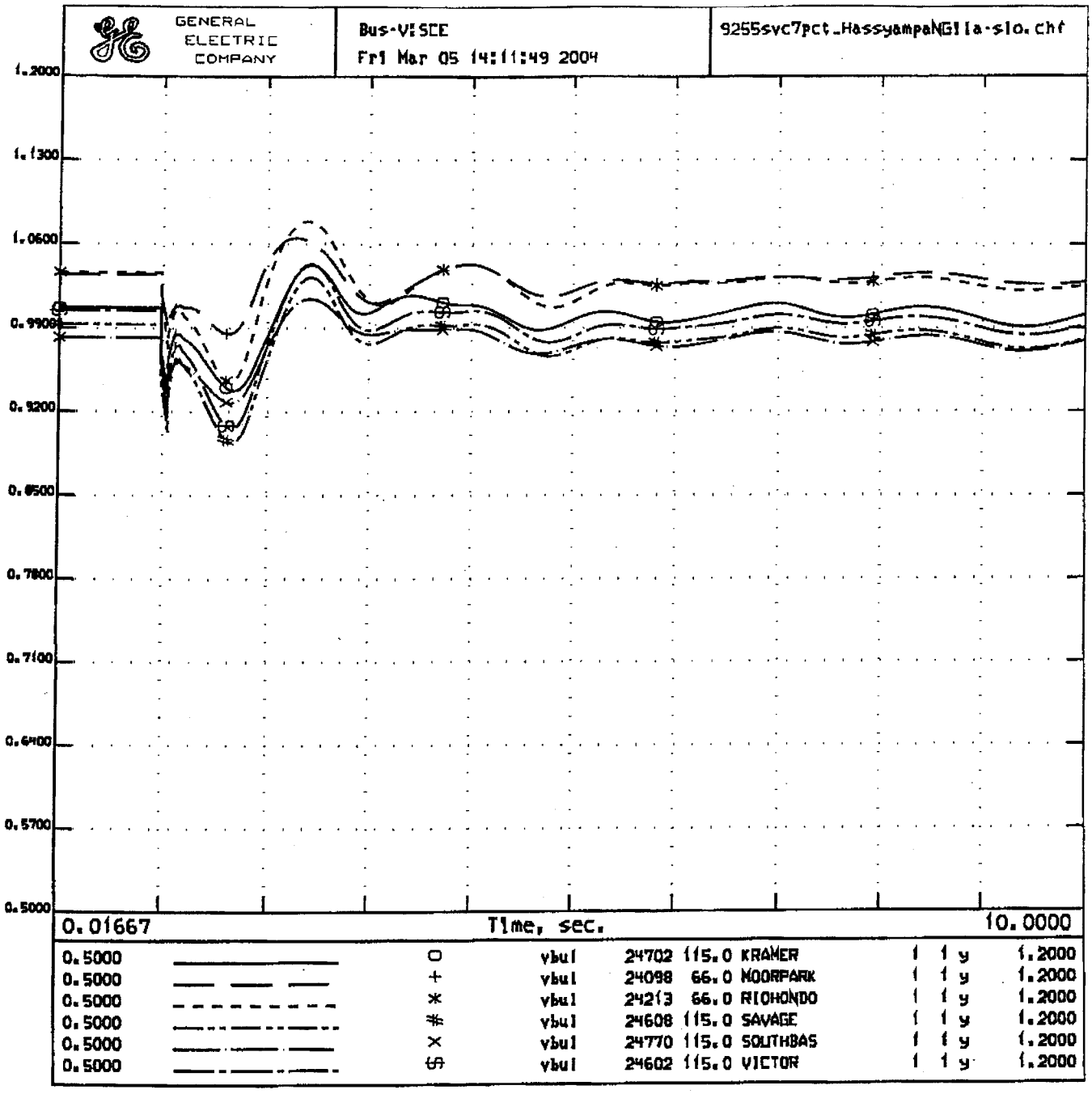

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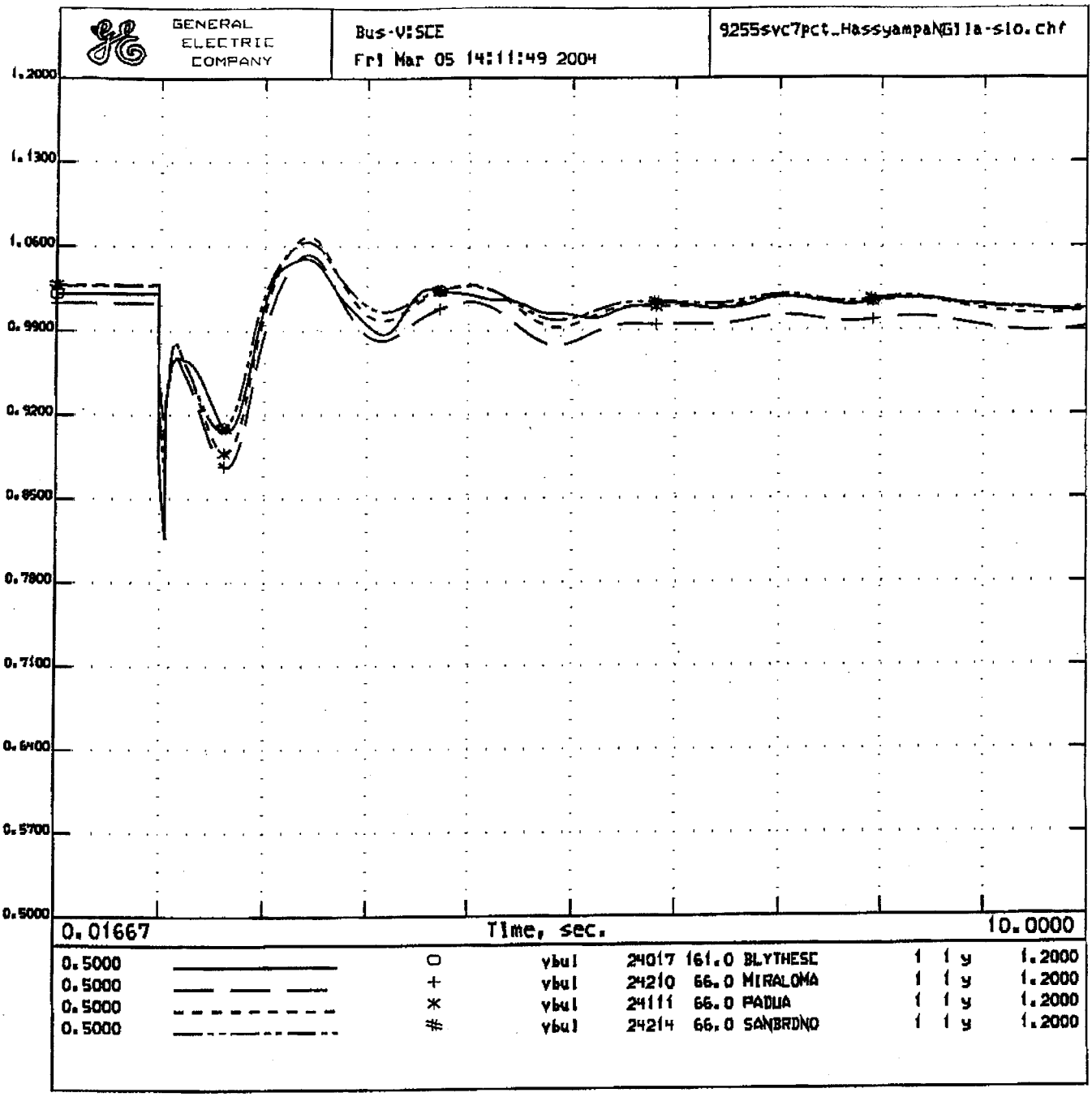

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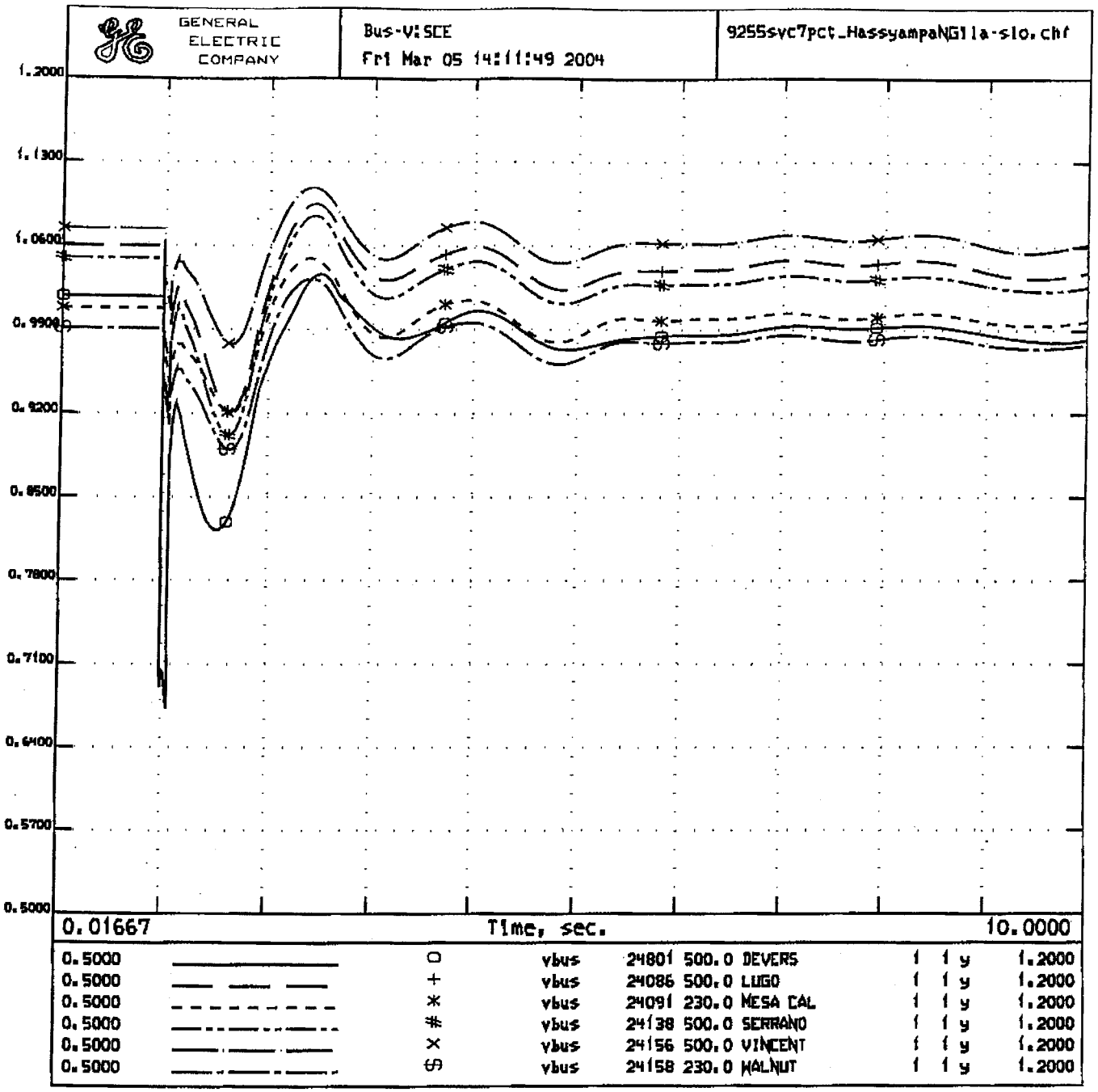

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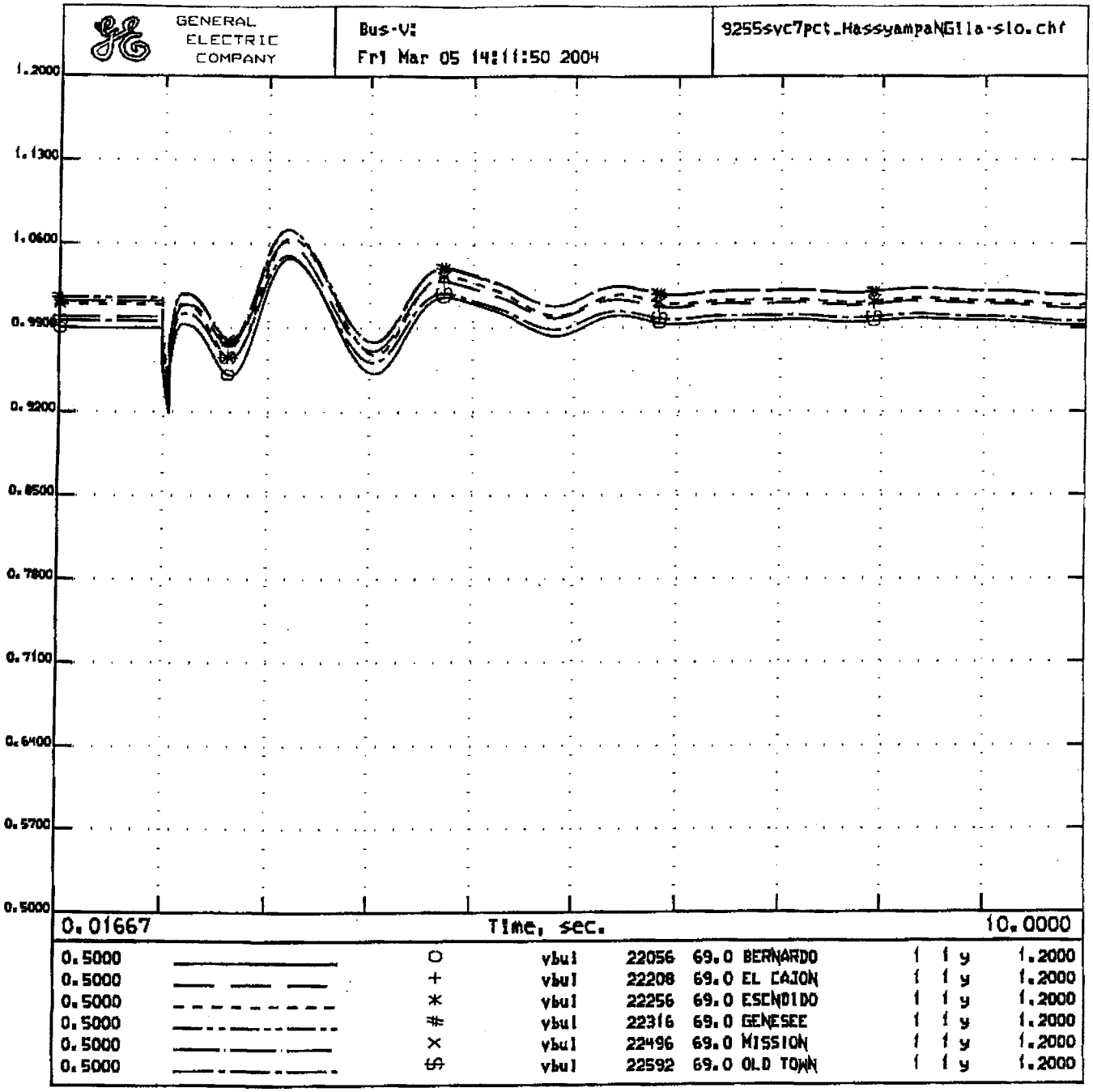

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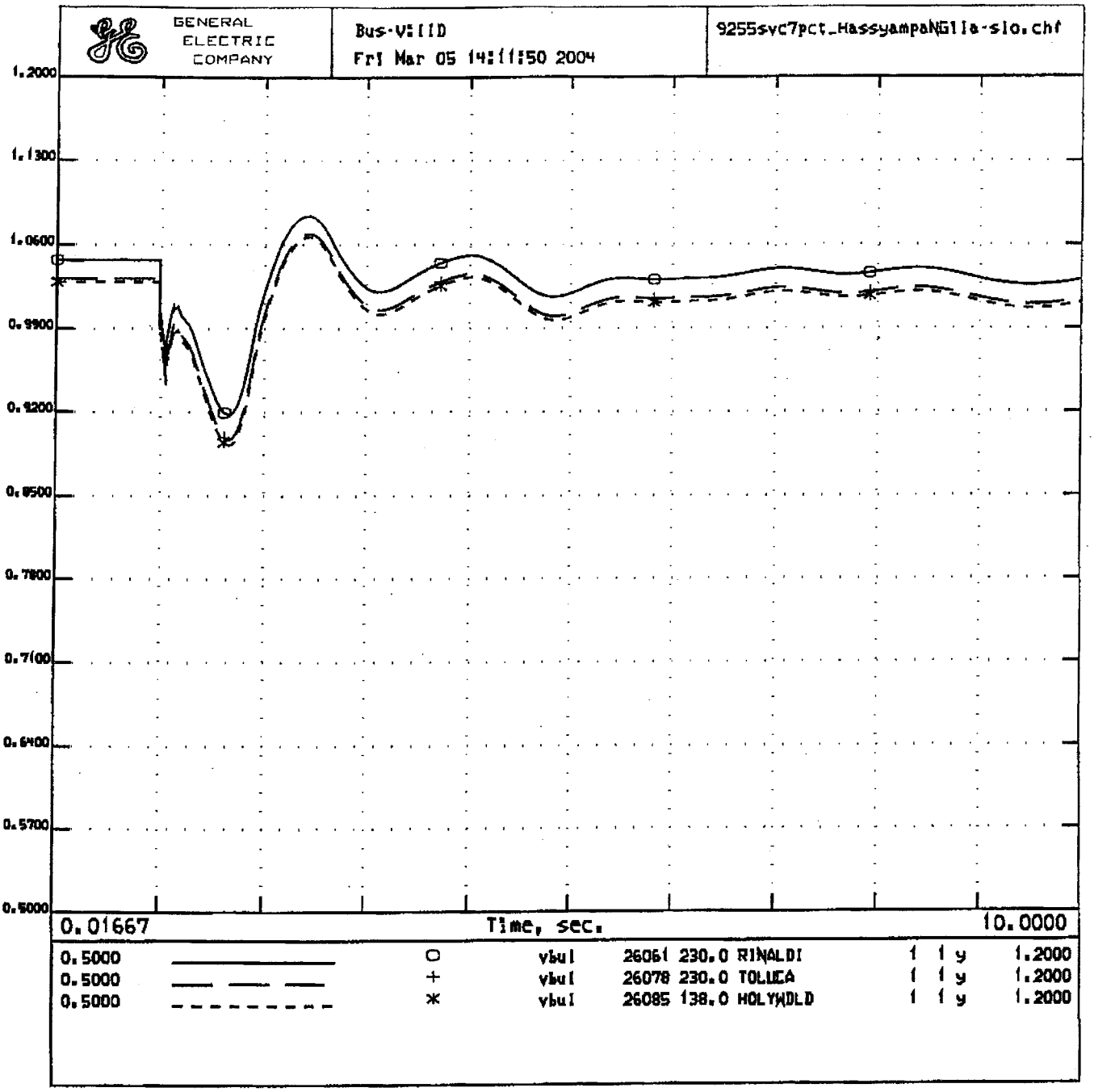

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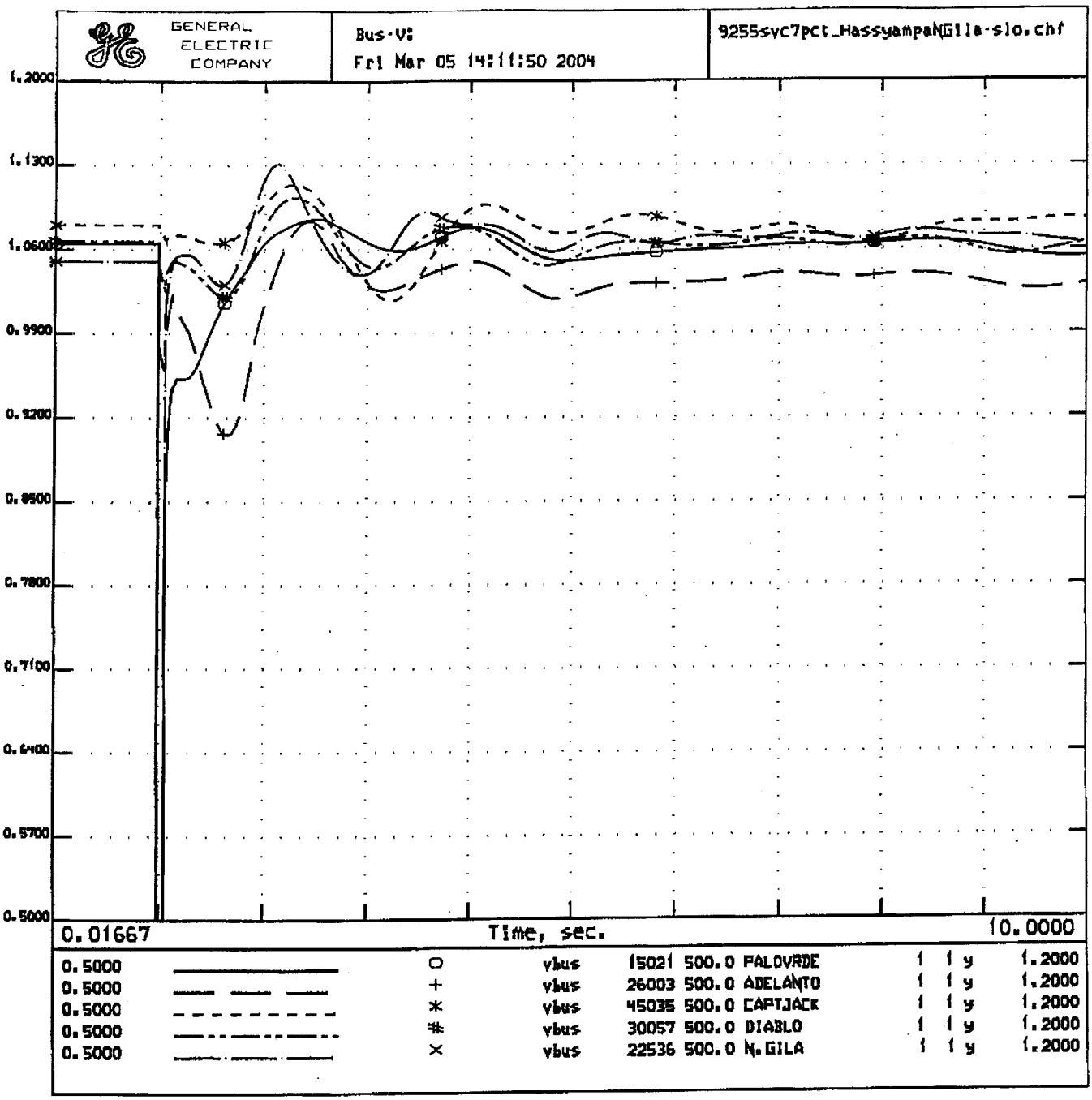

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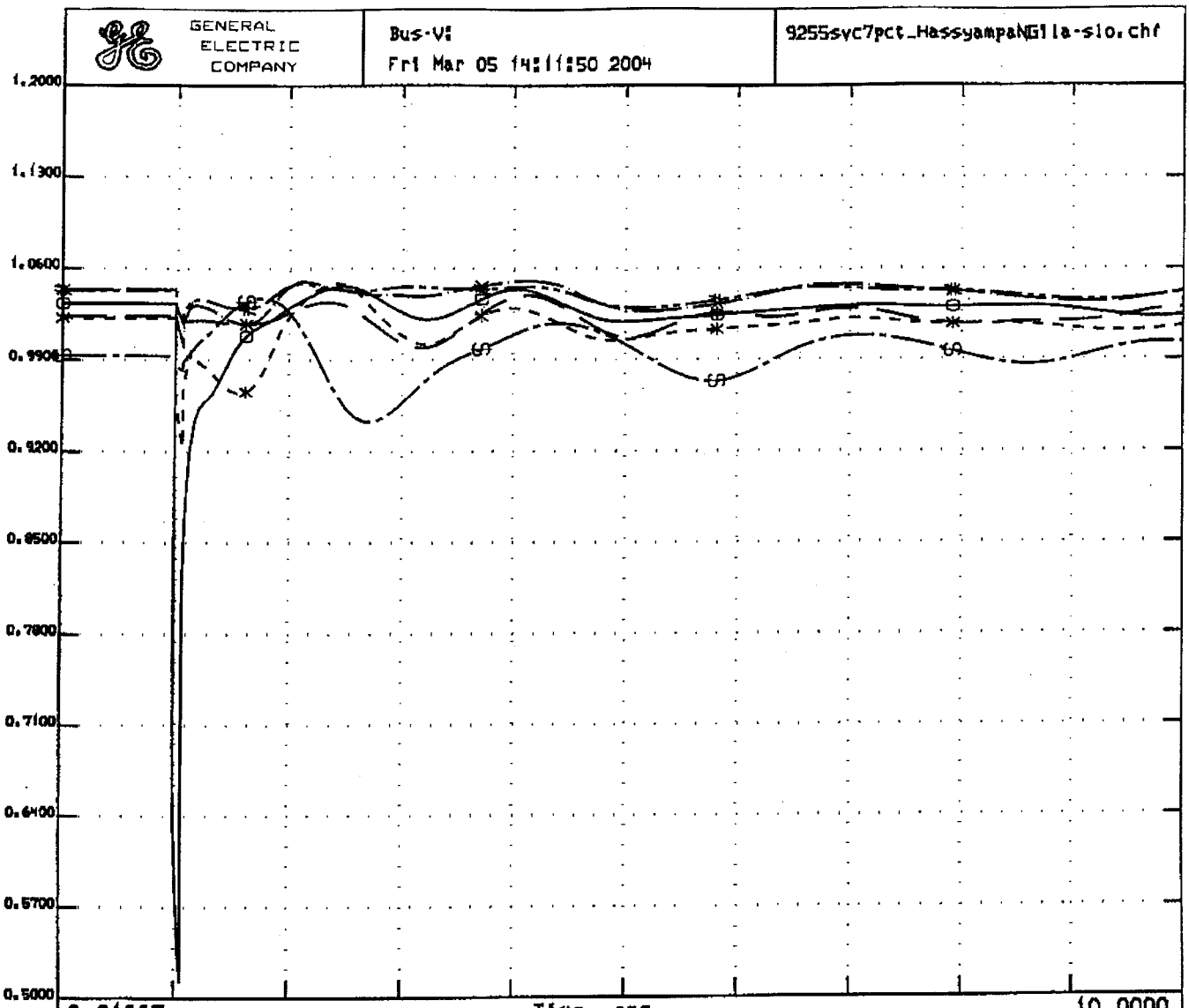
Change Impedance on Navaja-Crystal and Perkins-Mead 500 kV lines

Gens fine tuned for dynamic runs
Add 2x388 MVAR SVCs each at Devers and Valley 500kV substations



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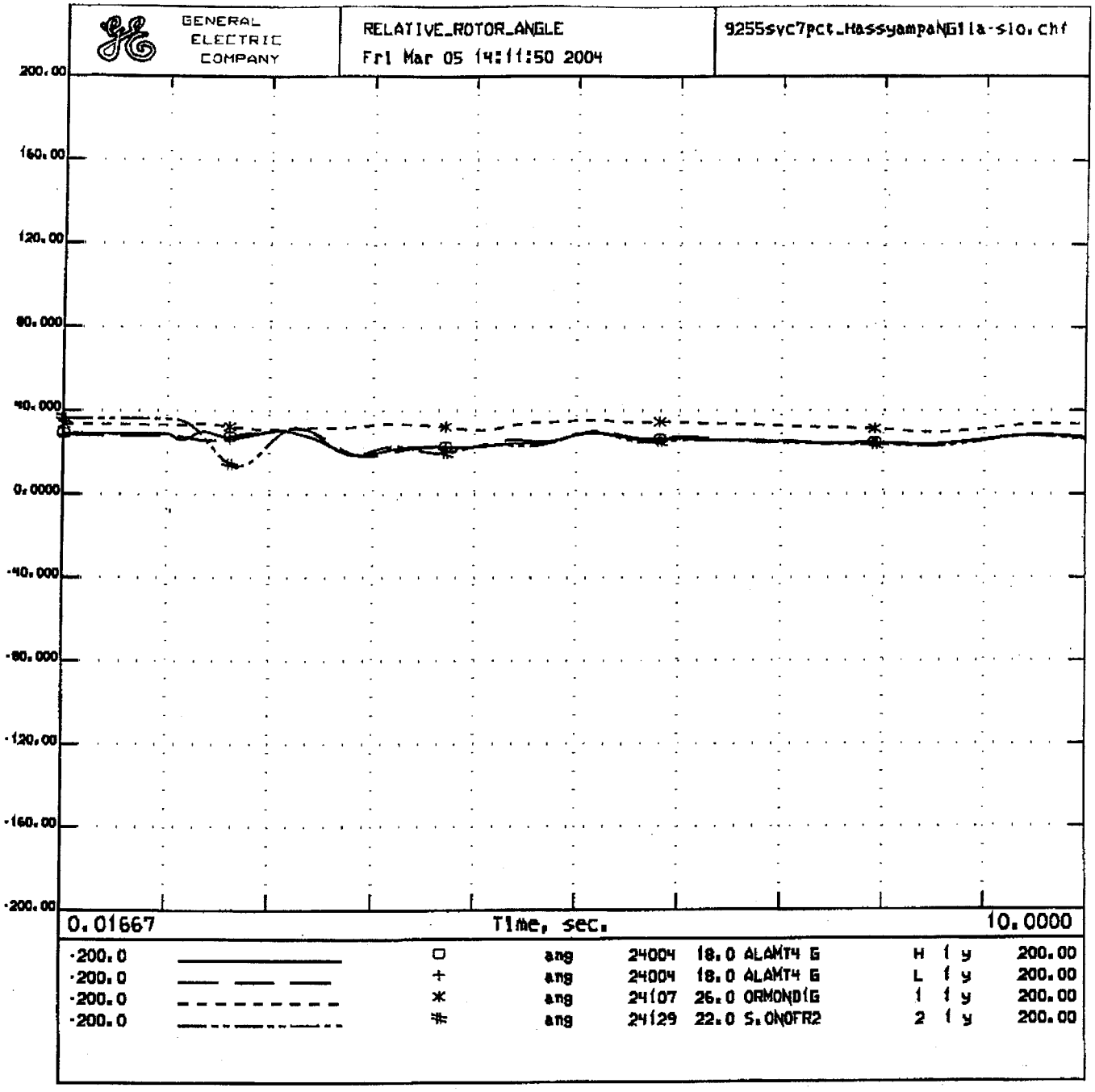

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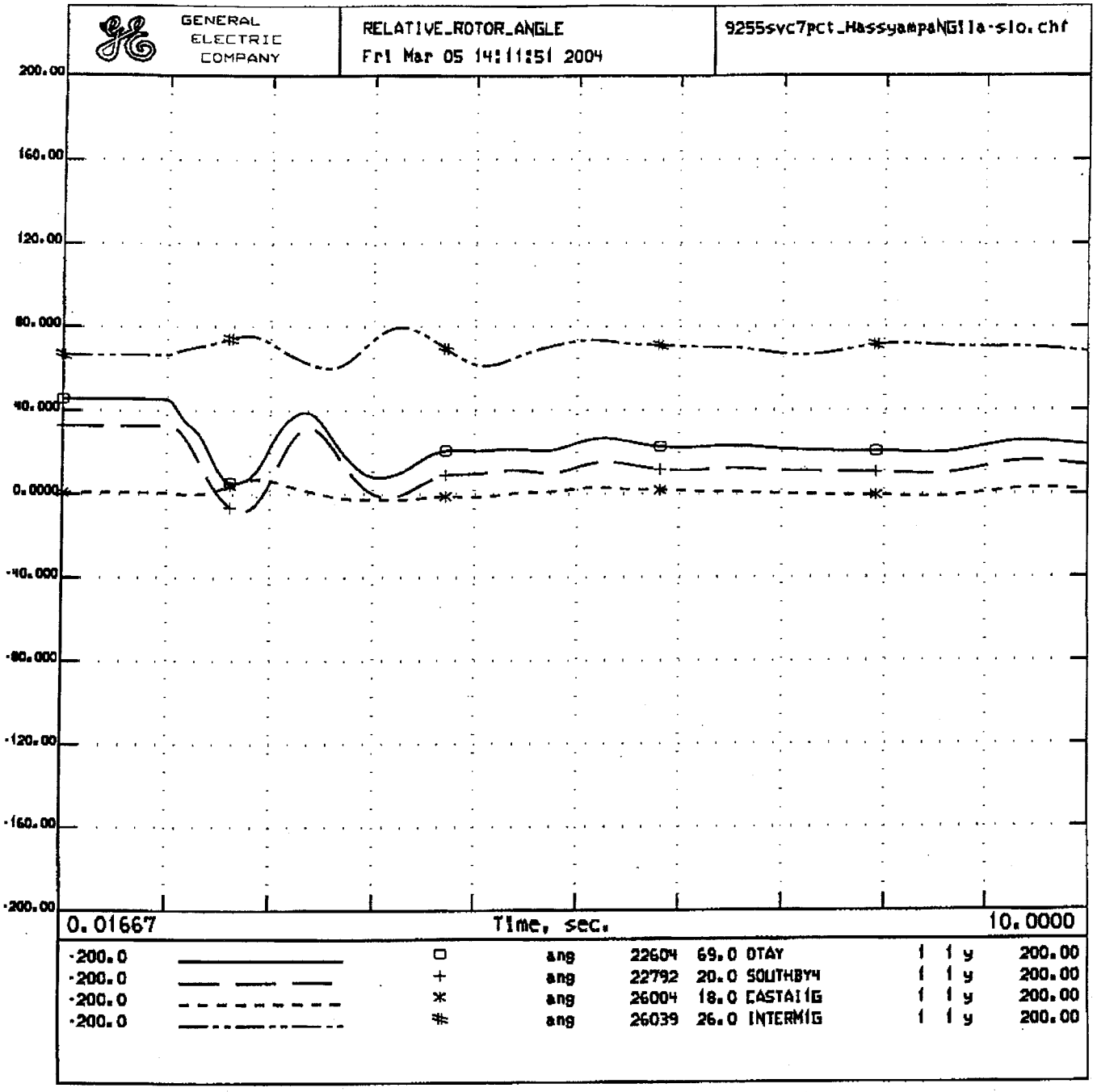

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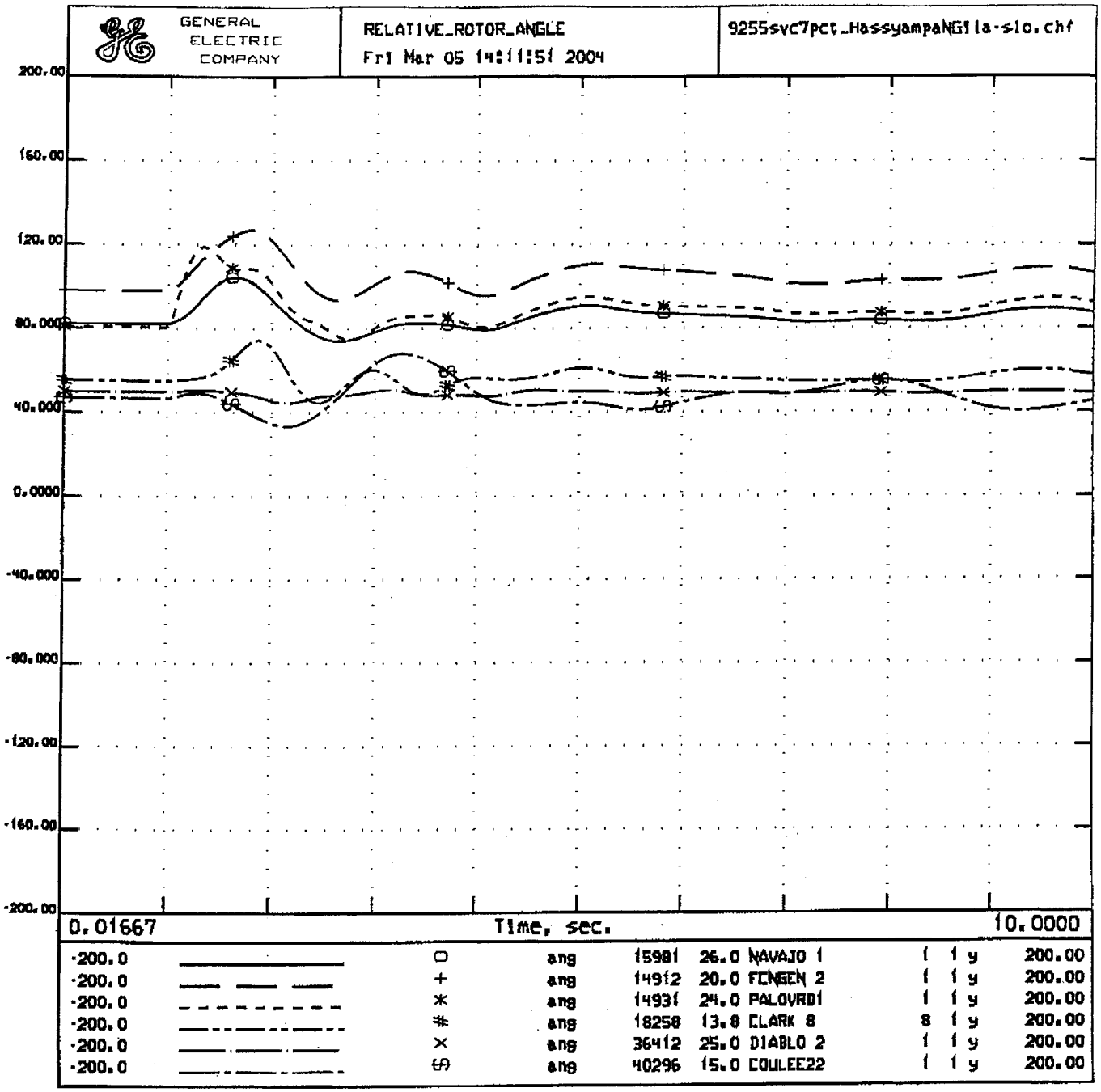

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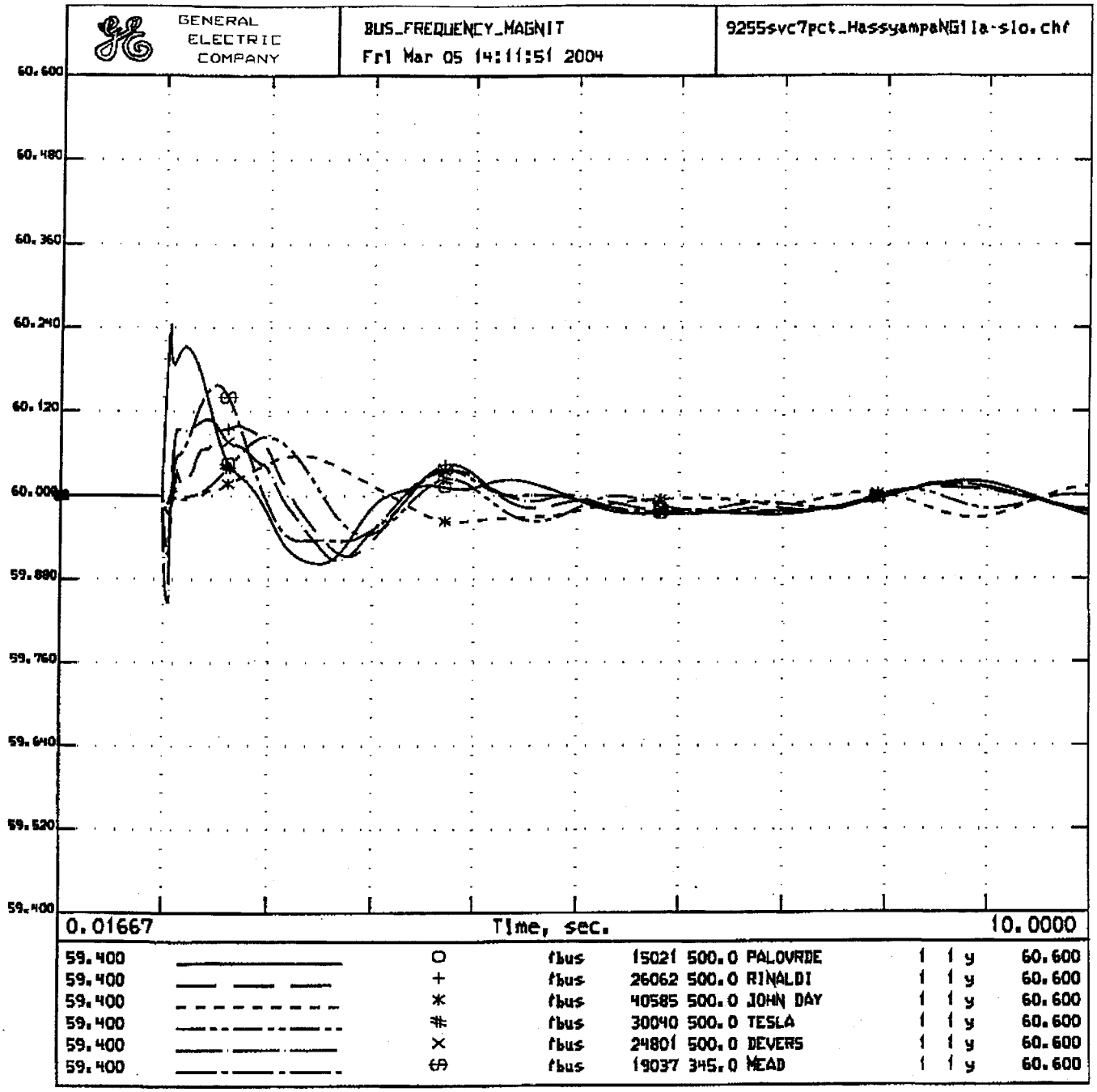

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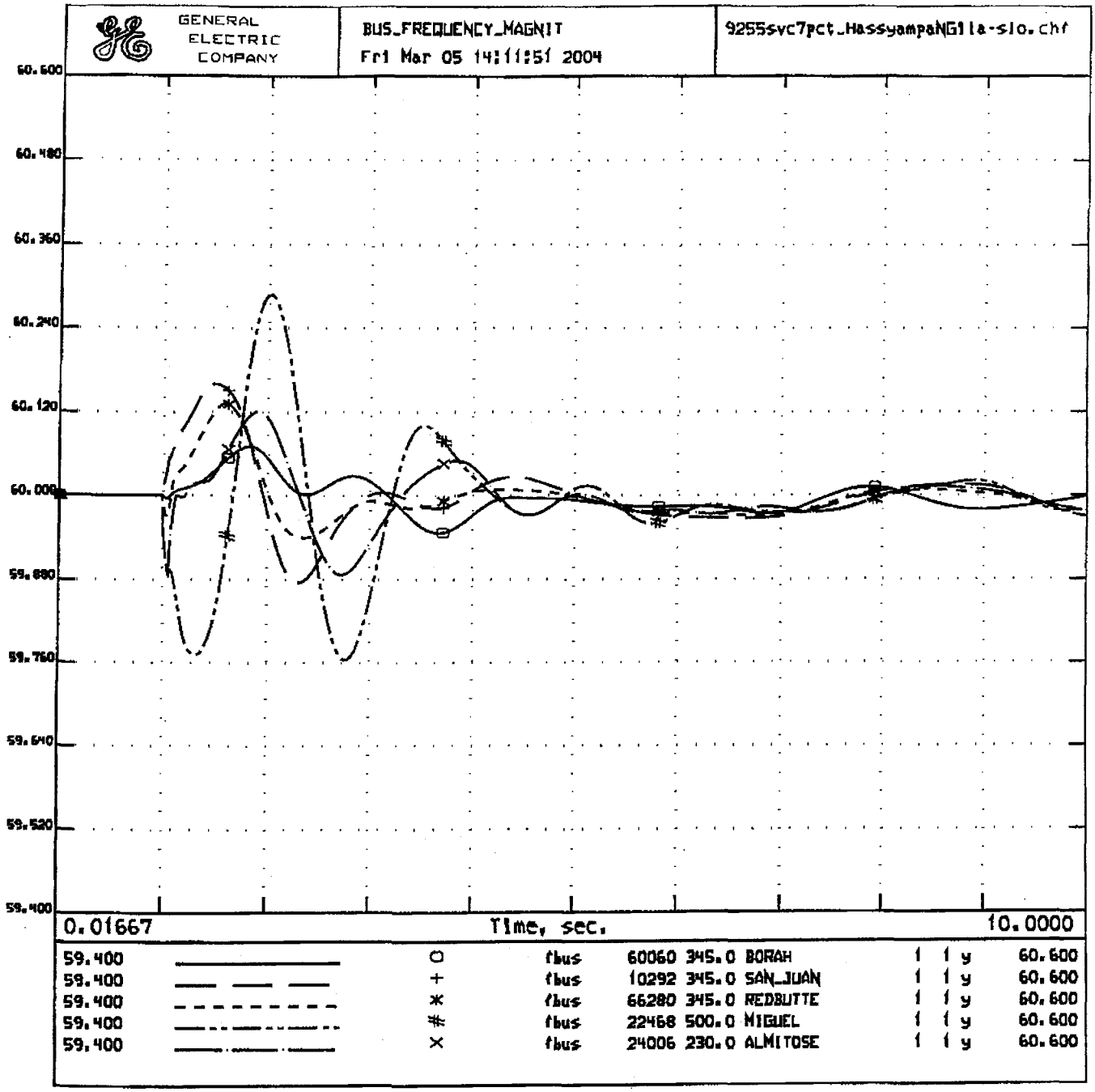

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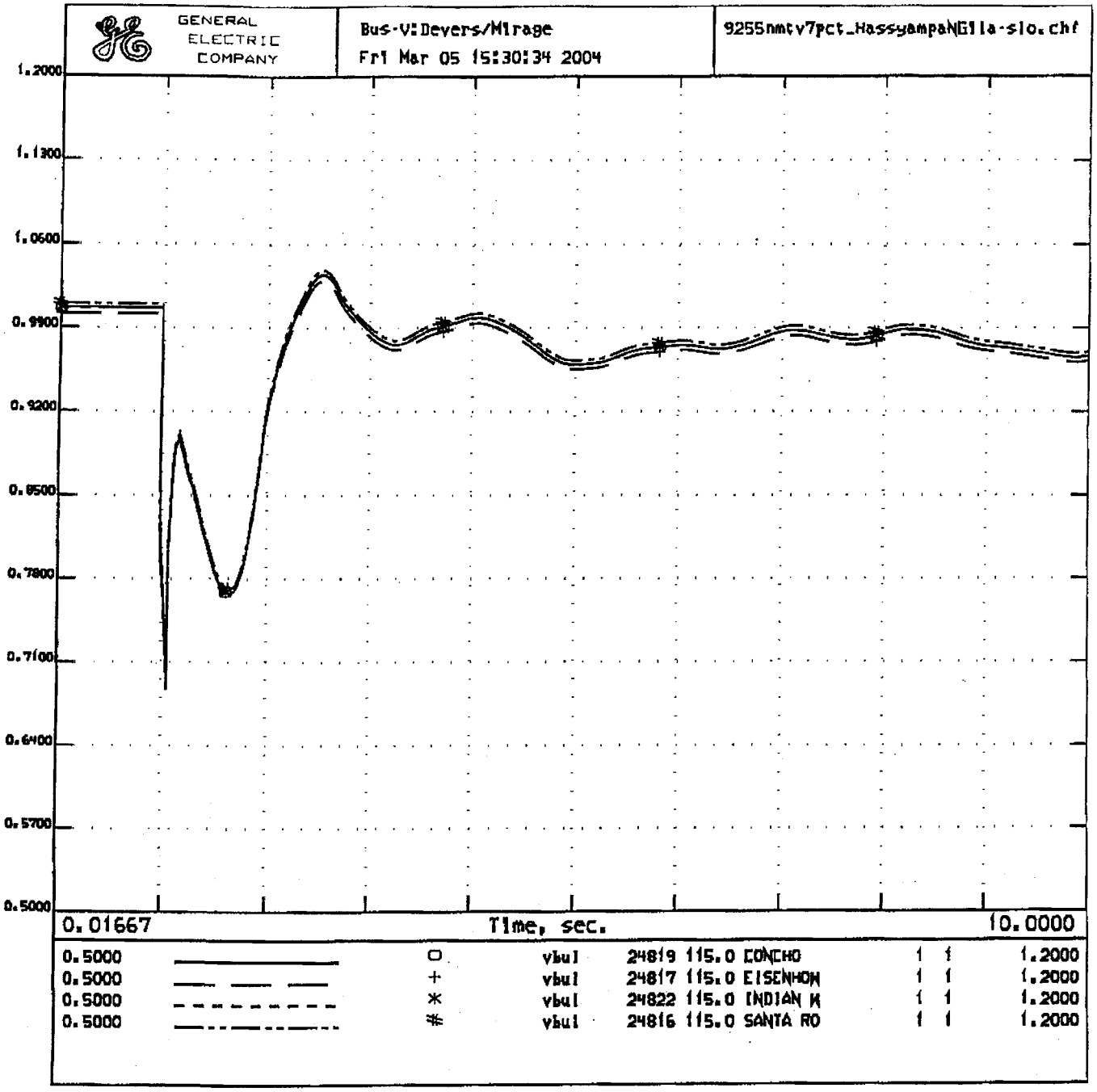
Transient Stability Study Plots - 13

CASE:	**Post-DPV2 with Path 49 at 9,903 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-1**
OUTAGE:	**Hassayampa-North Gila 500 kV Line**
EOR MARGIN:	**7%**
NOTES:	**Without Mountainview Generation Project**



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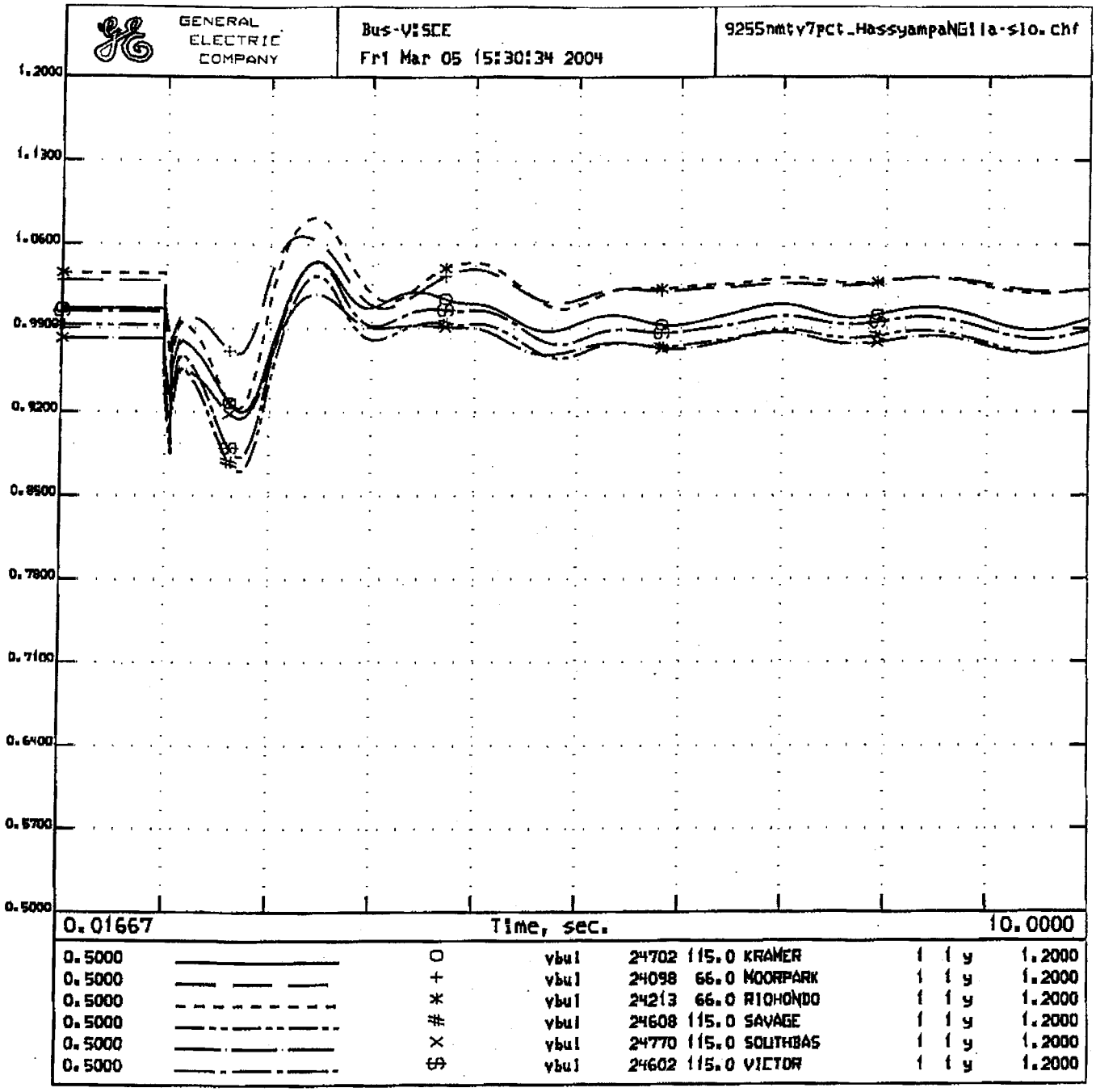

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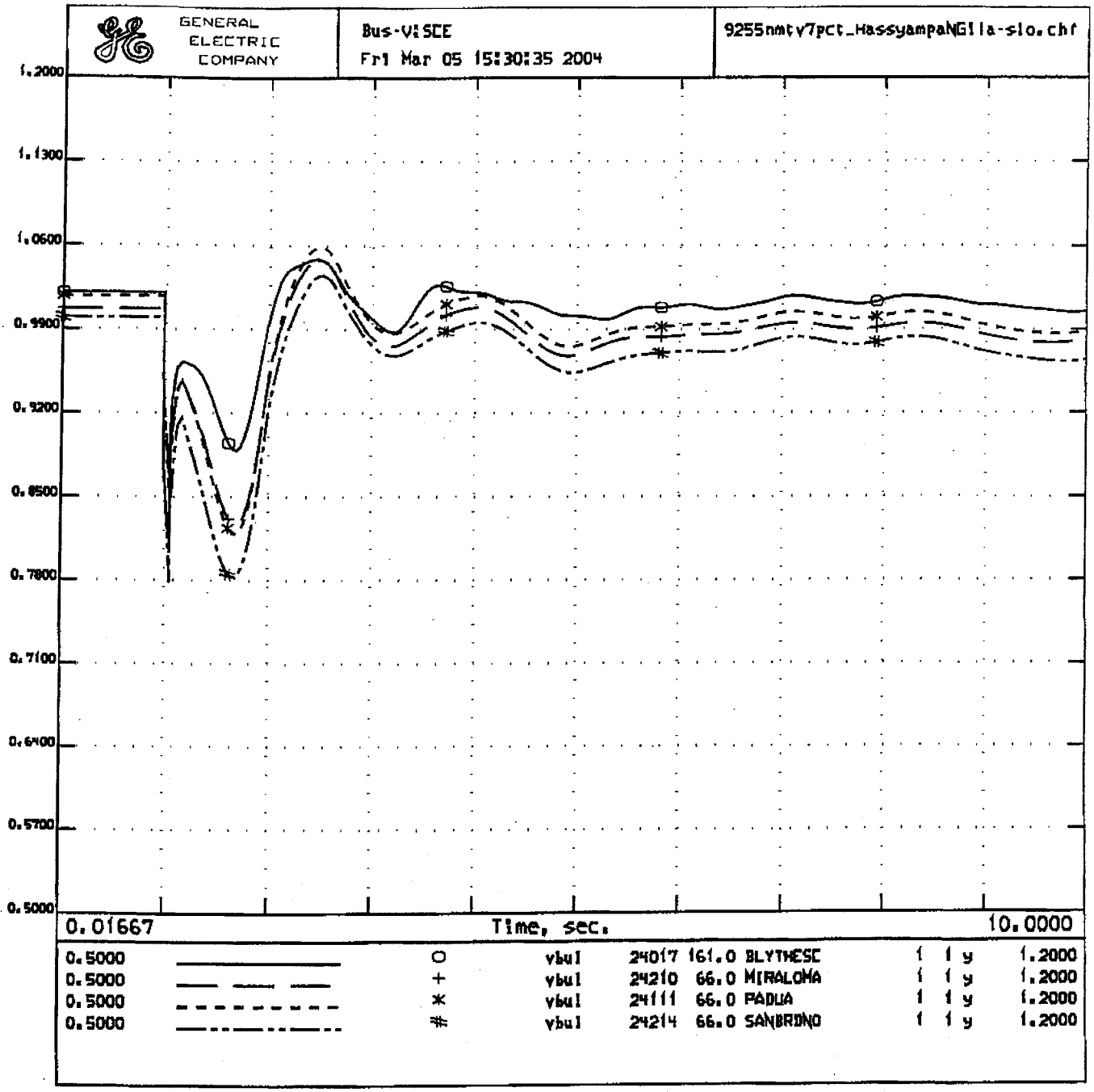

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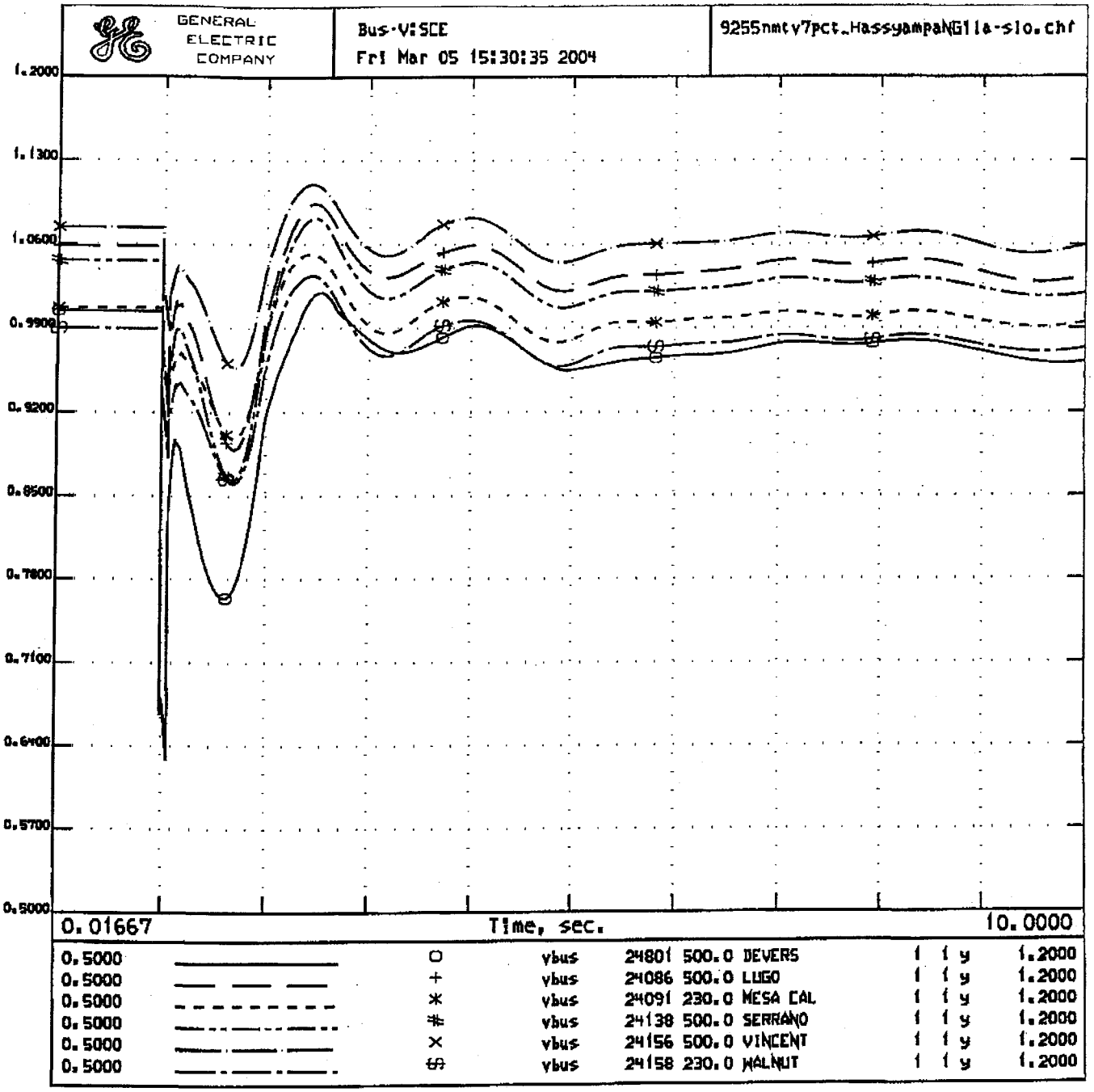

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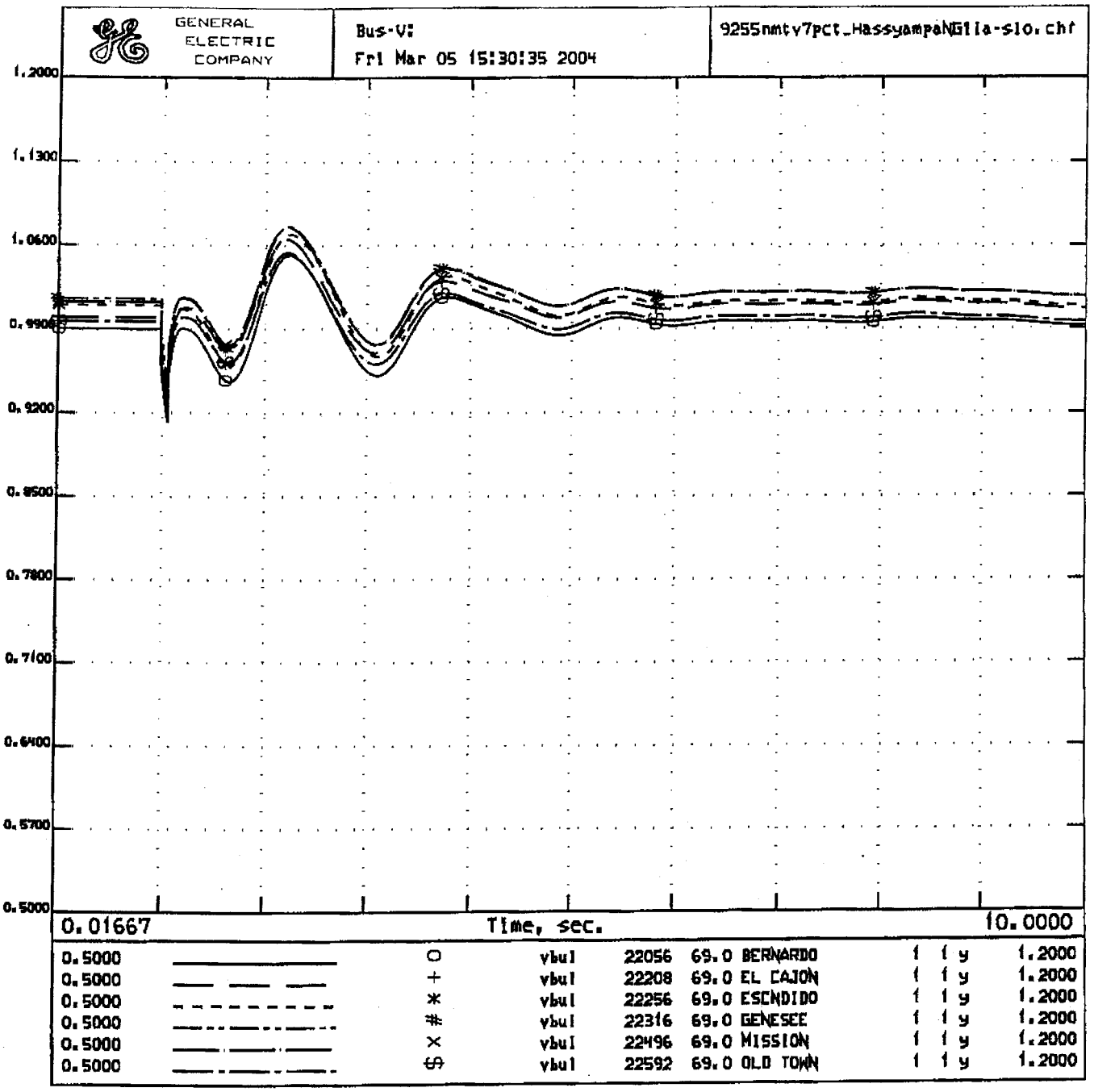

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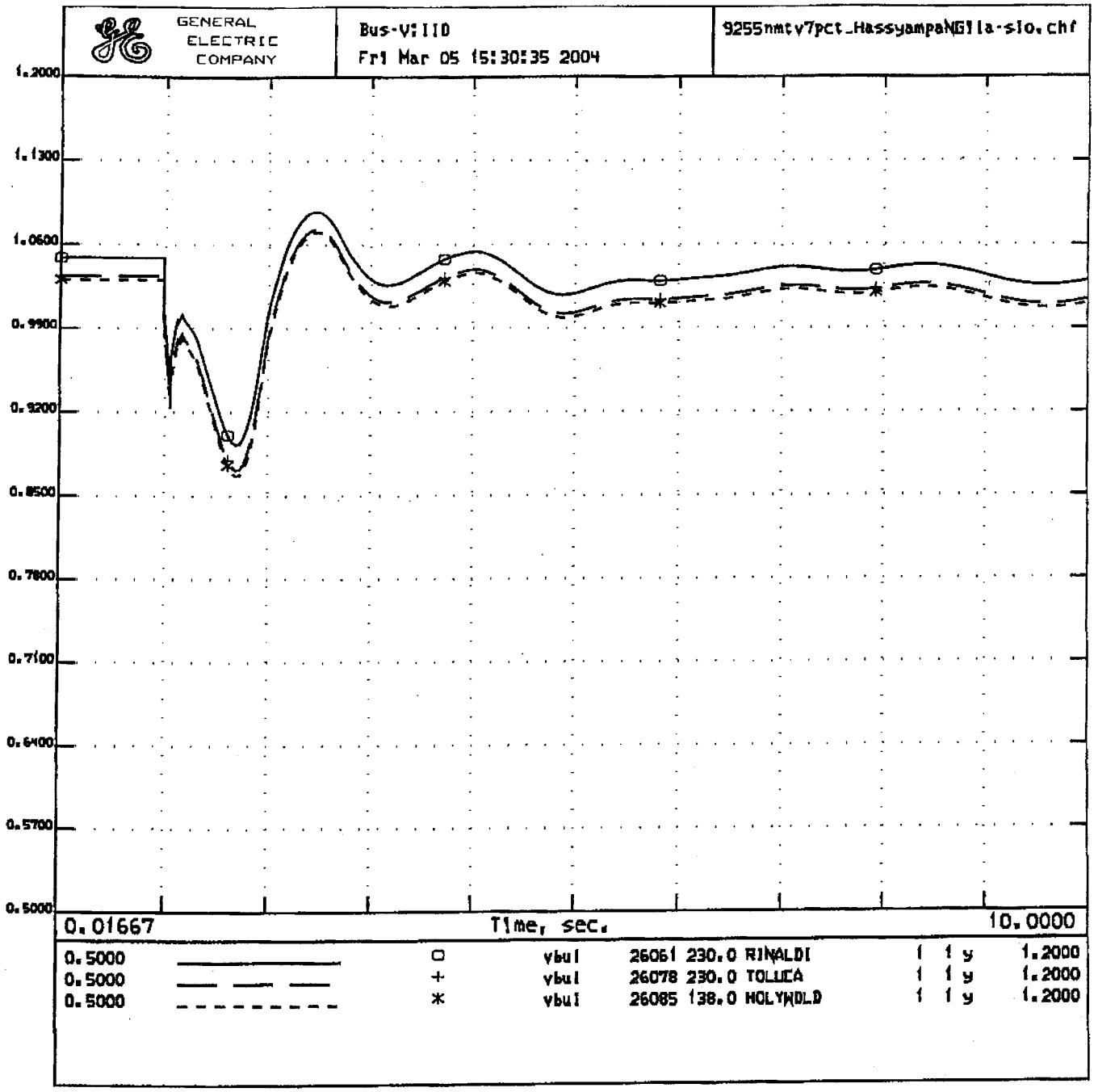

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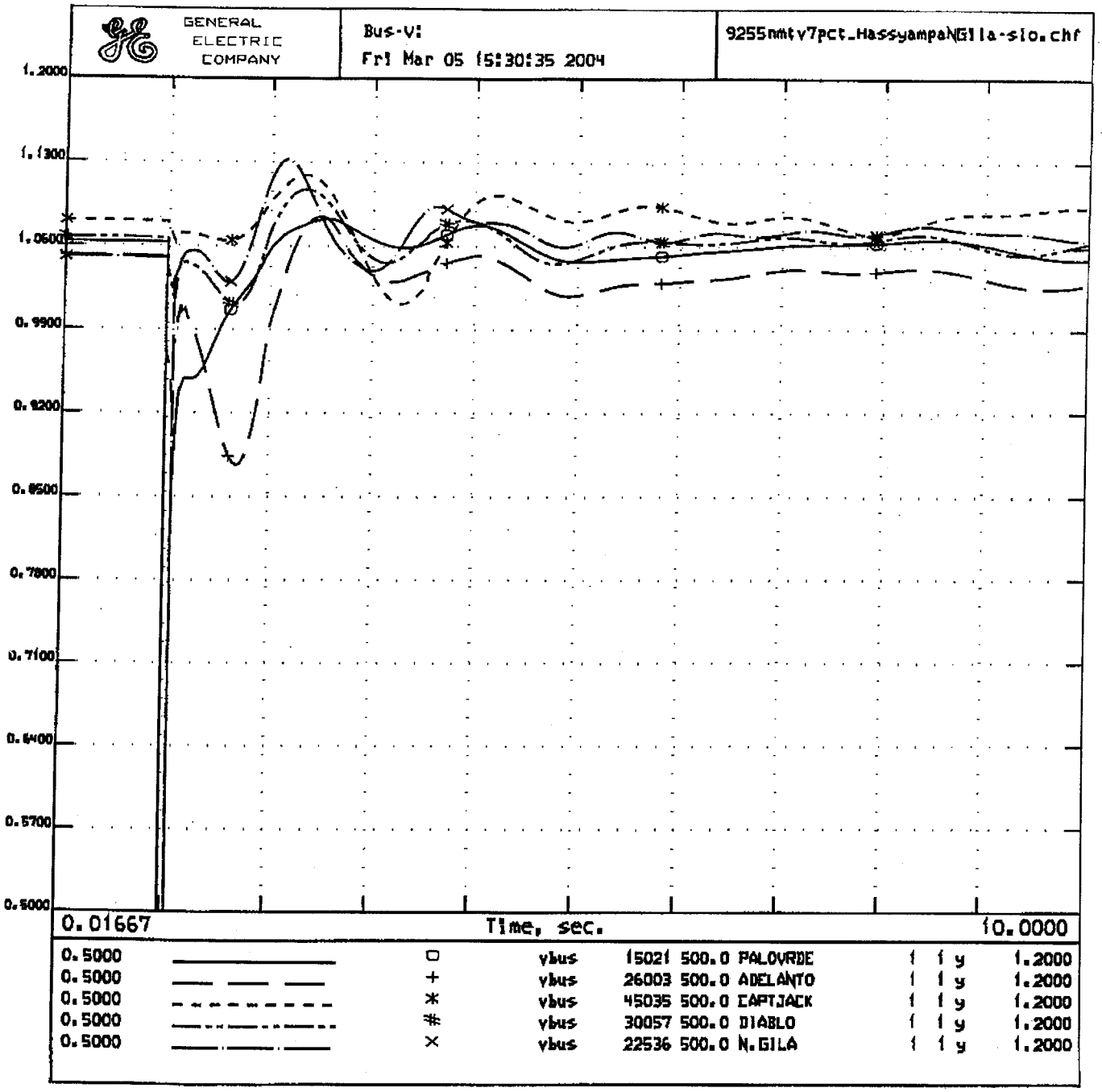

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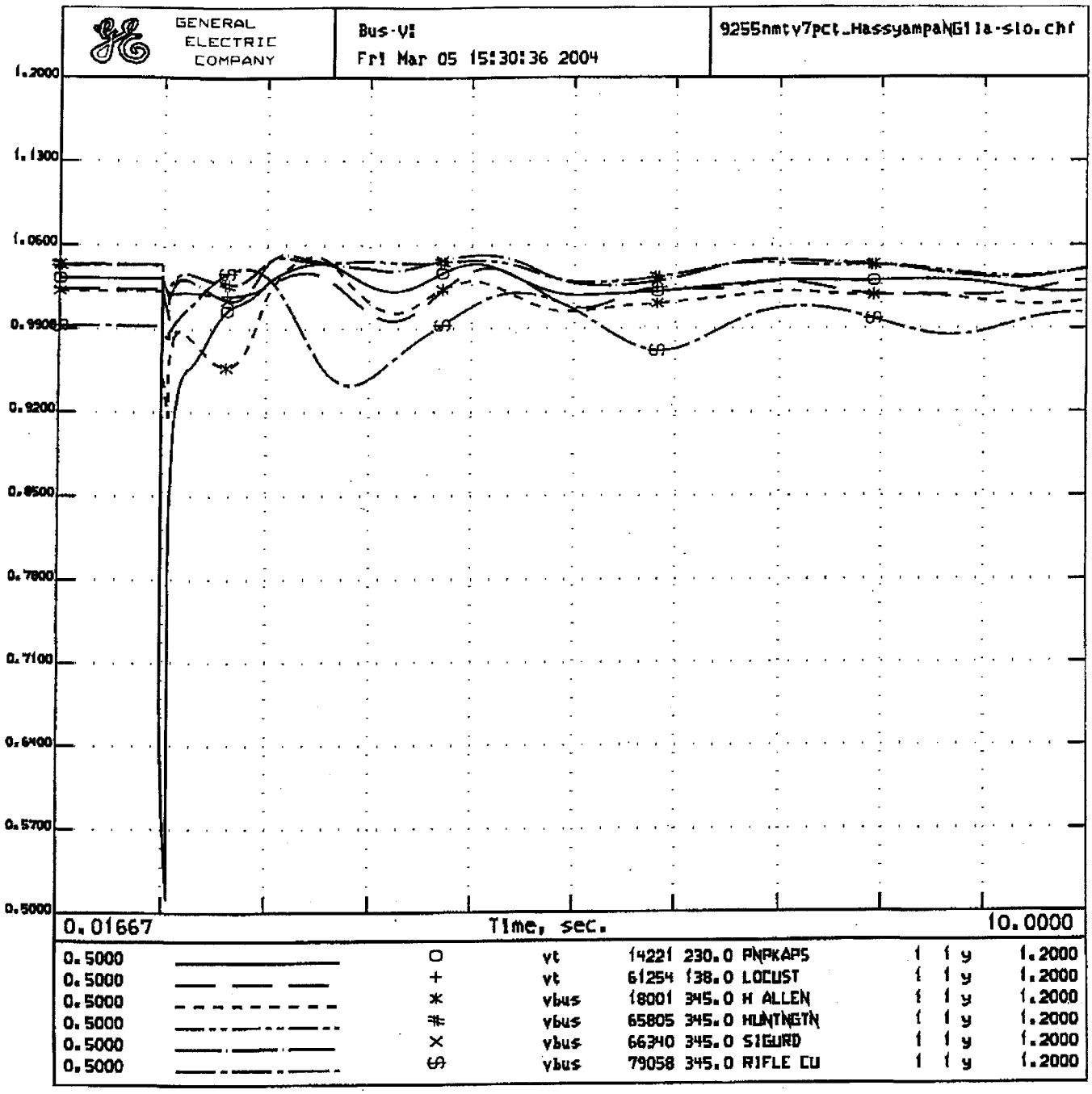

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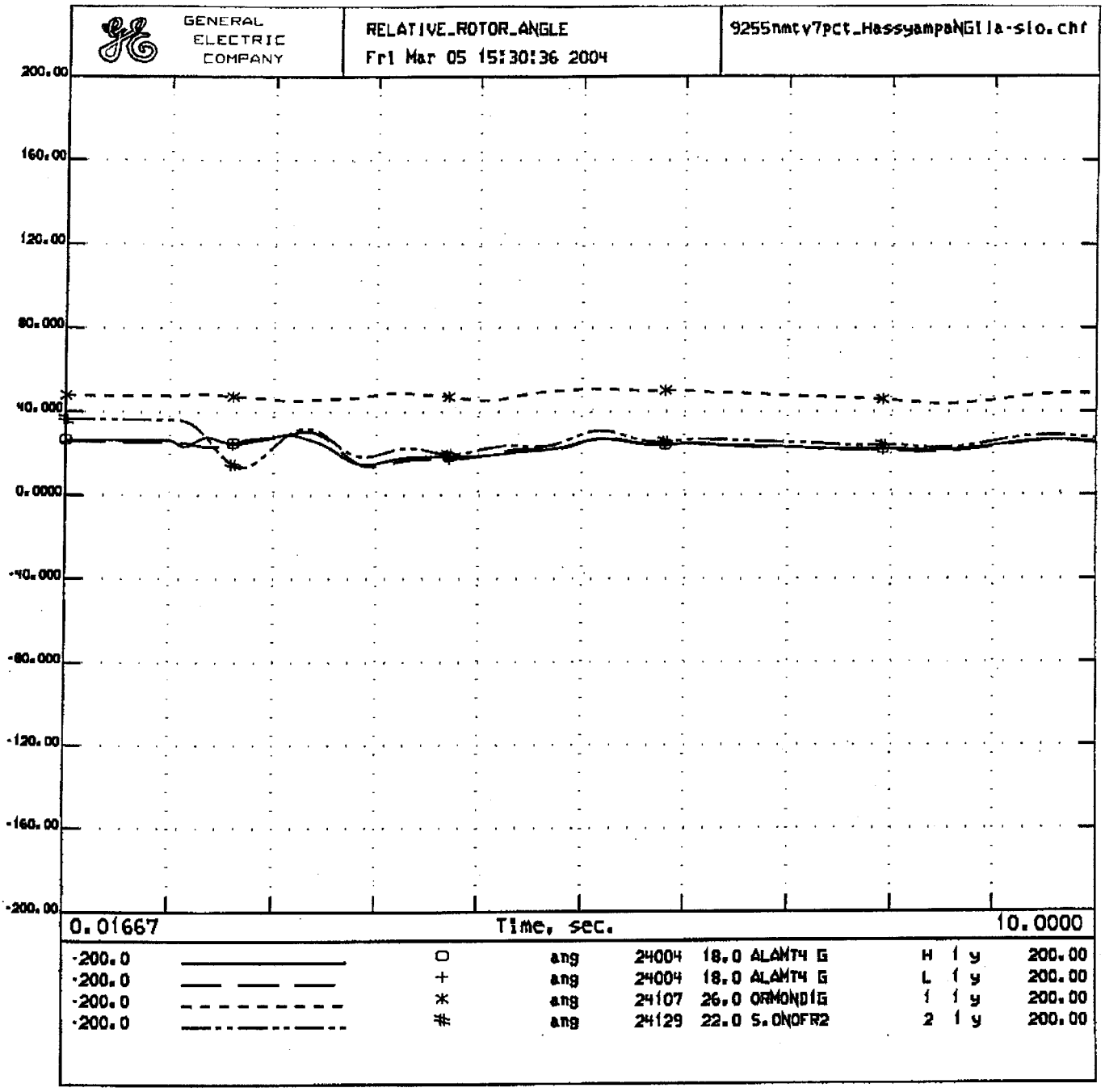

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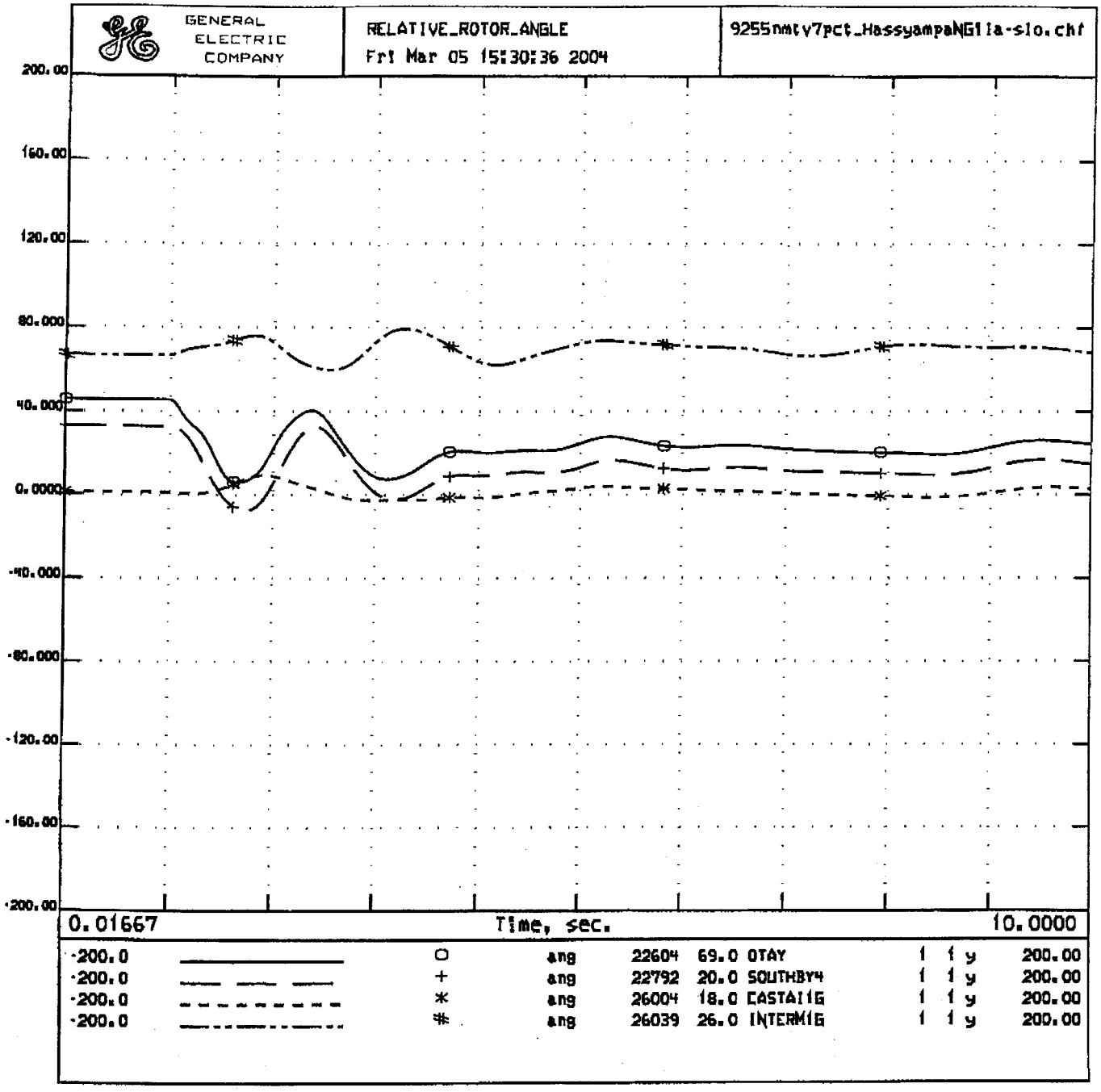

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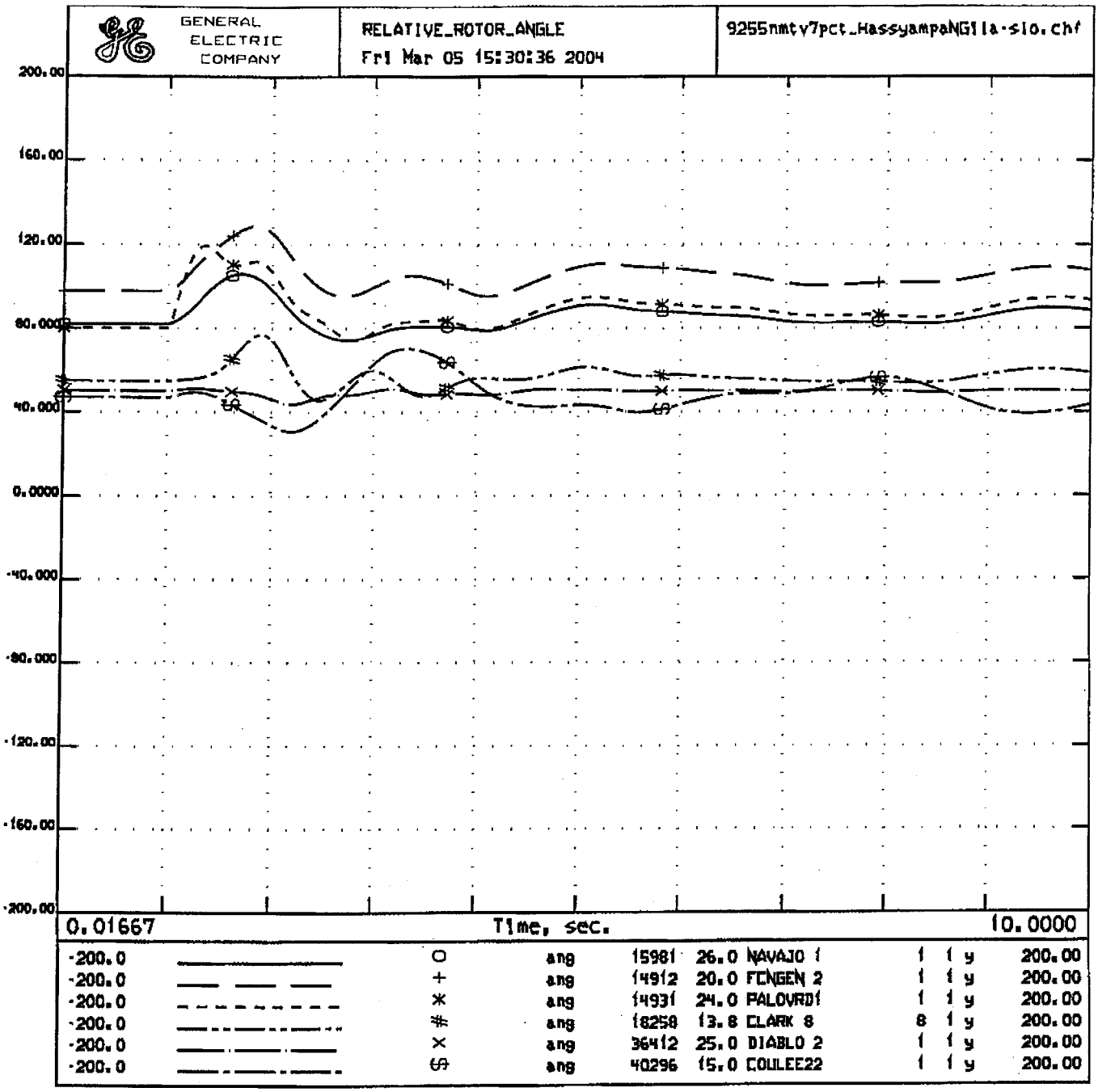

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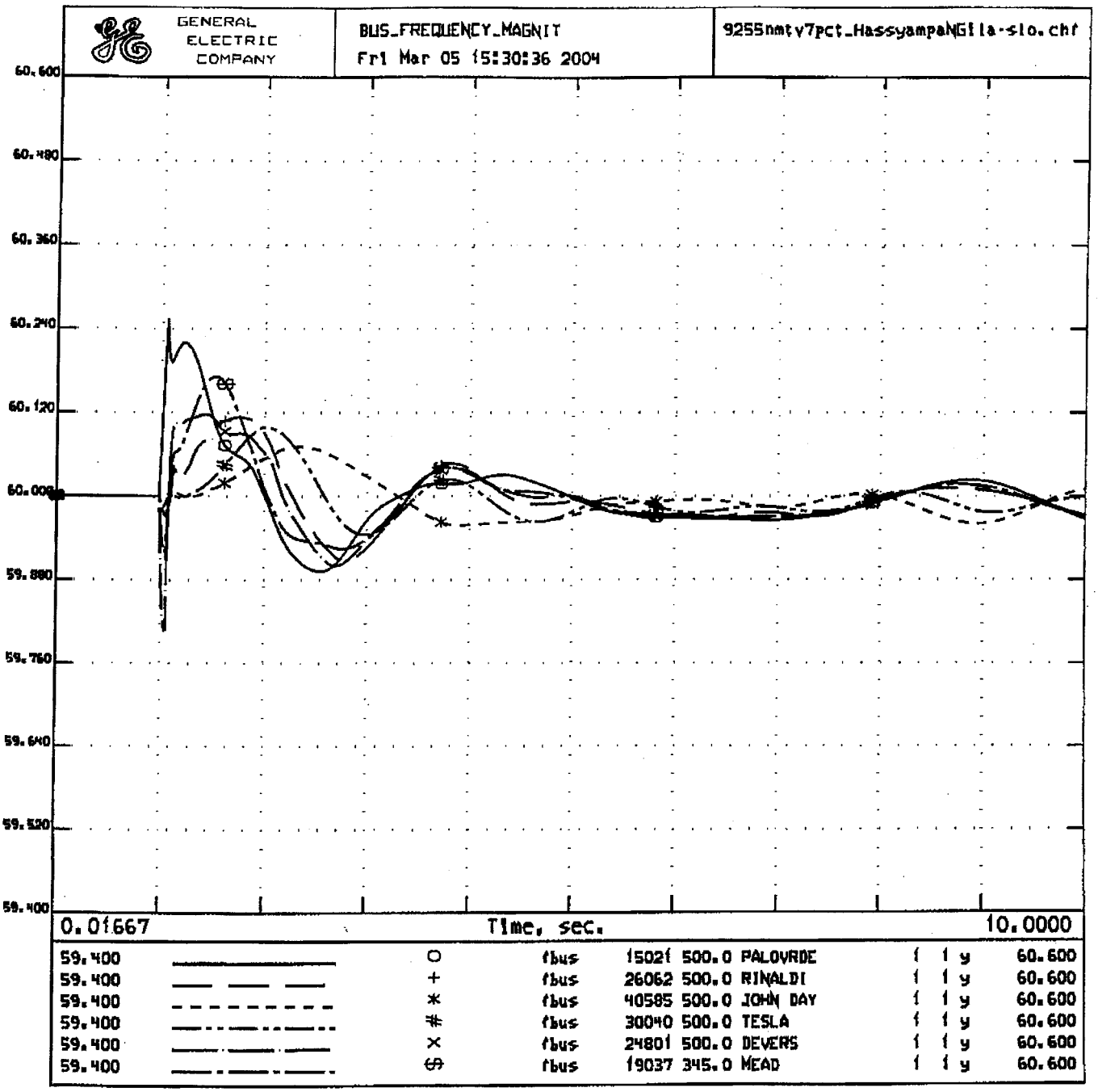

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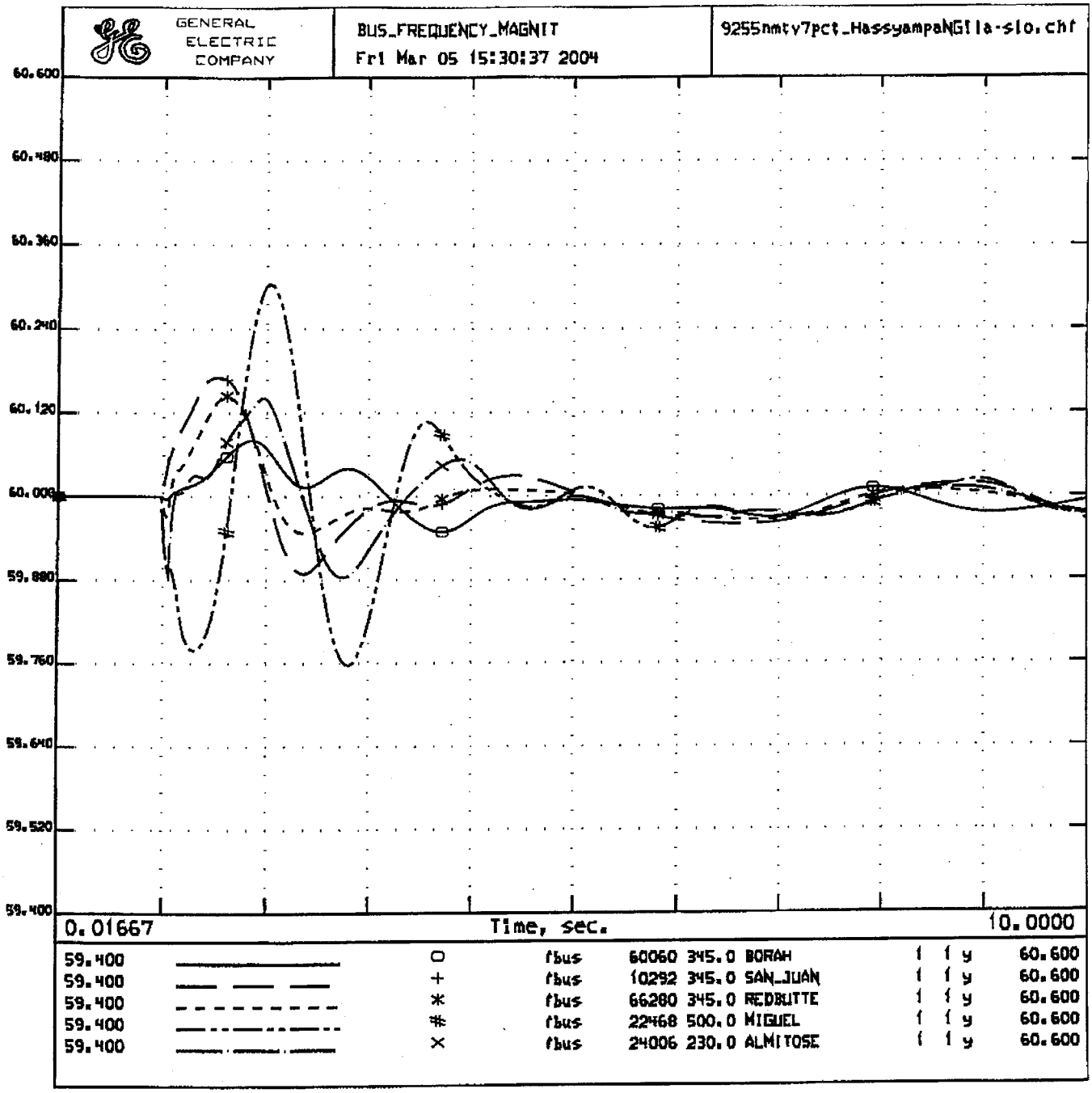

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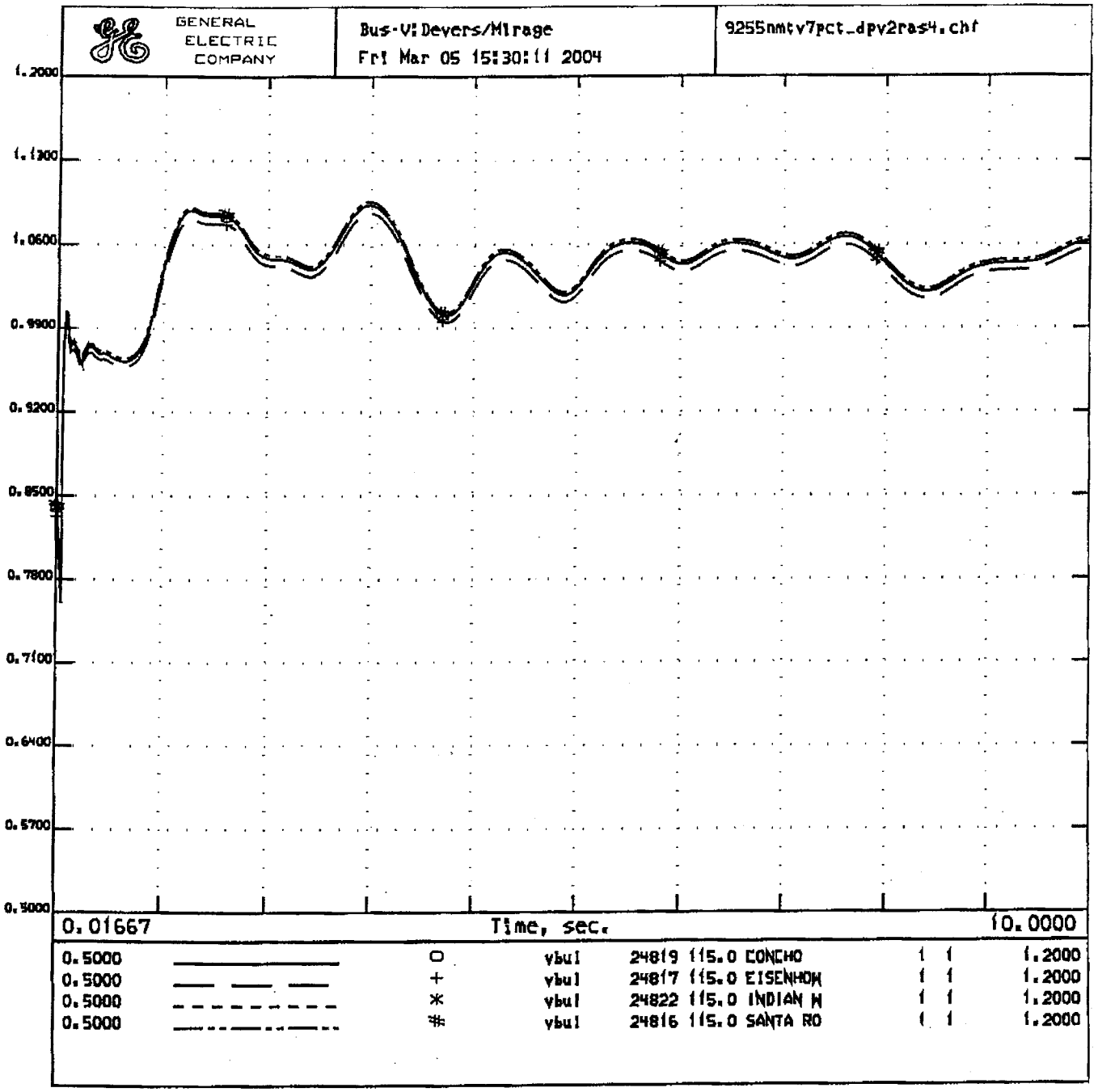
Transient Stability Study Plots - 14

CASE:	**Post-DPV2 with Path 49 at 9,903 MW**
FAULT:	**Three-Phase**
CONTINGENCY:	**N-2**
OUTAGE:	**Palo Verde-Devers 500 kV Line & Devers-Harquahala 500 kV Line**
EOR MARGIN:	**7%**
NOTES:	**Without Mountainview Generation Project**



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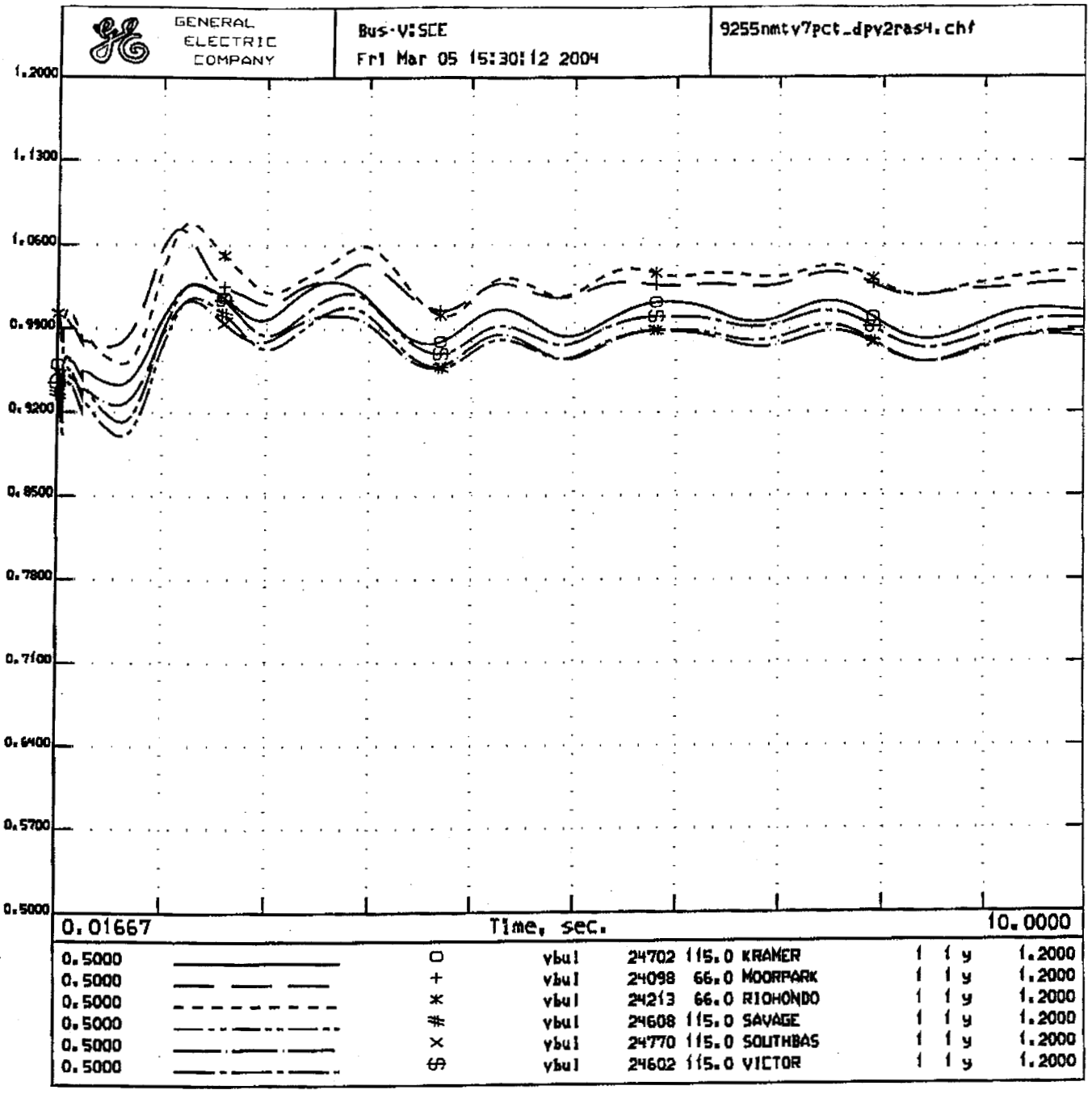

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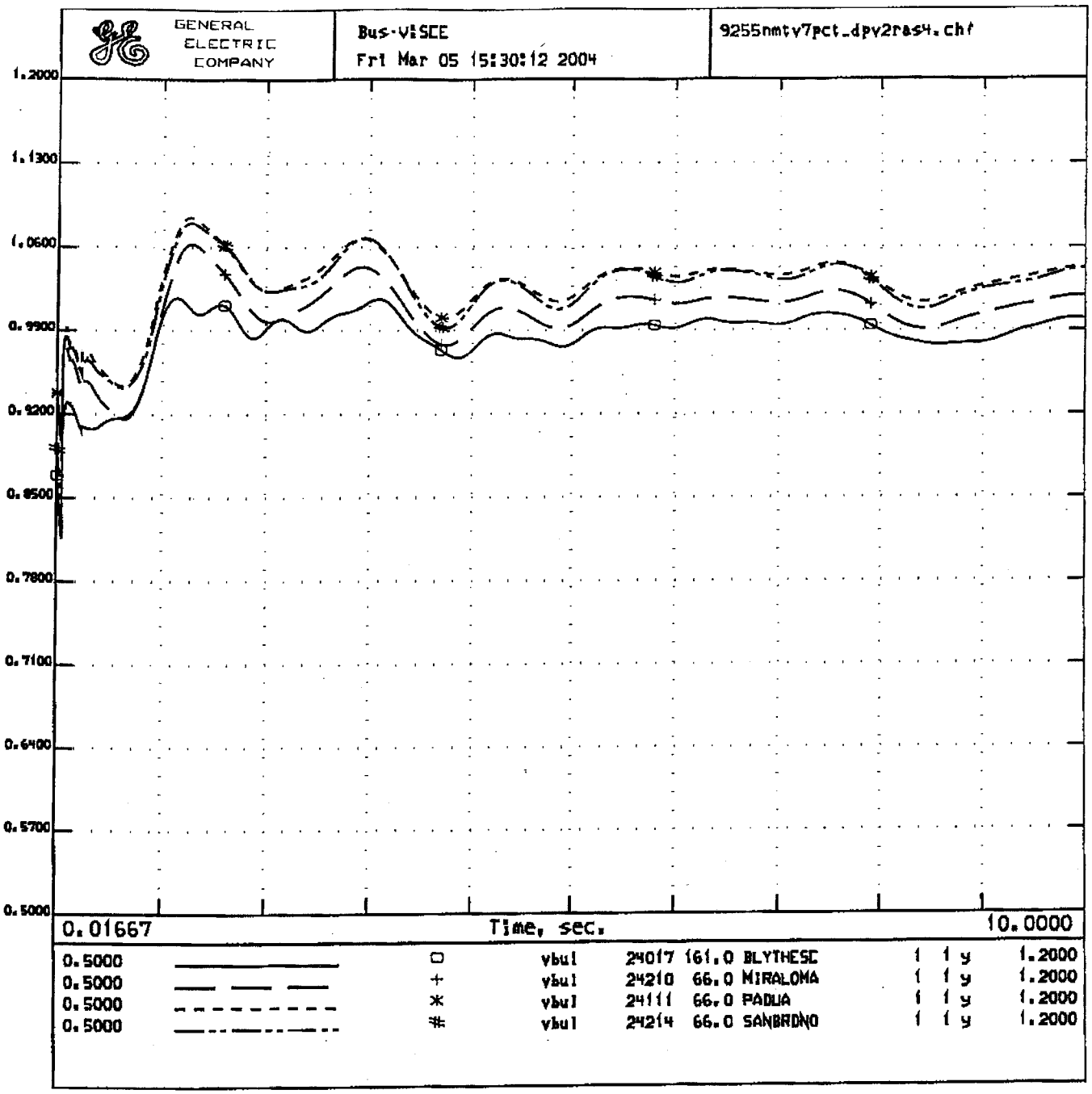

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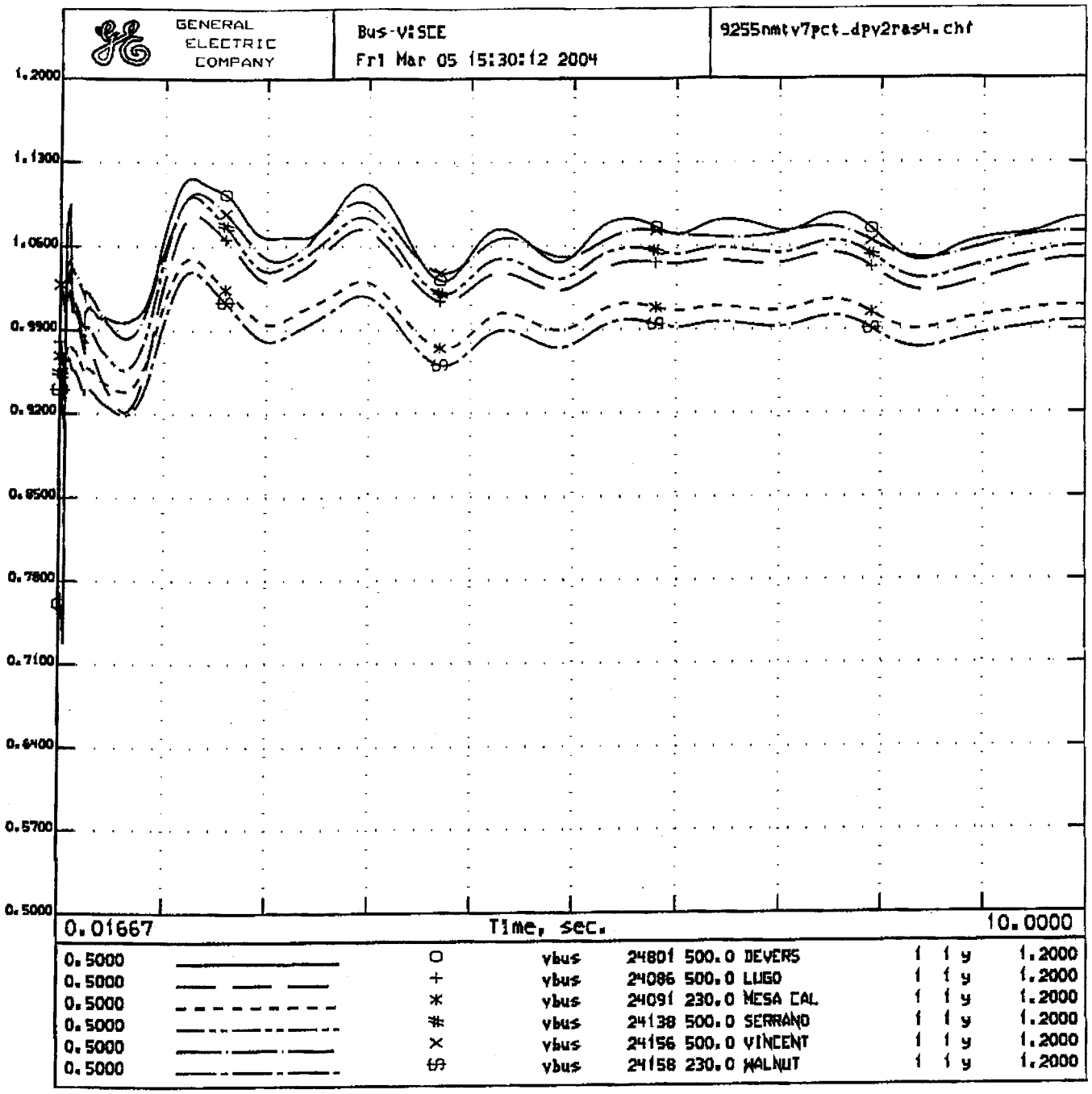

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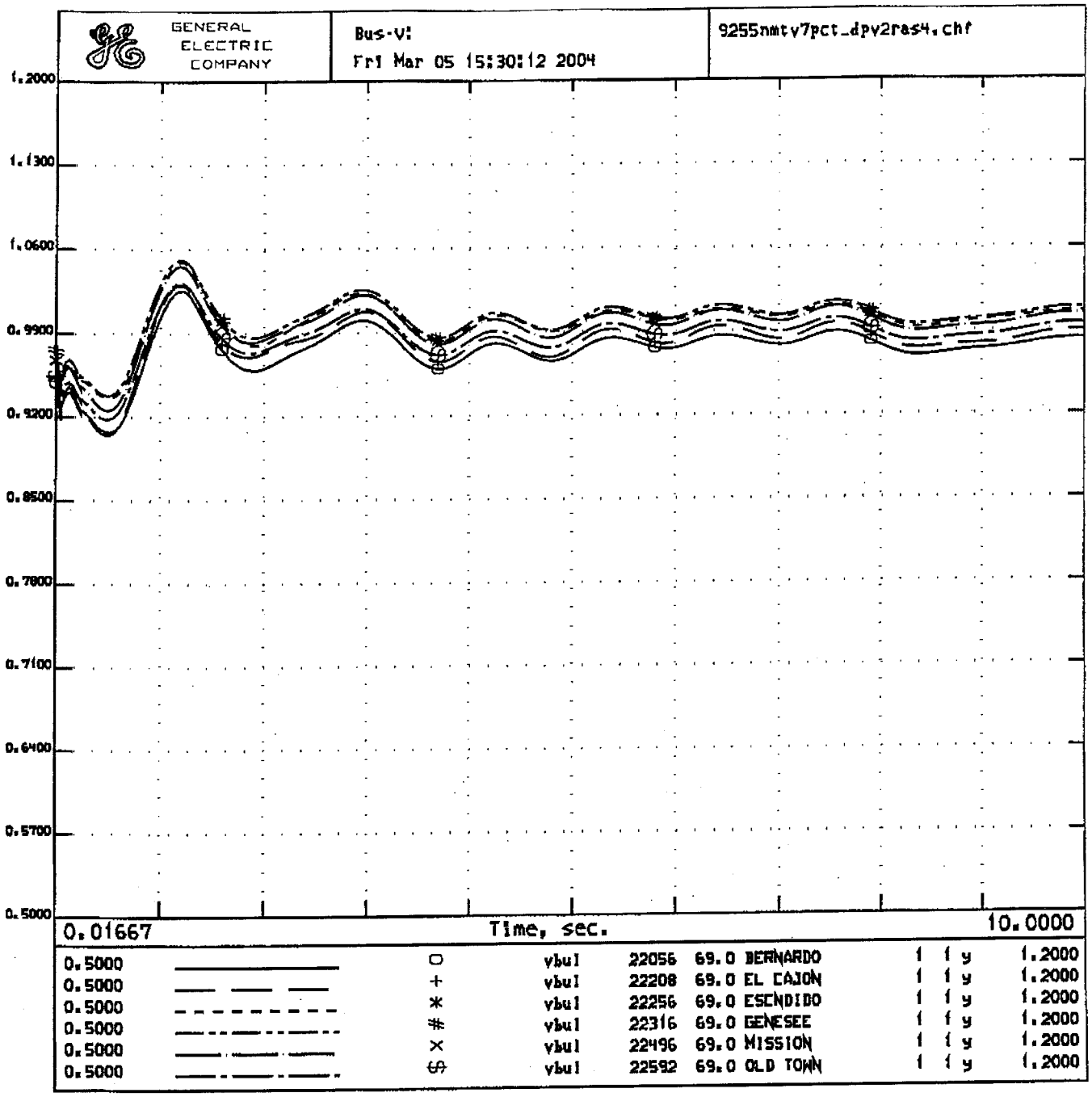

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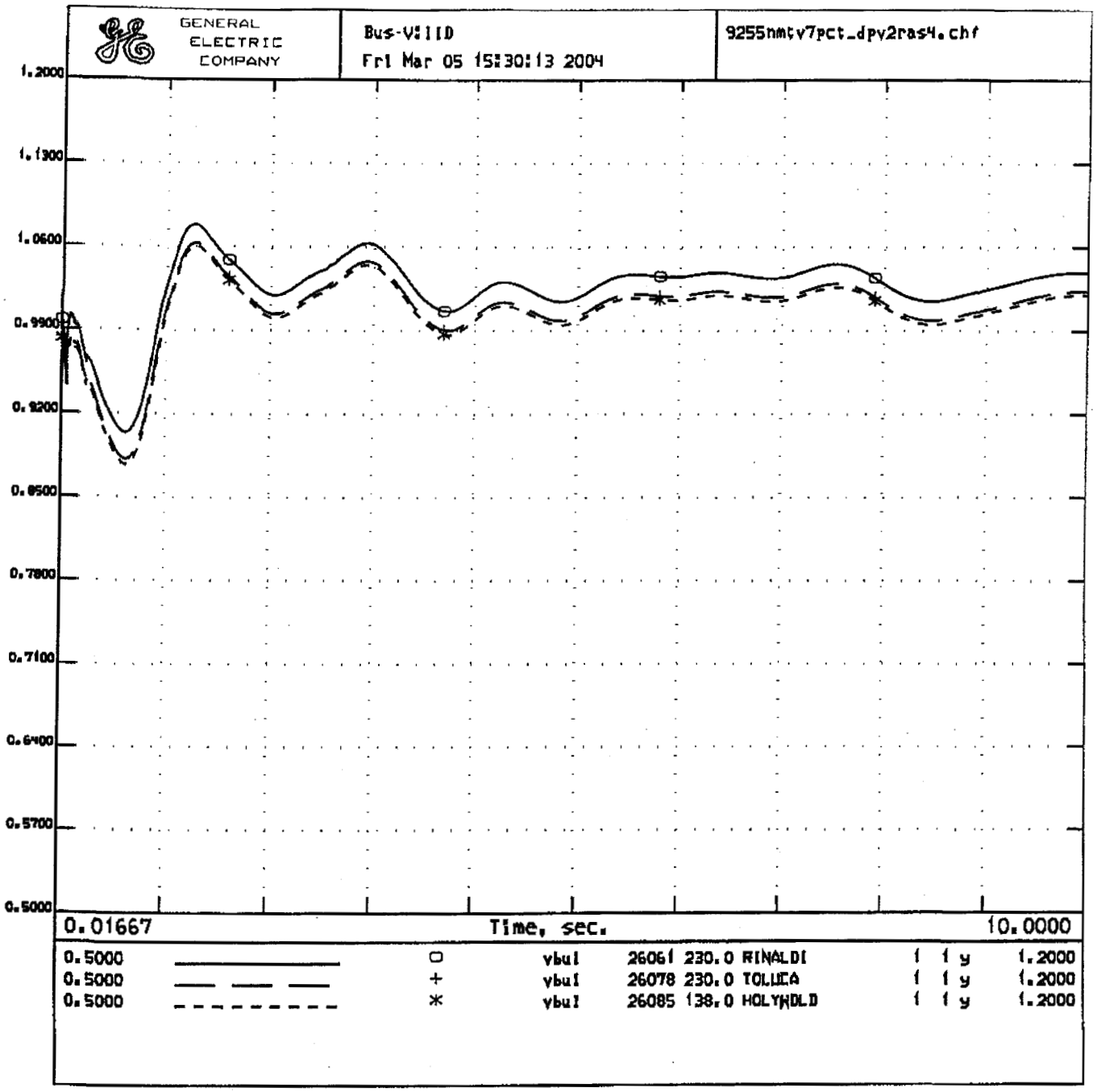

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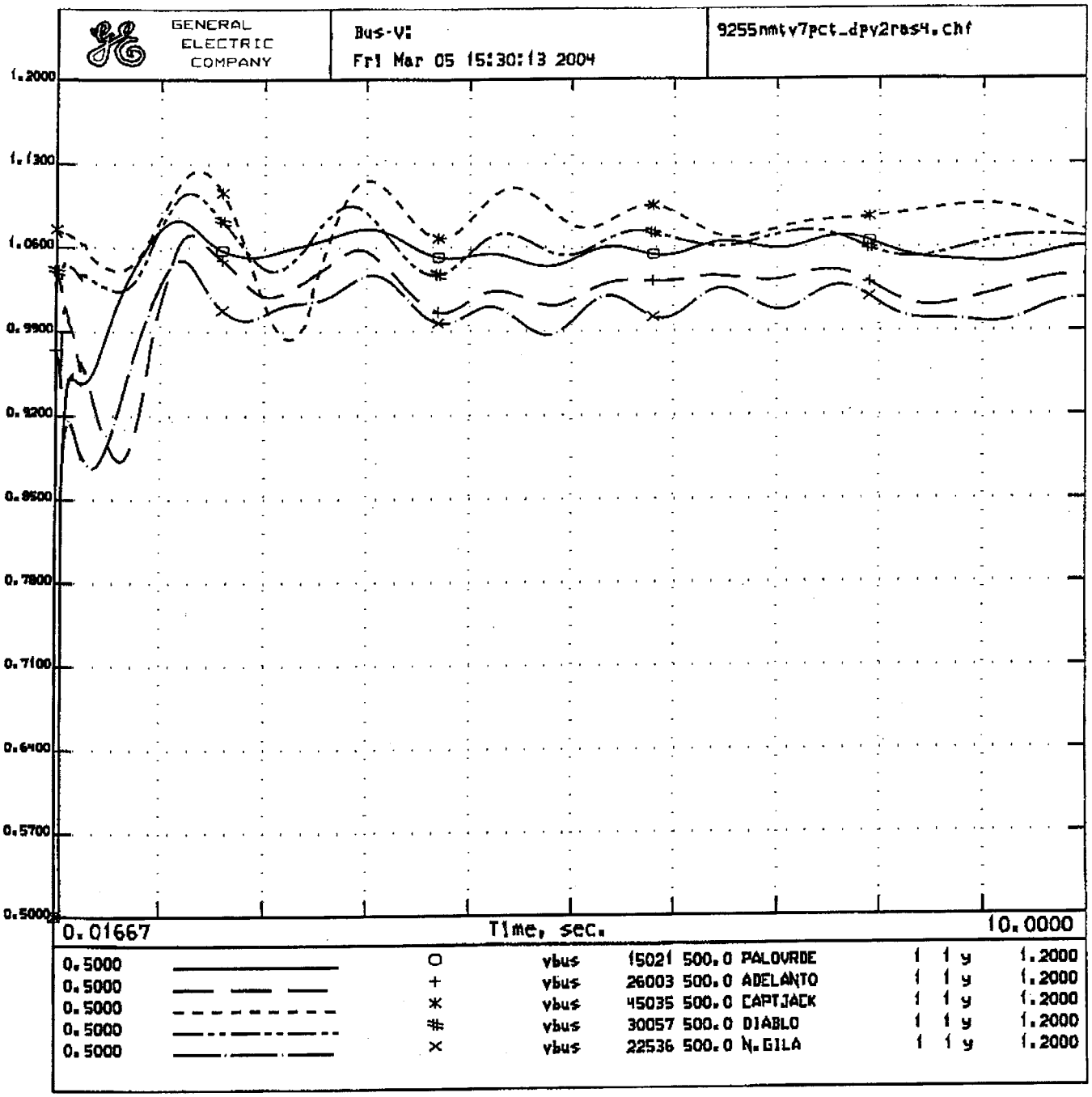

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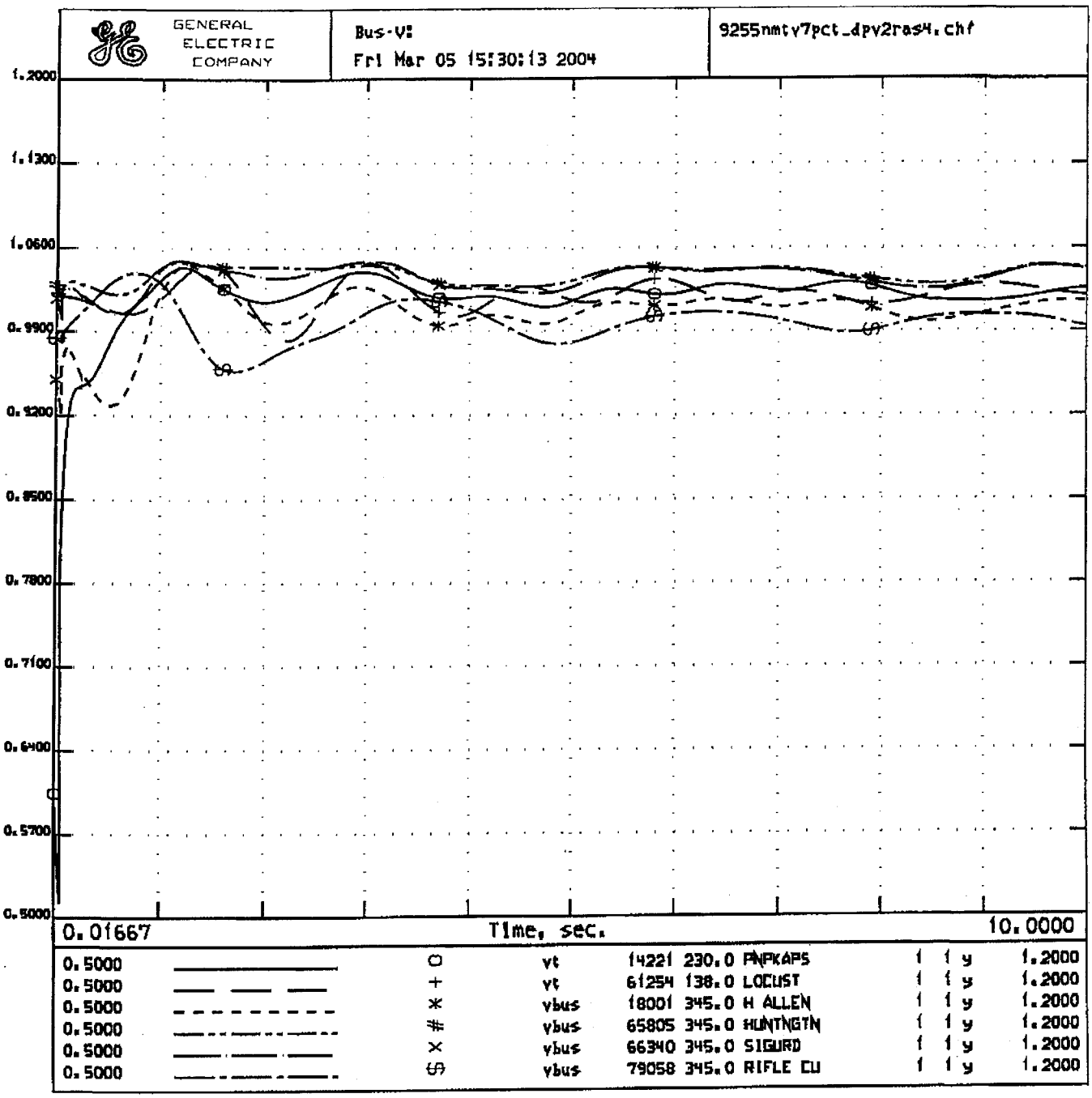

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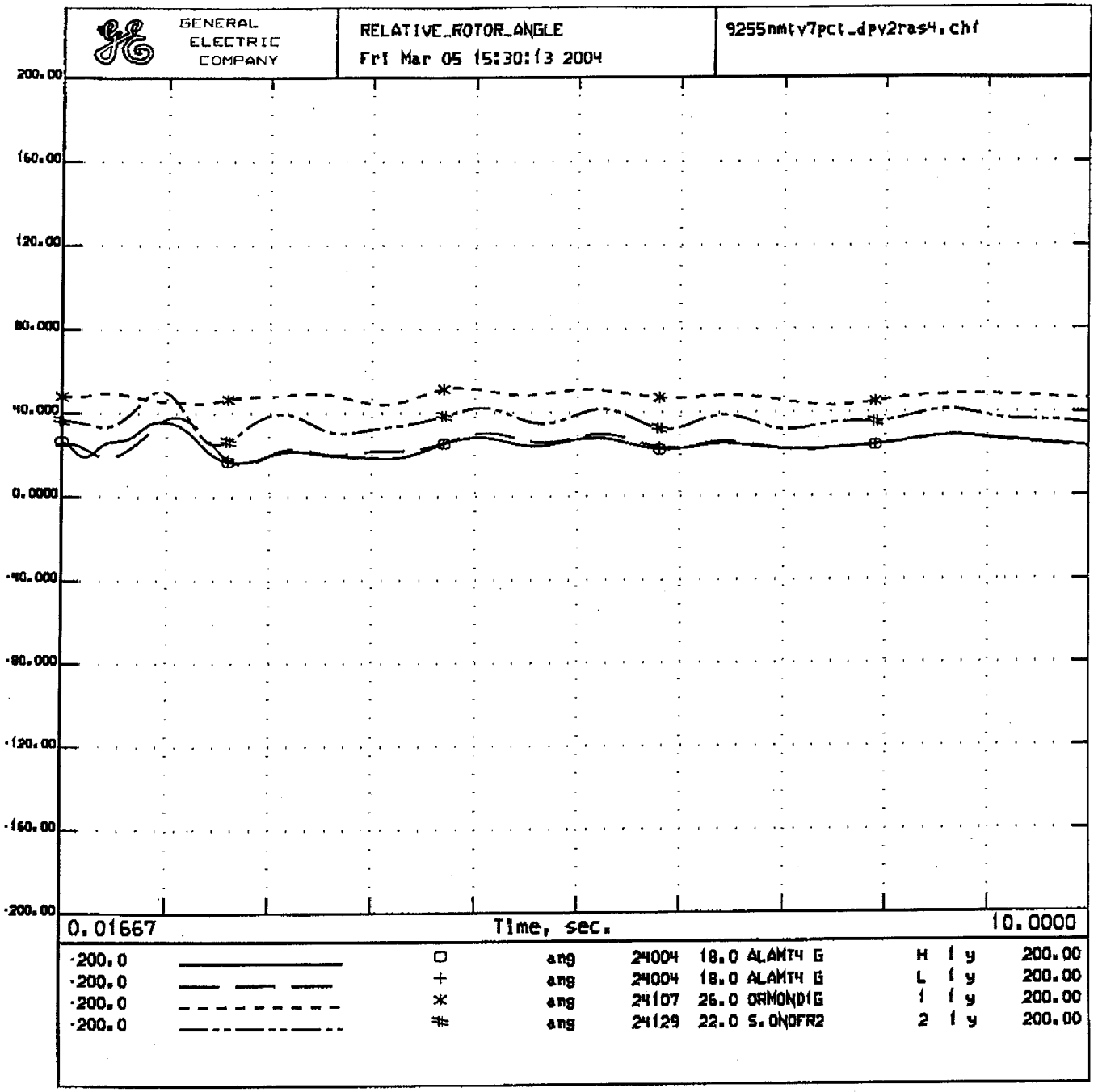

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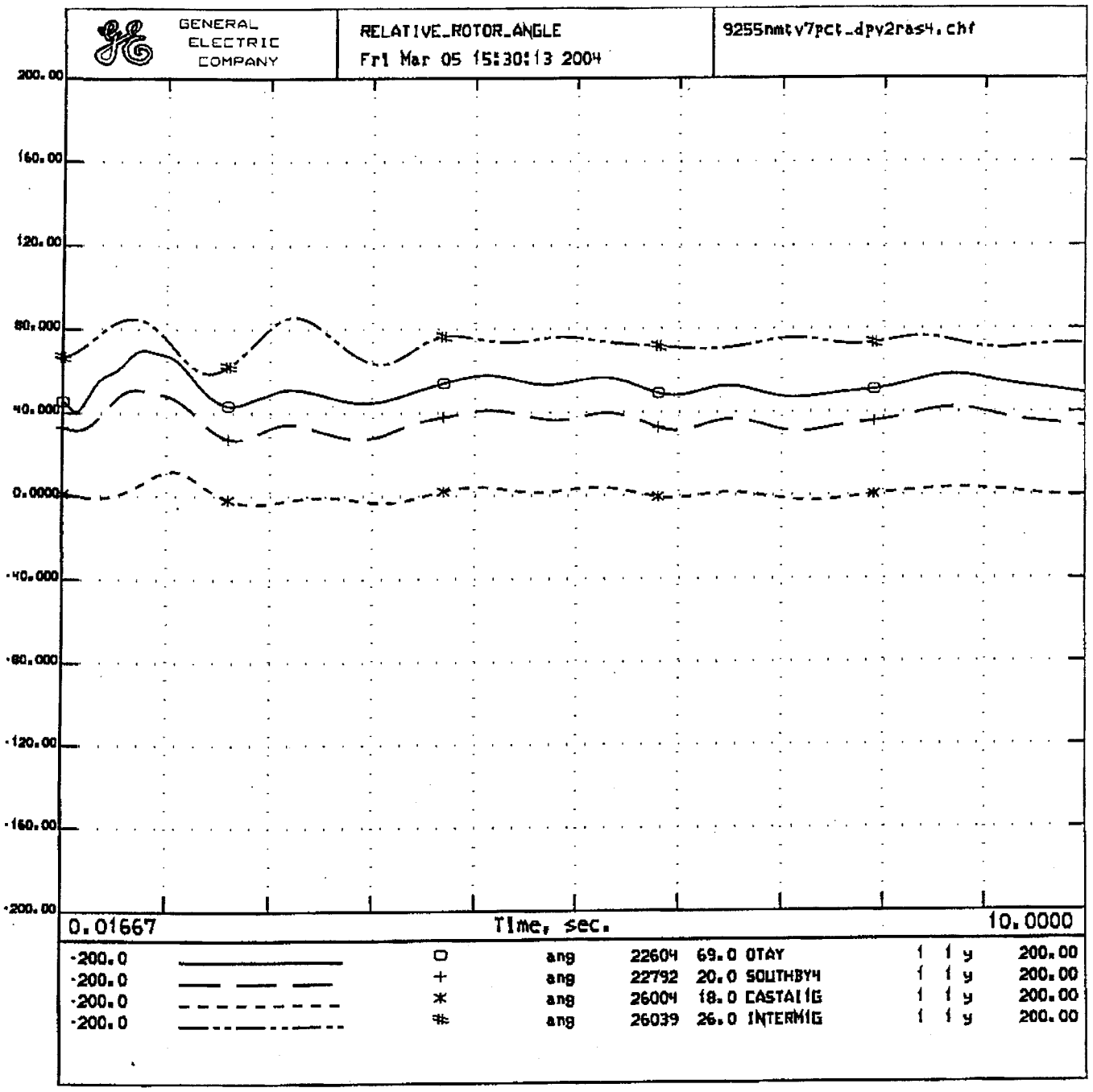

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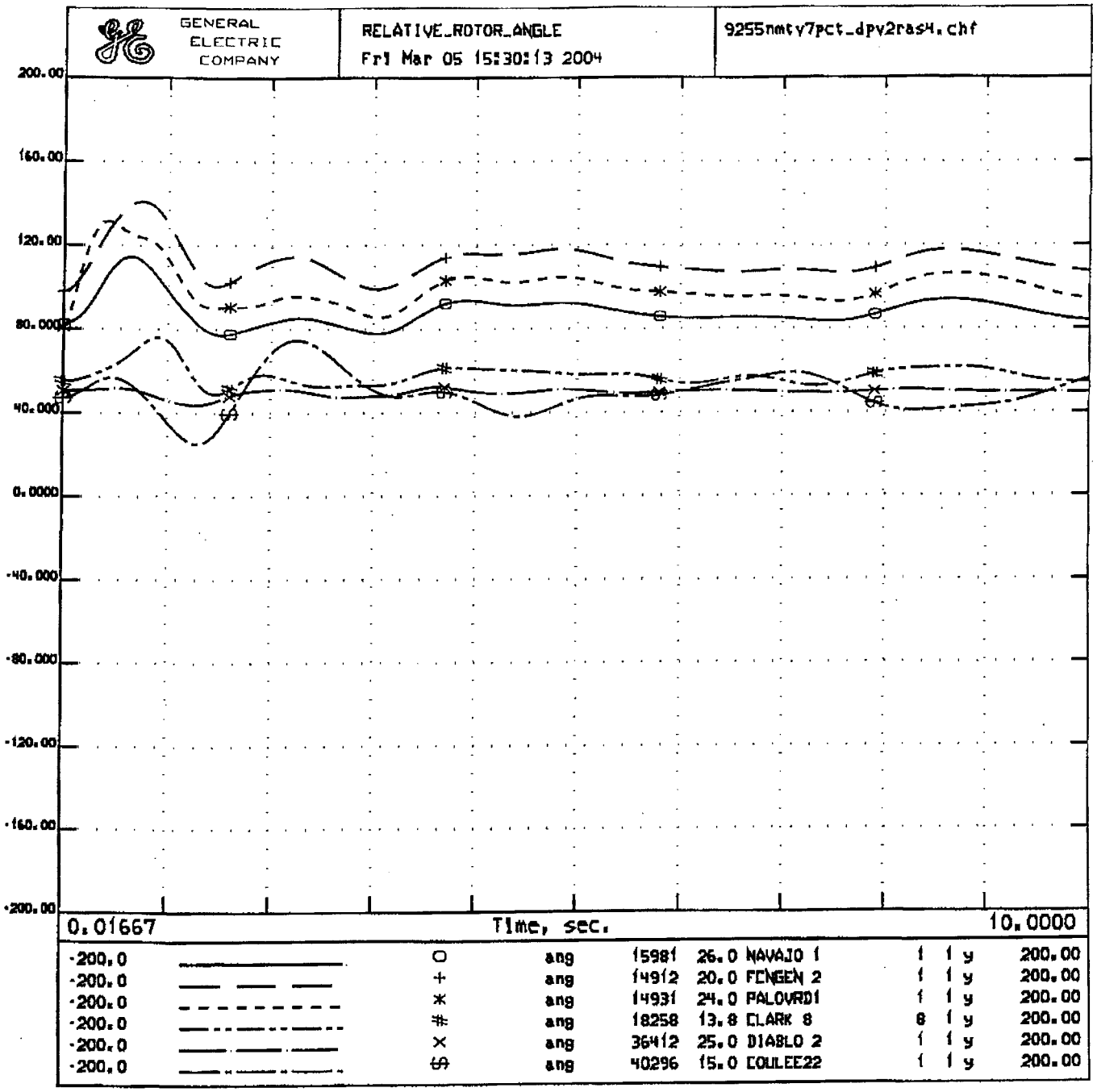

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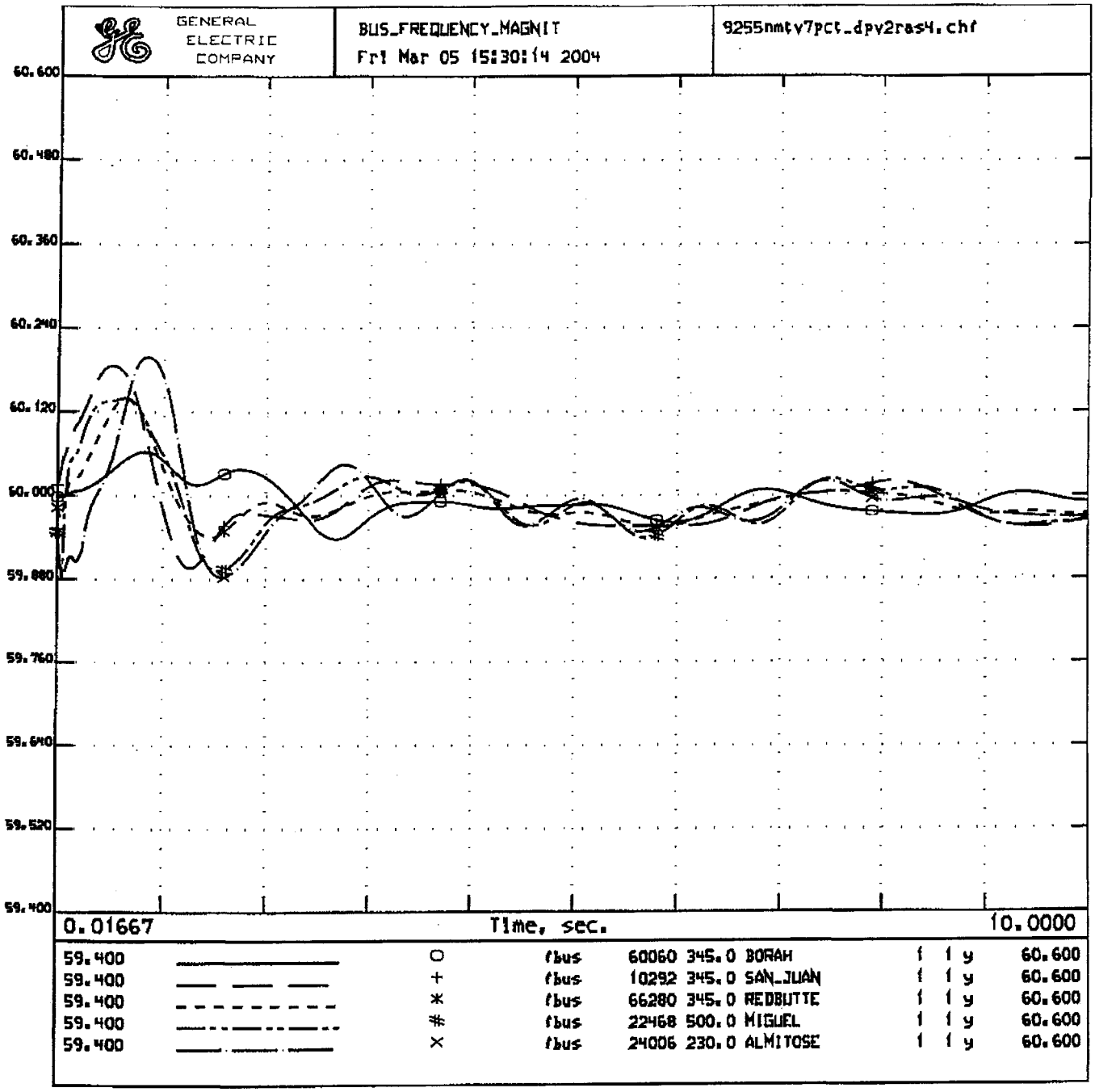

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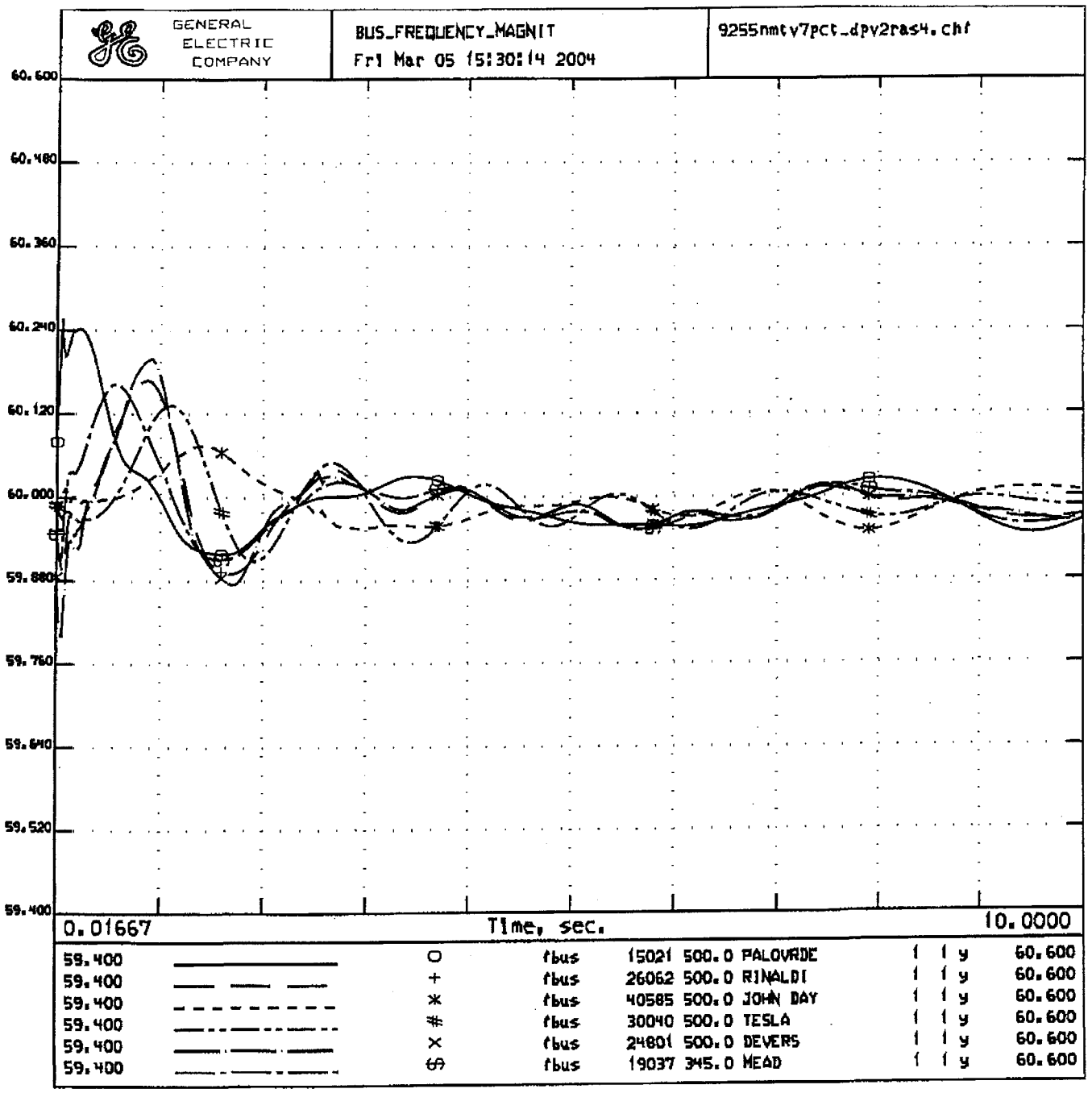

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