Southwest Power Pool

Impact Study for Generation Interconnection Request GEN – 2003 – 022

SPP Coordinated Planning
(#GEN-2003-022)

July 2004

Summary

ABB performed the following study at the request of the Southwest Power Pool (SPP) for SPP Generation Interconnection request Gen-2003-022. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff Attachment V, which covers new generation interconnections on SPP's transmission system.

Pursuant to the tariff, ABB was asked to perform a revised detailed stability analysis of the generation interconnection request to satisfy the System Impact Study Agreement executed by the requesting customer and SPP.

FEASIBILITY AND IMPACT STUDIES FOR GENERATION INTERCONNECTION REQUEST GEN-2003-022

Prepared for: SOUTHWEST POWER POOL

Final Report

REPORT NO.: Consulting 2004-10887-V03
June 29, 2004

Submitted by:

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ABB Consulting

Technical Report

Southwest Power Pool	**No. 2004-10887-V03**		
Title: Feasibility and Impact Studies for Generation Interconnection Request (GEN-2003-022)	**Dept.** ESC	**Date** June 29, 2004	**Pages** 37

Authors: **Lan Trinh, Ravi Varanasi**

Reviewer: **William Quaintance**

Summary

Southwest Power Pool (SPP) has requested feasibility and impact studies on behalf of <Customer> for the purpose of interconnecting a 120MW wind farm (80 GE 1.5 MW wind turbine generators) in the Weatherford, Oklahoma vicinity, within the service territory of American Electric Power (AEPW). The proposed wind farm will be connected to a new switching station to be constructed on the Weatherford Southeast – Clinton Junction 138 kV line and located approximately 3 miles from Weatherford tap. The proposed in-service date is December 2004. The generation developer requested that the feasibility study also be conducted for an alternate interconnection point located approximately 4 miles to the east of the proposed interconnection point described previously.

Power flow analysis indicates that, for the conditions studied, it is possible to interconnect up to 130 MW to either of the proposed locations. There are no significant thermal violations due to the proposed plant, when considering branches with distribution factors above 3% and ignoring pre-existing overloads. Also, there are no new voltage violations caused by the proposed plant.

Based on the results of the feasibility study, the developer and SPP requested that ABB perform the impact study of the wind farm using the primary point of interconnection at a generation level of 120 MW.

Based on the results of the stability analysis, it is concluded that the wind farm at 120 MW does not adversely impact the stability of the SPP system. This new wind farm will trip for most delayed clearing faults within 2 stations of its interconnection point, as well as most normal clearing faults on the lines emanating from the interconnection point. Traditional generating plants do not have this problem. It is recommended that automatic reclosing be disabled on transmission lines adjacent to the wind farm to protect the wind turbine generators from frequent tripping and undue stress from reclosing into faults. In addition, better low-voltage ride-through capability should be considered for the GEN-2003-022 and GEN-2002-005 wind farms, to avoid unnecessary and nuisance tripping of generation following transmission faults.

The results of this analysis are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study model change, the results provided in this report may not apply.

Rev. #	**Revision**	**Date**	**Author**	**Reviewed**	**Approved**
DISTRIBUTION: John E. Mills, Southwest Power Pool					

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Table of Contents

1 INTRODUCTION

SPP has requested feasibility and impact studies for the purpose of interconnecting a 120MW wind farm (80 GE 1.5 MW wind turbine generators) in the Weatherford, Oklahoma vicinity, within the service territory of American Electric Power (AEPW). The proposed wind farm will be connected to a new switching station to be constructed on the Weatherford Southeast – Clinton Junction 138 kV line and located approximately 3 miles from Weatherford tap. The proposed in-service date is December 2004. The generation developer requested that the feasibility study also be conducted for an alternate interconnection point located approximately 4 miles to the east of the proposed interconnection point described previously. After the feasibility (power flow) study was complete and before the impact (stability) study was begun, the developer requested that the impact study be performed only for the primary interconnection point, and the wind farm capacity was changed from 130 MW to 120 MW.

The objective of the feasibility study is to determine whether there are any steady-state criteria violations associated with the interconnection of the proposed wind farm. The incremental impact of the proposed wind farm under system intact and contingency case conditions would be determined by comparing the transmission system power flows and bus voltages both with and without the proposed wind farm.

As mentioned previously, the feasibility study was performed for both the proposed and the alternate points of interconnection. Based on the results of the feasibility study, the generation developer chose the primary point of interconnection for the system impact study.

The objective of the impact study is to determine the impact on system stability of connecting the 120 MW wind farm to the single chosen interconnection point.

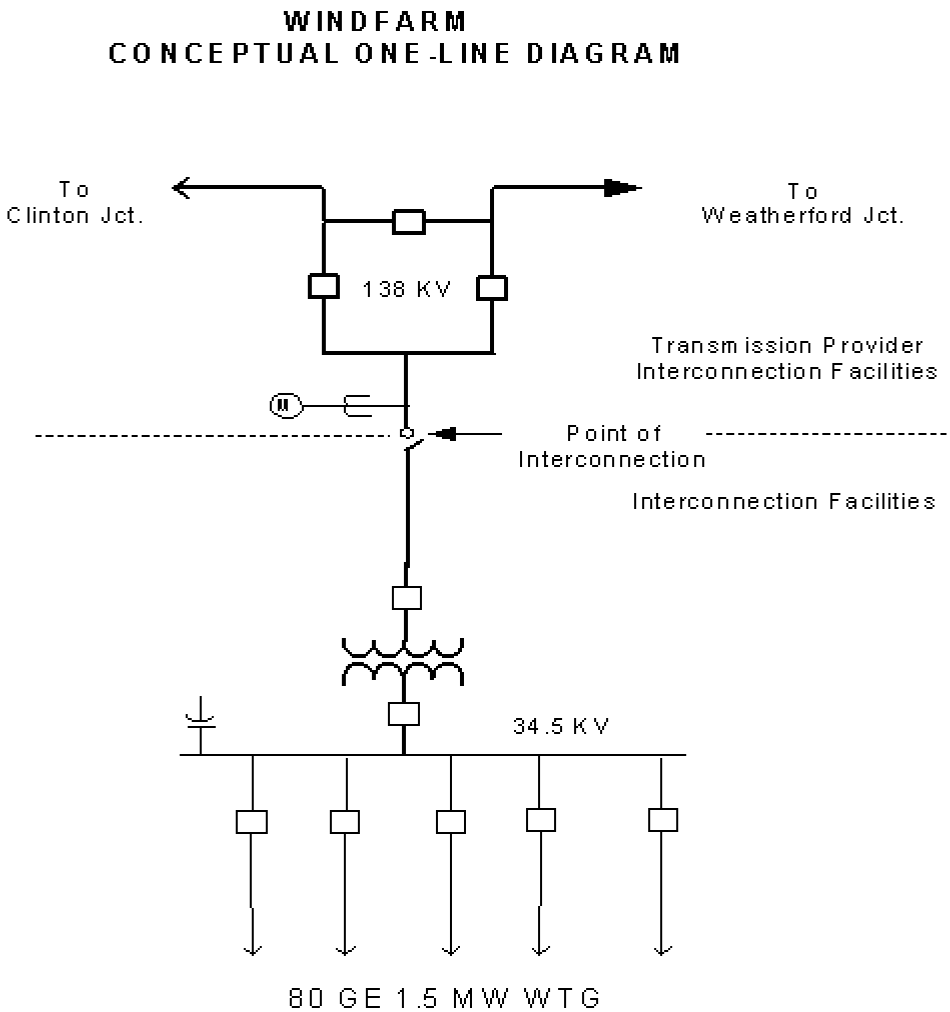
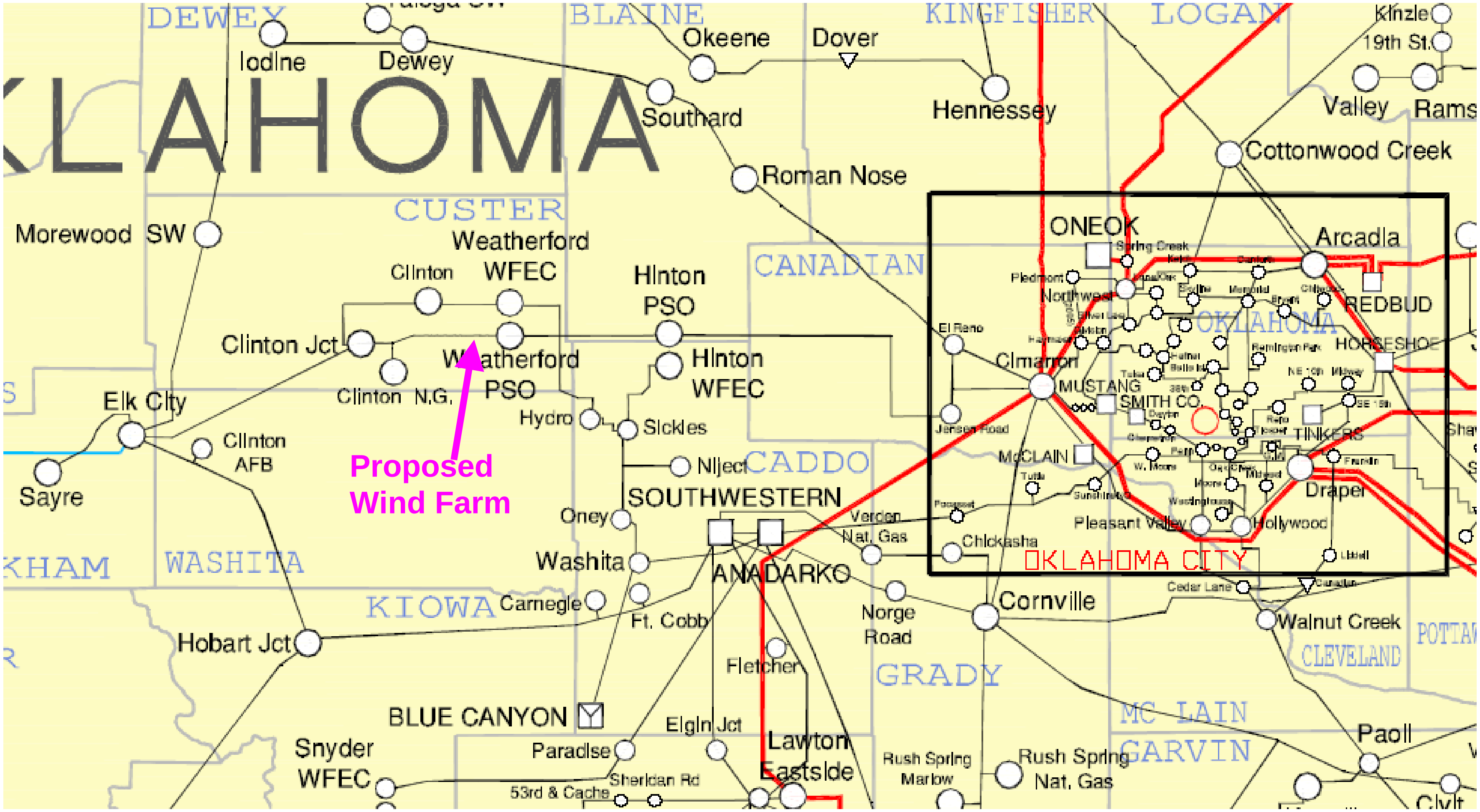


Figure 1. Proposed Interconnection of Wind Farm

Figure 2: Map of the surrounding area



2 POWER FLOW ANALYSIS

2.1 Power flow Analysis Methodology

The Southwest Power Pool (SPP) criteria states that the transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the criteria will meet the applicable NERC Planning Standards for System Adequacy and Security of Transmission Systems, Table l, and its applicable standards and measurements.

PTI's MUST First Contingency Incremental Transfer Capability (FCITC) DC analysis was used to study transmission system loadings under system intact and contingency conditions as power from the proposed wind farm is increased from 0 MW to its maximum capacity. The MUST options chosen to conduct the study can be found in Appendix A.2.

PTI's PSSE ACCC analysis was used to study bus voltages under system intact and contingency conditions both with and without the proposed wind farm. The ACCC options chosen to conduct study can be found in Appendix A.1.

There are several other proposed wind generation additions in the general area of the proposed facility. It was assumed in the analysis that not all of these other projects were in service. Those previously queued projects that have advanced to nearly complete phases were included in this feasibility study (included were Gen-2003-004, Gen-2003-005, and Gen-2002-005). Significant differences in the assumptions used in this feasibility study may require that this study be revisited to determine this facility's impacts on the SPP transmission system.

2.2 Power flow Cases

A power flow analysis was conducted for the facility using modified versions of the 2004 series SPP Planning models. The in-service date of the facility is proposed to be December 2004. The models used in this study were: 2005 Fall Peak, 2005 Summer Peak, 2005 Winter Peak, 2007 Summer Peak, 2007 Winter Peak, 2010 Summer Peak, and a 2010 Winter Peak. This is the extent of the current SPP planning horizon. The wind farm was modeled as a single aggregate unit as seen by the transmission system. Individual wind turbine generators and the wind farm collector system were not explicitly modeled, as this detail is not needed in power flow analysis. The output of the wind farm was offset in each model by a reduction in output of existing online AEPW generation.

2.3 Power flow Analysis Results

Option 1: Point of interconnection on the 138 kV line 3 miles from Weatherford Tap

The summary list of limiting elements from FCITC analysis is shown in Table 1. Full FCITC results are in Appendix D.

Table 1. FCITC Thermal Results

Study Case	Incremental Transfer Capability	Limiting Element	TDF	Pre Transfer Loading	Rating	Contingency
05SP	130+	none				
05FA	9.0	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.04127	-38.2	38.5	56001 MORWODS4 138 99994 Gen-2002-005 138 1
05FA	45.4	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03679	-24.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
05WP	130+	none				
07SP	58.9	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03477	-23.5	25.6	55999 MOORLND4 138 56001 MORWODS4 138 1
07WP	102.5	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03597	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
10SP	130+	none				
10WP	104.7	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03576	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1

The 69 kV lines (55897 ELKCITY269.0 54122 ELKCTY-269.0 1) and (55942 HM-BTTP269.0 56000 MORWODS269.0 1) were already overloaded in 2005 summer peak and winter peak base cases, and as such they are considered pre-existing problems.

Buses with voltage violations (above 1.1 pu or below 0.9 pu) in ACCC analysis were compared between the base cases and the corresponding cases with new generation interconnections. The only bus with voltage violations with the new wind farm that did not have violations in the base cases was due to an invalid contingency. All single contingencies in the area of study were automatically simulated. When using this automatic method, sometimes invalid contingencies are simulated. In this case, the 138 kV line from Iodine to Mooreland was tripped and voltage issues were seen at Iodine 138 kV bus due to switching of the Fort Supply 138/69 kV transformer taps. However, there is no 138 kV breaker separating the Iodine to Mooreland 138 kV line from the Iodine to Fort Supply 138 kV line, so both of these lines, the Iodine 138 kV bus, and the Iodine load would actually all trip together. Thus, the Iodine voltage is actually zero for this contingency both with and without the new wind farm. The Fort Supply 138/69 kV transformer is series connected to the Iodine to Fort Supply 138 kV line, and it is tripped as well. So no tap changing would take place. The key voltage to check for this contingency is at the Fort Supply 69 kV bus. This bus voltage stays within the required limits both with and without the new wind farm.

Option 2: Alternative point of interconnection - 4 miles to the east of the primary point of interconnection

The results of the Option 2 power flow analysis are similar to the Option 1 results.

The summary list of limiting elements from FCITC analysis is shown in Table 2. Full FCITC results are in Appendix D.

Table 2. FCITC Thermal Results – Alternative Interconnection Point

Study Case	Incremental Transfer Capability	Limiting Element	TDF	Pre Transfer Loading	Rating	Contingency
05SP	130+	none				
05FA	9.8	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03773	-38.2	38.5	56001 MORWODS4 138 99994Gen-2002-005 138 1
05FA	50.6	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03301	-24.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
05WP	130+	none				
07SP	65.8	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03114	-23.5	25.6	55999 MOORLND4 138 56001 MORWODS4 138 1
07WP	112.3	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03234	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
10SP	130+	none				
10WP	116.5	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03214	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1

The 69 kV lines (55897 ELKCITY269.0 54122 ELKCTY-269.0 1) and (55942 HM-BTTP269.0 56000 MORWODS269.0 1) are already overloaded in the 2005 summer peak and winter peak base cases and as such are considered pre-existing problems.

Buses with voltage violations (above 1.1 pu or below 0.9 pu) in ACCC analysis were compared between the base cases and the corresponding cases with new generation interconnections. The only bus with voltage violations with the new wind farm that did not have violations in the base cases was due to the same invalid contingency as discussed in wind farm location 1 above.

Since this is a preliminary Feasibility Study, not all previously queued projects were assumed to be in service in this Feasibility Study. If any of those projects are constructed, then this Feasibility Study will have to be revised to determine the impacts of this Interconnection Customer's project on transmission facilities. In accordance with FERC and SPP procedures the study cost for restudy shall be borne by the Interconnection Customer.

The costs included in this study do not include any costs associated with Network Resource (deliverability) of the energy to final customers. These costs are determined by separate studies when the Customer requests transmission service through Southwest Power Pool’s OASIS. This cost if any will be presented in a subsequent study results.

The costs of interconnecting the facility to the transmission system are listed in Tables 3 and 4. These costs do not include any cost that might be associated with short circuit study results or dynamic stability study results. These costs will be determined when and if a System Impact Study is conducted.

Table 3: Network Upgrade Facilities

Facility	ESTIMATED COST (2004 DOLLARS)
Interconnection Three Breaker Ring Bus	$2,275,000
Elk City to Elk City (Upgrade already Planned)	$ 0
Morewood Switch to Hammon-Butler Jct. Transmission Line and Line Switches on both ends	$3,452,000
Total	**$5,727,000**

Table 4: Direct Assignment Facilities

Facility	ESTIMATED COST (2004 DOLLARS)
Interconnection Facilities – Add 138kV bus, breaker, switches, metering, relaying, etc.	*
Customer – 138-34.5 kV Substation facilities.	*
Total	*

Note: * Estimates of cost to be determined by Customer.

3 STABILITY ANALYSIS

In this stability study, ABB investigated the stability of the system for faults in the vicinity of the proposed plant as defined by SPP. The faults involve three-phase and single-phase faults cleared by primary protection, reclosing with the fault still on, and then permanently clearing the fault by backup protection.

3.1 Stability Analysis Methodology

Using Planning Standards approved by NERC, the following stability definition was applied in the Transient Stability Analysis:

"Power system stability is defined as that condition in which the differences of the angular positions of synchronous machine rotors become constant following an aperiodic system disturbance."

Stability analysis was performed using PTI's PSS/E dynamics program V28. GE wind generators were modeled using the latest (June 2004) GE wind turbine model available from PTI, modified with known data for the proposed wind farm.

Disturbances such as three phase and single-phase line faults were simulated for the specified durations, including reclosing, and the synchronous machine rotor angles were monitored to make sure they maintained synchronism following the fault removal.

Single-phase line faults were simulated with the standard method of applying a fault impedance to the positive sequence network to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the fault location of approximately 60% of pre-fault voltage, which is a typical value.

The ability of the wind generators to stay connected to the grid during the disturbances and during the fault recovery was also monitored. This is primarily determined by their low-voltage ride-through capabilities, or lack thereof, as represented in the models by low-voltage trip settings.

3.2 Study Model

The study model consists of a power flow case and dynamics database, developed as follows.

Power Flow Case

SPP provided a PSS/E power flow case called "05_GEN-2003-022_BASECASE.SAV". This case represents 2005 Summer Peak conditions on the SPP system.

The new Washita – Southwestern Station 138 kV line was added to the power flow case using an IDEV file provided by SPP. The resulting case was used as the base case for this study.

The developer provided a detailed layout of the wind farm collector system and wind turbine generators. While it is not practical to model 80, 1.5 MW generators in power systems stability analysis, the detailed data was used to calculate a single machine equivalent for the 120 MW plant. The detailed plant was modeled in PSS/E power flow, and short-circuit analysis was used to determine the Thevenin equivalent impedance of the wind farm at the low side of the substation transformer. For aesthetic purposes, this impedance was separated into two parts, one an equivalent 0.575/34.5 kV, 140 MVA (80 * 1.75) GSU transformer, and the remainder representing an equivalent 34.5 kV collector system impedance[1].

Appendix B notes there was a Customer provided wind farm one-line diagram provided by SPP and equivalent model data for creation of an accurate study Model.

Because PSS/E's DFIG model was to be used, the Wind farm's 120 MW generators were initially modeled at the GSU high-side bus (34.5 kV), and then the PTI IPLAN program was run to create the GSUs and move the generators to the low side (0.575 kV). The PSS/E DFIG default data were modified as necessary to match available data provided by the developer and the calculated equivalent.

The resulting PSS/E one-line diagram for the 120 MW case is shown below in Figure 3.

Stability Data

SPP provided the stability database in the form of a PSS/E dynamic raw data file "05sp_gen-2003-022_basecase.dyr" as well as IDEV and IPLAN files to compile and link user-written models. The provided files required the use of PSS/E version 28.

The latest PSS/E DFIG dynamic model was used to model the 120 MW wind farm. As mentioned above, the PSS/E DFIG model requires execution of an IPLAN program to create the GSUs and move the generators to the low-side (0.575 kV). This IPLAN program also generates a dynamic data file (*.dyr) for the DFIG machines. The direct dispatch (100.0%) for MW generation and voltage control mode for Mvar generation were used. The dynamic model used for the GEN-2002-024 wind plant (#55787) has been updated to reflect the latest DFIG model available in order to be consistent with the DFIG model used at the Wind farm. The under-voltage and frequency trip settings have been retained.

[1] An example of why this split is purely aesthetic is as follows: If the impedance of all the individual GSU transformers were to change, it would not be sufficient to simply change the impedance of the equivalent GSU transformer. One would need to change the individual GSU impedances in the detailed model and recalculate the Thevenin impedance. Subtracting out the new equivalent GSU impedance would leave a new and different equivalent collector system impedance. The only instance where one can expect the equivalent collector impedance to stay the same when changing the GSUs is if all wind generators were identically distant in impedance from the substation, which is rarely the case.

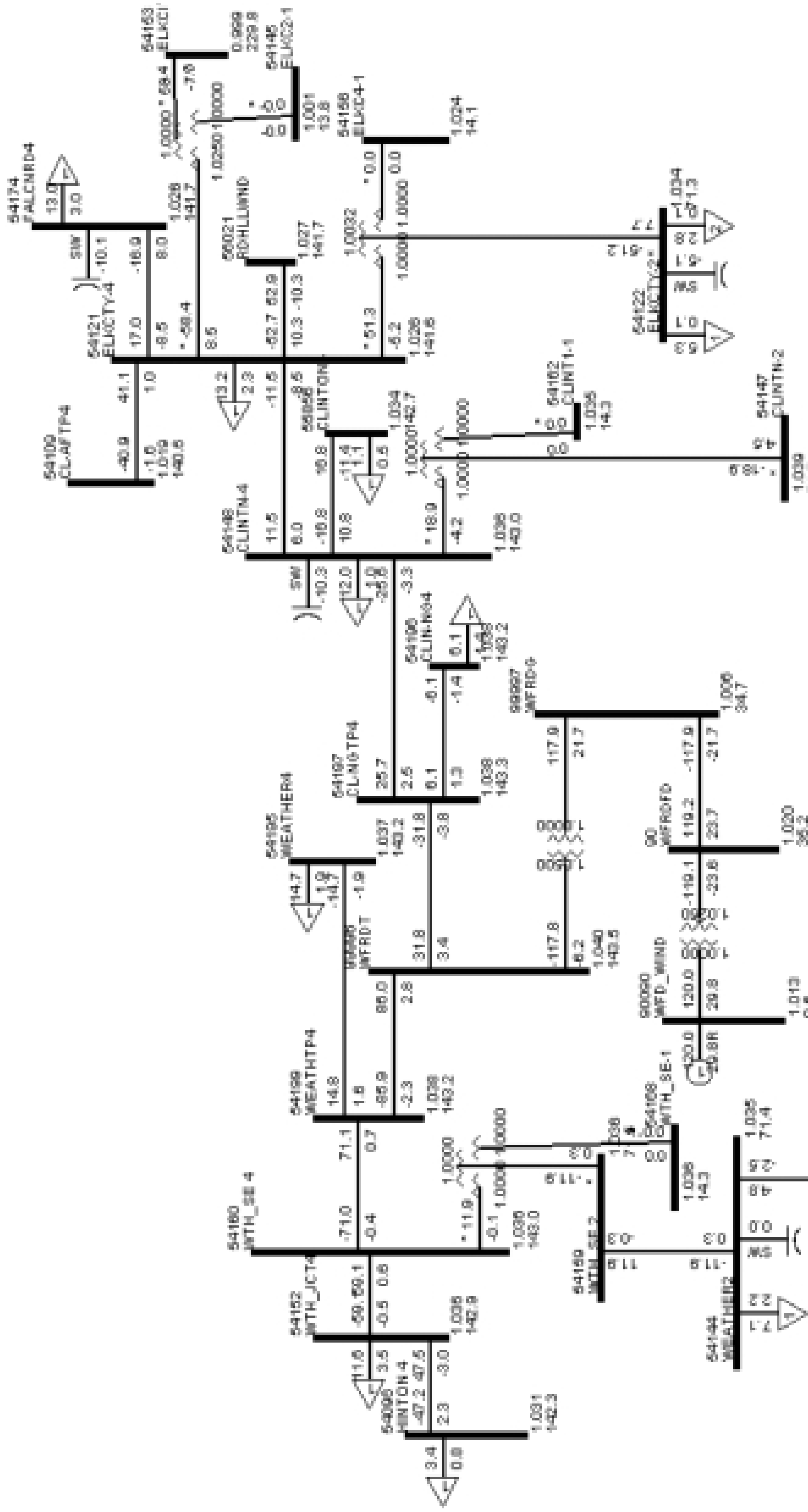


Figure 3. PSS/E One-line diagram of the Weatherford Area with Wind Farm at 120 MW

It is important to note that the PSS/E DFIG model includes under- and over-voltage and frequency trip relays in the model. The undervoltage settings are the most critical. The developer stated that the generators in the new wind farm will have ride-through capability for voltages below 70% for up to 100 msec. This is the current standard ride-through capability available from GE Wind Energy, and the dynamic model was adjusted to reflect this. The following voltage settings were used:

Table 5. DFIG Voltage Trip Settings

Undervoltage settings (per unit)	Time Delay (seconds)
0.3	0.02
0.7	0.1
0.75	1
0.85	10
Overvoltage settings (per unit)	Time Delay (seconds)
1.1	1
1.15	0.1
1.3	0.02

The frequency trip models for the Wind farm were disabled as PSS/E is not capable of calculating accurate frequencies during three-phase bolted fault conditions, and the wind farm would incorrectly trip during the fault.

Dynamic data for the equivalent 120 MW DFIG generator is shown in Appendix C.

Contingencies Tested

Fourteen three-phase and single-phase line faults were simulated on branches connected to Weatherford Junction, Weatherford SE, Clinton Junction, and Elk City 138 kV stations, as well as four faults at the proposed 138 kV wind farm interconnection station, for a total of 18 faults. It is assumed that the wind farm will be connected to the system via a 138 kV, 3-breaker ring bus. Figure 4 shows the fault locations on a one-line diagram of the area. Breaker locations are also shown. All transmission lines were assumed to have reclosing enabled, although reclosing should probably be turned off once the new wind farm comes on line. The complete fault descriptions are included in Table 6.

Table 6: Description of Faults with Wind Farm at 120MW

FAULT	FAULT DESCRIPTION
FLT1-3PH 3-phase Fault	**1. FAULT ON WEATHERFORD JUNCTION (54152)- JENSEN ROAD (54821), 138KV LINE, NEAR WEATHERFORD JUNCTION.**
	a. Apply fault at the Weatherford Junction (54152).
	b. Clear fault after 3.5 cycles by removing the line from 54152 to 54821.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 24 cycles, then trip the line in (b) and remove fault.
FLT2-1PH 1-phase Fault	**2. FAULT ON WEATHERFORD JUNCTION (54152)- JENSEN ROAD (54821), 138KV LINE, NEAR WEATHERFORD JUNCTION.**
	a. Apply fault at the Weatherford Junction (54152).
	b. Clear fault after 3.5 cycles by removing the line from 54152 to 54821.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 24 cycles, then trip the line in (b) and remove fault.
FLT3-3PH 3-phase Fault	**3. FAULT ON WEATHERFORD JUNCTION (54152)- WEATHERFORD SE (54160), 138KV LINE, NEAR WEATHERFORD JUNCTION.**
	a. Apply fault at the Weatherford Junction (54152).
	b. Clear fault after 3.5 cycles by removing the line from 55893 to 54160.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 24 cycles, then trip the line in (b) and remove fault.
FLT4-1PH 1-phase Fault	**4. FAULT ON WEATHERFORD JUNCTION (54152)- WEATHERFORD SE (54160), 138KV LINE, NEAR WEATHERFORD JUNCTION.**
	a. Apply fault at the Weatherford Junction (54152).
	b. Clear fault after 3.5 cycles by removing the line from 55893 to 54160.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 24 cycles, then trip the line in (b) and remove fault.
FLT5-3PH 3-phase Fault	**5. FAULT ON WEATHERFORD JUNCTION SE (54160) – GEN-2003-022 WIND FARM (99996), NEAR WEATHERFORD SE (54160).**
	a. Apply fault at the Weatherford SE (54160).
	b. Clear fault after 3.5 cycles by removing the line from 54160 to 99996.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT6-1PH 1-phase Fault	**6. FAULT ON WEATHERFORD JUNCTION SE (54160) – GEN-2003-022 WIND FARM (99996), NEAR WEATHERFORD SE (54160).**
	a. Apply fault at the Weatherford SE (54160).
	b. Clear fault after 3.5 cycles by removing the line from 54160 to 99996.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.

FAULT	FAULT DESCRIPTION
FLT7-3PH 3-phase Fault	**7. FAULT ON THE CLINTON JUNCTION (54148) – GEN-2003-022 WIND FARM (99996), NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 99996.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT8-1PH 1-phase Fault	**8. FAULT ON THE CLINTON JUNCTION (54148) – GEN-2003-022 WIND FARM (99996), NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 99996.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT9-3PH 3-phase Fault	**9. FAULT ON THE CLINTON JUNCTION (54148) – WFEC WASHITA (56089), 138 KV LINE, NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 55856.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT10-1PH 1-phase Fault	**10. FAULT ON THE CLINTON JUNCTION (54148) – WFEC WASHITA (56089), 138 KV LINE, NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 55856.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT11-3PH 3-phase Fault	**11. FAULT ON THE CLINTON JUNCTION (54148) – ELK CITY (54121), 138 KV LINE, NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 54121.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT12-1PH 1-phase Fault	**12. FAULT ON THE CLINTON JUNCTION (54148) – ELK CITY (54121), 138 KV LINE, NEAR CLINTON JUNCTION (54148).**
	a. Apply fault at the Clinton Junction (54148).
	b. Clear fault after 3.5 cycles by removing the line from 54148 to 54121.
	c. Use 3 shot re-closing at 6 cycles, 120 cycles, and 180 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.

FAULT	FAULT DESCRIPTION
FLT13-3PH 3-phase Fault	**13. FAULT ON THE ELK CITY (54121) – MOOREWOOD (55999), 138KV LINE, NEAR ELK CITY.**
	a. Apply fault at the Elk City (54121).
	b. Clear fault after 3.5 cycles by removing the line from 54121 to 56021.
	c. Use 2 shot re-closing at 30 cycles and 120 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT14-1PH 1-phase Fault	**14. FAULT ON THE ELK CITY (54121) – MOOREWOOD (55999), 138KV LINE, NEAR ELK CITY.**
	a. Apply fault at the Elk City (54121).
	b. Clear fault after 3.5 cycles by removing the line from 54121 to 56021.
	c. Use 2 shot re-closing at 30 cycles and 120 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT15-3PH 3-phase Fault	**15. FAULT ON THE GEN-2003-022 (99996) – CLINTON JUNCTION (54197), 138KV LINE, GEN-2003-022.**
	a. Apply fault at the Gen-2003-022 (99996).
	b. Clear fault after 3.5 cycles by removing the line from 99996 to 54197.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT16-1PH 1-phase Fault	**16. FAULT ON THE GEN-2003-022 (99996) – CLINTON JUNCTION (54197), 138KV LINE, GEN-2003-022.**
	a. Apply fault at the Gen-2003-022 (99996).
	b. Clear fault after 3.5 cycles by removing the line from 99996 to 54197.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT17-3PH 3-phase Fault	**17. FAULT ON THE GEN-2003-022 (99996) – WEATHERFORD JUNCTION (54199), 138KV LINE, GEN-2003-022.**
	a. Apply fault at the Gen-2003-022 (99996).
	b. Clear fault after 3.5 cycles by removing the line from 99996 to 54199.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.
FLT18-1PH 1-phase Fault	**18. FAULT ON THE GEN-2003-022 (99996) – WEATHERFORD JUNCTION (54199), 138KV LINE, GEN-2003-022.**
	a. Apply fault at the Gen-2003-022 (99996).
	b. Clear fault after 3.5 cycles by removing the line from 99996 to 54199.
	c. Use 1 shot re-closing at 30 cycles for the line in (b) into the fault.
	d. Leave fault on for 15 cycles, then trip the line in (b) and remove fault.

3.3 STABILITY RESULTS

Results are tabulated in Table 7. As shown, the results indicate that the system is stable following all faults. In addition, the Wind farm trips in almost every simulated fault scenario, due to its undervoltage trip settings (See Table 5) incorporated as per the new information provided by the developer.

The only other issue is undervoltage tripping of the Gen-2002-005 120 MW Wind generator during all 3-phase faults and one single-phase fault. It is also observed that this plant trips in the base case without the proposed wind farm. The reason that the Gen-2002-005 Wind generator trips in all fault simulations is that it does not have low-voltage ride-though capability. The Gen-2002-005 Wind dynamic model trips the generator if the voltage goes below 75% for more than 80 msec. If the Gen-2002-005 wind farm is not yet installed, there may still be time to request better low-voltage ride-through capability for its wind turbine generators.

The GEN-2003-022 developer stated that his GE wind turbines will have ride-through capability for voltages below 70% for up to 100 msec. They can also ride through voltages below 75% for 1 second and below 85% for 10 seconds. However, the generators will trip instantaneously for voltages below 30% (PSS/E models a 20 msec time delay). The Wind farm trips instantaneously for all simulated three phase faults due to this instantaneous undervoltage trip setting. In the simulation of three phase faults, the terminal voltage of the Wind farm falls below 30% of rated value, which triggers the instantaneous under-voltage trip setting causing the generator to trip. In all of the single phase faults (except FLT141PH), the terminal voltage of the Wind farm falls slightly less than 70% of its rated value. The dynamic model has an undervoltage trip setting of 100 msec (6 cycles) below 70% voltage, so the plant trips whenever a fault is applied for more than 6 cycles in the single phase fault simulations.

Three-phase faults #1 and #3, which include multiple reclosing events totaling 34.5 cycles (575 msec) of fault time, cause the voltage could go as low as 12% at the wind generator terminals every time a 3-phase fault occurs at Weatherford Junction. Currently the PSS/E model does not consider cumulative low-voltage time caused by multiple reclosings. However, cumulative fault time in a short time span may indeed be important in determining true low-voltage ride-through capability. To study this phenomenon in detail, a three-phase electromagnetic transient study would be needed, along with more information from the wind turbine manufacturer.

Reclosing into 3-phase faults near the plant is also detrimental to the turbine shafts, independent of nominal mechanical speed. The problem is that electrical power and torque are slamming back and forth between approximately 1.0 per unit and 0 per unit, causing mechanical fatigue. If reclosing takes place when shaft oscillations are still persisting, the resultant torques on the shaft may be even more severe. Standard industry practice is to have no fast (<10sec) reclosing on multi-phase faults near generating plants without detailed studies of shaft fatigue duty. Ultimately, ABB recommends no automatic line reclosing at the Wind Farm, Weatherford SE, Weatherford Junction, and Clinton Junction substations to prevent tripping of and/or damage to the wind turbines.

Simulation plots for all fault cases are shown in Appendix E.

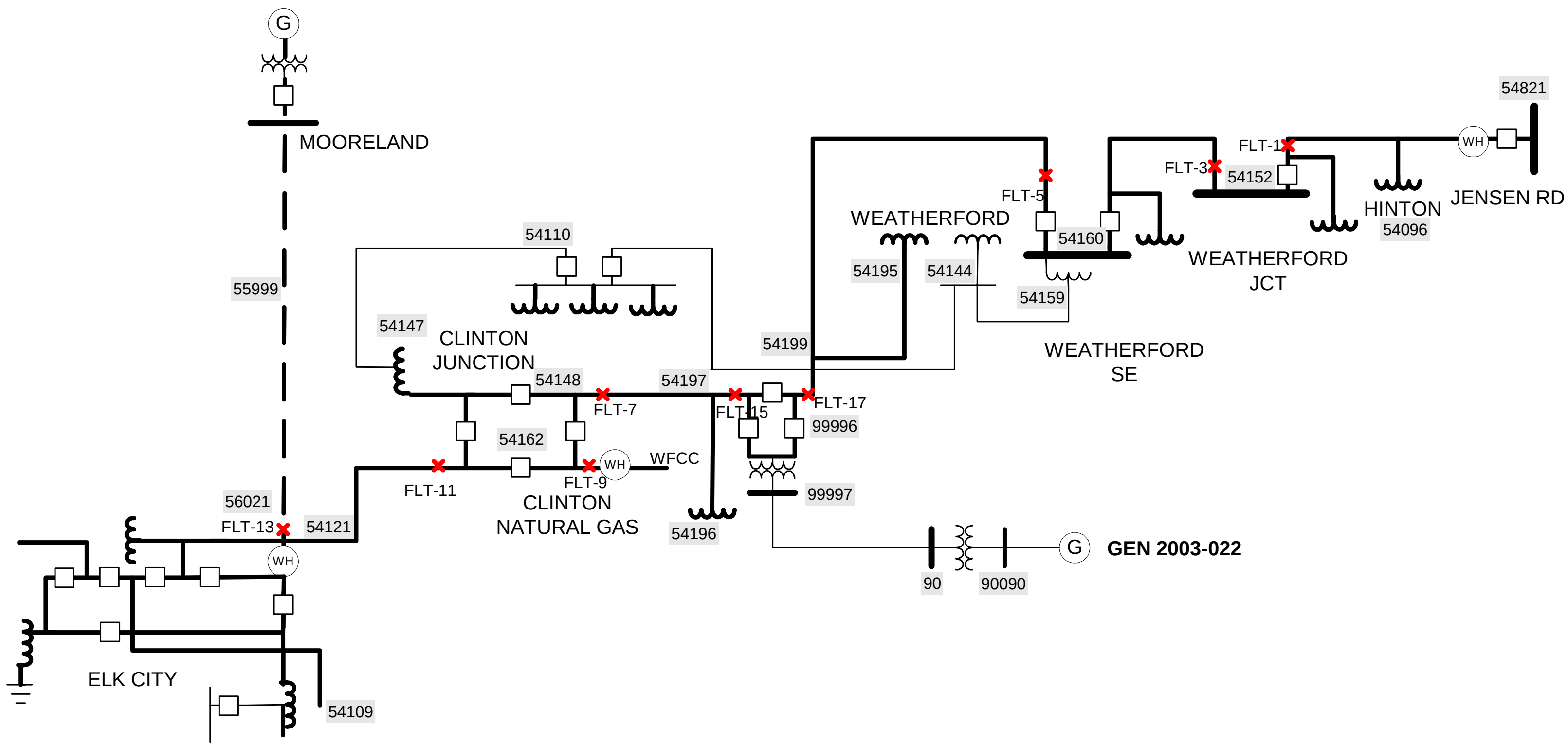


Figure 4. System One-line Showing Locations of Simulated Faults

Table 7: Summary of Fault results with Wind Farm at 120MW

Fault	Fault Location:	Generator Tripping		System Stability
		GEN 2003-022	GEN 2002-005	
FLT1-3PH	Weatherford Junction (54152)- Jensen Road (54821), 138kV line, near Weatherford function.	X	X	Stable
FLT2-1PH	Weatherford Junction (54152)- Jensen Road (54821), 138kV line, near Weatherford function.	X	-	Stable
FLT3-3PH	Weatherford Junction (54152)- Weatherford SE (54160), 138kV line, near Weatherford function.	X	X	Stable
FLT4-1PH	Weatherford Junction (54152)- Weatherford SE (54160), 138kV line, near Weatherford function.	X	-	Stable
FLT5-3PH	Weatherford Junction SE (54160) – Gen-2003-022 Wind farm (99996), near Weatherford SE (54160).	X	X	Stable
FLT6-1PH	Weatherford Junction SE (54160) – Gen-2003-022 Wind farm (99996), near Weatherford SE (54160).	X	-	Stable
FLT7-3PH	Clinton Junction (54148) – Gen-2003-022 Wind farm (99996), near Clinton Junction (54148).	X	X	Stable
FLT8-1PH	Clinton Junction (54148) – Gen-2003-022 Wind farm (99996), near Clinton Junction (54148).	X	-	Stable
FLT9-3PH	Clinton Junction (54148) – WFEC Washita (56089), 138 kV line, near Clinton Junction (54148).	X	X	Stable
FLT10-1PH	Clinton Junction (54148) – WFEC Washita (56089), 138 kV line, near Clinton Junction (54148).	X	-	Stable
FLT11-3PH	Clinton Junction (54148) – Elk City (54121), 138 kV line, near Clinton Junction (54148).	X	X	Stable
FLT12-1PH	Clinton Junction (54148) – Elk City (54121), 138 kV line, near Clinton Junction (54148).	X	-	Stable
FLT13-3PH	Elk City (54121) – Moorewood (55999), 138kV line, near Elk City.	X	X	Stable
FLT14-1PH	Elk City (54121) – Moorewood (55999), 138kV line, near Elk City.	-	X	Stable
FLT15-3PH	Gen-2003-022 (99996) – Clinton Junction (54197), 138kV line, Gen-2003-022.	X	X	Stable
FLT16-1PH	Gen-2003-022 (99996) – Clinton Junction (54197), 138kV line, Gen-2003-022.	X	-	Stable
FLT17-3PH	Gen-2003-022 (99996) – Weatherford Junction (54199), 138kV line, Gen-2003-022.	X	X	Stable
FLT18-1PH	Gen-2003-022 (99996) – Weatherford Junction (54199), 138kV line, Gen-2003-022.	X	-	Stable

Notes:
X - Plant tripped on Undervoltage.
GEN-2002-005 at Bus 56007 trips for the faults in cases with and without the new wind farm at Weatherford

4 STUDY CONCLUSIONS

The power flow analysis showed that there was no thermal overloading of lines due to proposed plant, when considering only lines with OTDF above 3%. If OTDFs below 3% are considered, a few lines are adversely impacted by the wind farm. The few problems are either pre-existing or have extremely low response to the new power injection from the plant.

There are no new voltage violations due to the new wind farm in the studied cases.

Based on the results of the stability analysis, it is concluded that the Wind farm at 120 MW does not adversely impact the stability of the SPP system. The cost of interconnecting the facility to the transmission system due to dynamic stability results is $ 0. This cost added with the cost due to the thermal results is $ 5,727,000. This new Wind farm will trip for most delayed clearing faults within 2 stations of its interconnection point, as well as most normal clearing faults on the lines emanating from the interconnection point. Traditional generating plants do not have this problem. It is recommended that automatic reclosing be disabled on transmission lines adjacent to the wind farm to protect the wind turbine generators from frequent tripping and undue stress from reclosing into faults. In addition, better low-voltage ride-through capability should be considered for the GEN-2003-022 and GEN-2002-005 wind farms, to avoid unnecessary and nuisance tripping of generation following transmission faults.

The results of this analysis are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study model change, the results provided in this report may not apply.

APPENDIX A – POWER FLOW SIMULATION SETTINGS

Appendix A.1 (PSS/E)

PSS/E CHOICES IN RUNNING LOAD FLOW PROGRAM AND ACCC

BASE CASES:
Solutions – Fixed slope decoupled Newton-Raphson solution (FDNS)
1. Tap adjustment – Stepping
2. Area interchange control – Tie lines only
3. Var limits – Apply immediately
4. Solution options - X Phase shift adjustment
   _ Flat start
   _ Lock DC taps
   _ Lock switched shunts

ACCC CASES:
Solutions – AC contingency checking (ACCC)
1. MW mismatch tolerance – 0.5
2. Contingency case rating – Rate B
3. Percent of rating – 100
4. Output code – Summary
5. Min flow change in overload report – 1mw
6. Exclude cases w/ no overloads form report – YES
7. Exclude interfaces from report – NO
8. Perform voltage limit check – YES
9. Elements in available capacity table – 60000
10. Cutoff threshold for available capacity table – 99999.0
11. Minimum contingency case voltage change for report – 0.02
12. Sorted output – None

Newton Solution:
1. Tap adjustment – Stepping
2. Area interchange control – Tie lines only
3. Var limits – Apply automatically
4. Solution options - X Phase shift adjustment
   _ Flat start
   _ Lock DC taps
   _ Lock switched shunts

Appendix A.2 (MUST)

MUST CHOICES IN RUNNING FCITC DC ANALYSIS

CONSTRAINTS/CONTINGENCY INPUT OPTIONS

1. AC Mismatch Tolerance – 2 MW
2. Base Case Rating – Rate A
3. Base Case % of Rating – 100%
4. Contingency Case Rating – Rate B
5. Contingency Case % of Rating – 100%
6. Base Case Load Flow – PSS/E
7. Convert branch ratings to estimated MW ratings – Yes
8. Contingency ID Reporting – Labels
9. Maximum number of contingencies to process - 50000

MUST CALCULATION OPTIONS

1. Phase Shifters Model for DC Linear Analysis – Constant flow for Base Case and Contingencies
2. Report Base Case Violations with FCITC – Yes
3. Maximum number of violations to report in FCITC table - 50000
4. Distribution Factor (OTDF and PTDF) Cutoff – 0.03
5. Maximum times to report the same elements - 10
6. Apply Distribution Factor to Contingency Analysis – Yes
7. Apply Distribution Factor to FCITC Reports – Yes
8. Minimum Contingency Case flow change – 1 MW
9. Minimum Contingency Case Distribution Factor change – 0.0
10. Minimum Distribution Factor for Transfer Sensitivity Analysis – 0.0

APPENDIX B – COLLECTOR SYSTEM

Customer provided detailed One-Line for creation of model

Substation Main Transformer data:

138-34.5 kV 81/108/135 MVA
YG-Delta Buried-YG

Z @ 81MVA base.

Z+
H-X 8.9%
H-Y 14.0%
X-Y 3.9%

Z0
H-X 7.5%
H-Y 10.8%
X-Y 3.3%

Collector system Equivalent:

R = 0.009336
X = 0.01346

GSU Equivalent:

0.575 – 34.5 kV, 1.750 MVA * 80 = 140 MVA
5.87% impedance @ 140 MVA

APPENDIX C - STABILITY MODEL PARAMETERS FOR WIND FARM

PSS/E Dynamic Data for Equivalent DFIG Generator Modeling 120 MW

```
 PLANT MODELS

 REPORT FOR ALL MODELS                                    BUS 90090 [WFD_WIND0.5750] MODELS


 THE DFIGPQ6.FOR MODEL, RELEASE # 03, WAS UPDATED ON MARCH 03, 2004

 ** DFIGPQ **   BUS X-- NAME --X BASEKV MC     C O N S      S T A T E S          VAR          ICON
             90090      WFD_WIND 0.5750 1  222029-222036  82598-82599   15418-15435     6794

     RA         LA         LM         R1         L1         H          DAMP
   0.0071     0.1714     2.9040     0.0050     0.1563     0.5700     0.0000

      -SLIP
   0.2000



 THE CGECN2.FOR MODEL, RELEASE # 03, WAS UPDATED ON MAY 07, 2004

 ** CGECN2 for DFIGPQ **  BUS X-- NAME --X BASEKV MC     C O N S      S T A T E S          VAR
ICON
                        90090      WFD_WIND 0.5750 1  222037-222057  82600-82607   15436-15442
6795-6798

     TFV        KPV        KIV         RC         XC         TFP          KPP
   0.1500    20.0000    10.0000     0.0000     0.0000     0.0500     3.0000

     KIP         PMX      PMN         QMX         QMN      IQMAX      TRV
   0.6000     1.1200     0.0900     0.3000    -0.4300     1.1100     0.0500

     RPMX        RPMN       T_POWER
   0.4500    -0.4500     5.0000

     KQV         VMINCL     VMAXCL     KVQ
   0.0250     0.9000     1.1000    50.0000

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, JUN 22 2004  16:32
 SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
 (C) 2004 SOUTHWEST POWER POOL, INC. (SEE DISCLAIMER BELOW)

 CONEC MODELS

 REPORT FOR ALL MODELS                                    BUS 90090 [WFD_WIND0.5750] MODELS


                  *** CALL TWIND1(  6799,222058,      0, 15443) ***


 THE TWIND1.FOR MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

  ** TWIND1 ** BUS X-- NAME --X BASEKV MC     C O N S        V A R S         ICONS
             90090 WFD_WIND     0.5750 1  222058-222064  15443-15445    6799-6800

     VWB      T1G       TG     MAXG      T1R      T2R     MAXR
  12.0009999.000   5.000  30.0009999.0009999.000  30.000

               Wind generator Bus #  90090
               Wind Generator ID        1
```

```
 THE TSHAFT2.FOR MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

 ** TSHAFT for a machine **  BUS X-- NAME --X BASEKV MC    C O N S         STATE          VAR
ICON
                        90090     WFD_WIND 0.5750 1  222065-222069   82608-82609   15446-15448
6801-6803

           D12        K12         Ta1          p          Rq
      1.5000      1.2460      7.6400      3.0000      72.0000


               Wind Generator Bus #  90090
               Wind Generator ID         1

 THE GEAERO1.FOR MODEL, RELEASE # 01, WAS DEVELOPED ON FEBRUARY 25, 2004

 ** GEAERO for DFIGPQ **      BUS X-- NAME --X BASEKV MC    C O N S         STATE          VAR
ICON
                        90090     WFD_WIND 0.5750 1  222070-222081   82610-82610   15449-15452
6804-6806

     VWinit      Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta
      12.0000      20.0000      0.0000      27.0000      -4.0000      0.0000

       RHO       Radius          GB_RATIO     SYNCHR       Power_Rate      MBASE1
      1.2250      35.2500      72.0000      1200.0       1500.0       1.6670


               Wind Generator Bus #  90090
               Wind Generator ID         1

 THE TGPTCH1.FOR MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

 ** TGPTCH for DFIGPQ **  BUS X-- NAME --X BASEKV MC    C O N S         STATE          VAR
ICON
                        90090     WFD_WIND 0.5750 1  222082-222091   82611-82613   15453-15455
6807-6809

        Tp              Kpp         Kip             Kpc             Kic
      0.2000      150.0000      25.0000      3.0000      30.0000
         TetaMin    TetaMax   RTetaMin    RTetaMax     PMX
         -4.0000    27.0000   -10.0000    10.0000     0.9100


               Wind Generator Bus #  90090
               Wind Generator ID         1

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, JUN 22 2004  16:32
 SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
 (C) 2004 SOUTHWEST POWER POOL, INC. (SEE DISCLAIMER BELOW)

 CONET MODELS

 REPORT FOR ALL MODELS                         BUS 90090 [WFD_WIND0.5750] MODELS


 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6810,222092,     0, 15456) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV
              90090 WFD_WIND.575           90090 WFD_WIND.575

                   I C O N S      C O N S       V A R
                   6810-6814   222092-222095   15456

                     VLO       VUP       PICKUP     TB
                     0.300     5.000     0.020     0.150
```

```
 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6815,222096,     0, 15457) ***

                BUS   NAME  BSKV         GENR BUS   NAME  BSKV
              90090 WFD_WIND.575            90090 WFD_WIND.575

                   I C O N S      C O N S        V A R
                   6815-6819   222096-222099   15457

                     VLO        VUP      PICKUP     TB
                     0.700      5.000     0.100     0.150


 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6820,222100,     0, 15458) ***

                BUS   NAME  BSKV         GENR BUS   NAME  BSKV
              90090 WFD_WIND.575            90090 WFD_WIND.575

                   I C O N S      C O N S        V A R
                   6820-6824   222100-222103   15458

                     VLO        VUP      PICKUP     TB
                     0.750      5.000     1.000     0.150


 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6825,222104,     0, 15459) ***

                BUS   NAME  BSKV         GENR BUS   NAME  BSKV
              90090 WFD_WIND.575            90090 WFD_WIND.575

                   I C O N S      C O N S        V A R
                   6825-6829   222104-222107   15459

                     VLO        VUP      PICKUP     TB
                     0.850      5.000    10.000     0.150


 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6830,222108,     0, 15460) ***

                BUS   NAME  BSKV         GENR BUS   NAME  BSKV
              90090 WFD_WIND.575            90090 WFD_WIND.575

                   I C O N S      C O N S        V A R
                   6830-6834   222108-222111   15460

                     VLO        VUP      PICKUP     TB
                     0.000      1.100     1.000     0.150


 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6835,222112,     0, 15461) ***

                BUS   NAME  BSKV         GENR BUS   NAME  BSKV
              90090 WFD_WIND.575            90090 WFD_WIND.575

                   I C O N S      C O N S        V A R
                   6835-6839   222112-222115   15461

                     VLO        VUP      PICKUP     TB
                     0.000      1.150     0.100     0.150
```

```
 THE VTGTRP.FLX MODEL, RELEASE # 02, WAS UPDATED ON FEBRUARY 24, 2004

               *** CALL VTGTRP(  6840,222116,     0, 15462) ***

                BUS    NAME   BSKV        GENR BUS    NAME   BSKV
              90090 WFD_WIND.575             90090 WFD_WIND.575

                   I C O N S      C O N S       V A R
                   6840-6844   222116-222119   15462

                     VLO       VUP      PICKUP     TB
                     0.000     1.300     0.020     0.150
```

APPENDIX D – COMPLETE POWER FLOW RESULTS

Study Case	Incremental Transfer Capability	Limiting Element	TDF	Pre Transfer Loading	Rating	Contingency
			2005			
05FA	9	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.04127	-38.2	38.5	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05FA	45.4	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03679	-24.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
05FA-ALT	9.8	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03773	-38.2	38.5	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05FA-ALT	50.6	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03301	-24.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
05SP	-176.4	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.04127	-46.2	38.9	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05SP	-34.6	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03584	-26.3	25.1	55999 MOORLND4 138 56001 MORWODS4 138 1
05SP	52.9	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03101	-37.3	38.9	56000 MORWODS269.0 56001 MORWODS4 138 1
05SP-ALT	-193	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03773	-46.2	38.9	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05SP-ALT	-38.7	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03206	-26.3	25.1	55999 MOORLND4 138 56001 MORWODS4 138 1
05WP-ALT	-152.6	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03773	-44.4	38.7	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05WP-ALT	-119.6	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03212	-29.1	25.3	55999 MOORLND4 138 56001 MORWODS4 138 1
05WP	-139.5	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.04128	-44.4	38.7	56001 MORWODS4 138 99994 GEN-2002-005 138 1
05WP	-107.1	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.0359	-29.1	25.3	55999 MOORLND4 138 56001 MORWODS4 138 1
05WP	114.6	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.031	-35.1	38.7	56000 MORWODS269.0 56001 MORWODS4 138 1
			2007			
07SP	-146.3	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.04019	-44.9	39	56001 MORWODS4 138 99994 GEN-2002-005 138 1
07SP	45.6	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03039	-37.6	39	56000 MORWODS269.0 56001 MORWODS4 138 1
07SP	58.9	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03477	-23.5	25.6	55999 MOORLND4 138 56001 MORWODS4 138 1
07SP-ALT	-159.9	55897 ELKCITY269.0 54122 ELKCTY-269.0 1	-0.03678	-44.9	39	56001 MORWODS4 138 99994 GEN-2002-005 138 1
07SP-ALT	65.8	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03114	-23.5	25.6	55999 MOORLND4 138 56001 MORWODS4 138 1
07WP	102.5	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03597	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
07WP-ALT	112.3	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03234	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
			2010			
10WP	104.7	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03576	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1
10WP-ALT	116.5	55942 HM-BTTP269.0 56000 MORWODS269.0 1	-0.03214	-22.1	25.8	55999 MOORLND4 138 56001 MORWODS4 138 1

APPENDIX E – STABILITY PLOTS

POWER
TECHNOLOGIES
INC.®

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

FILE: FLT13PH.out

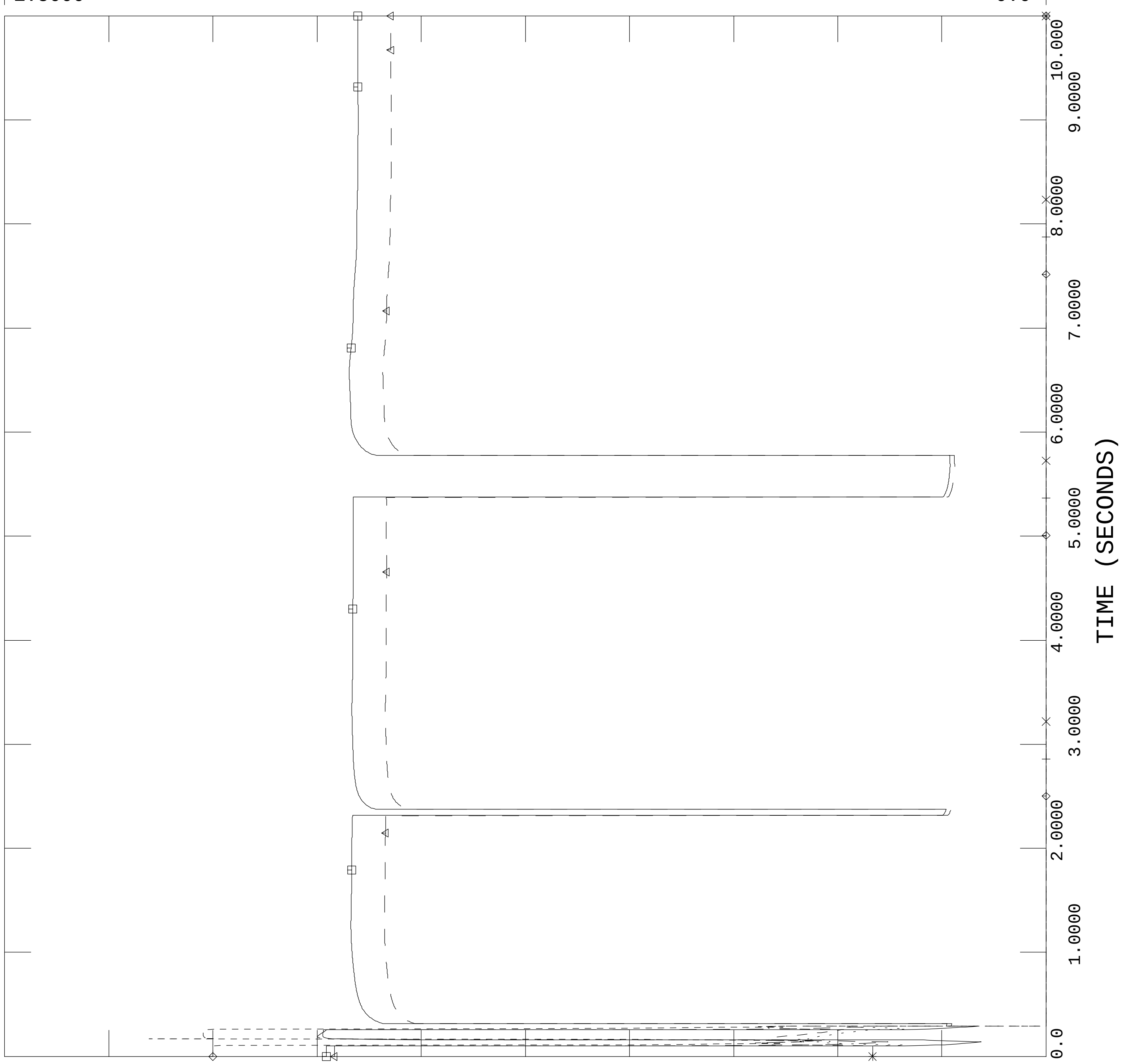
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 0.0

CHNL# 403: [VOLT 99996 [WFRDT   138.00]]
1.5000 0.0



TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT13PH.out

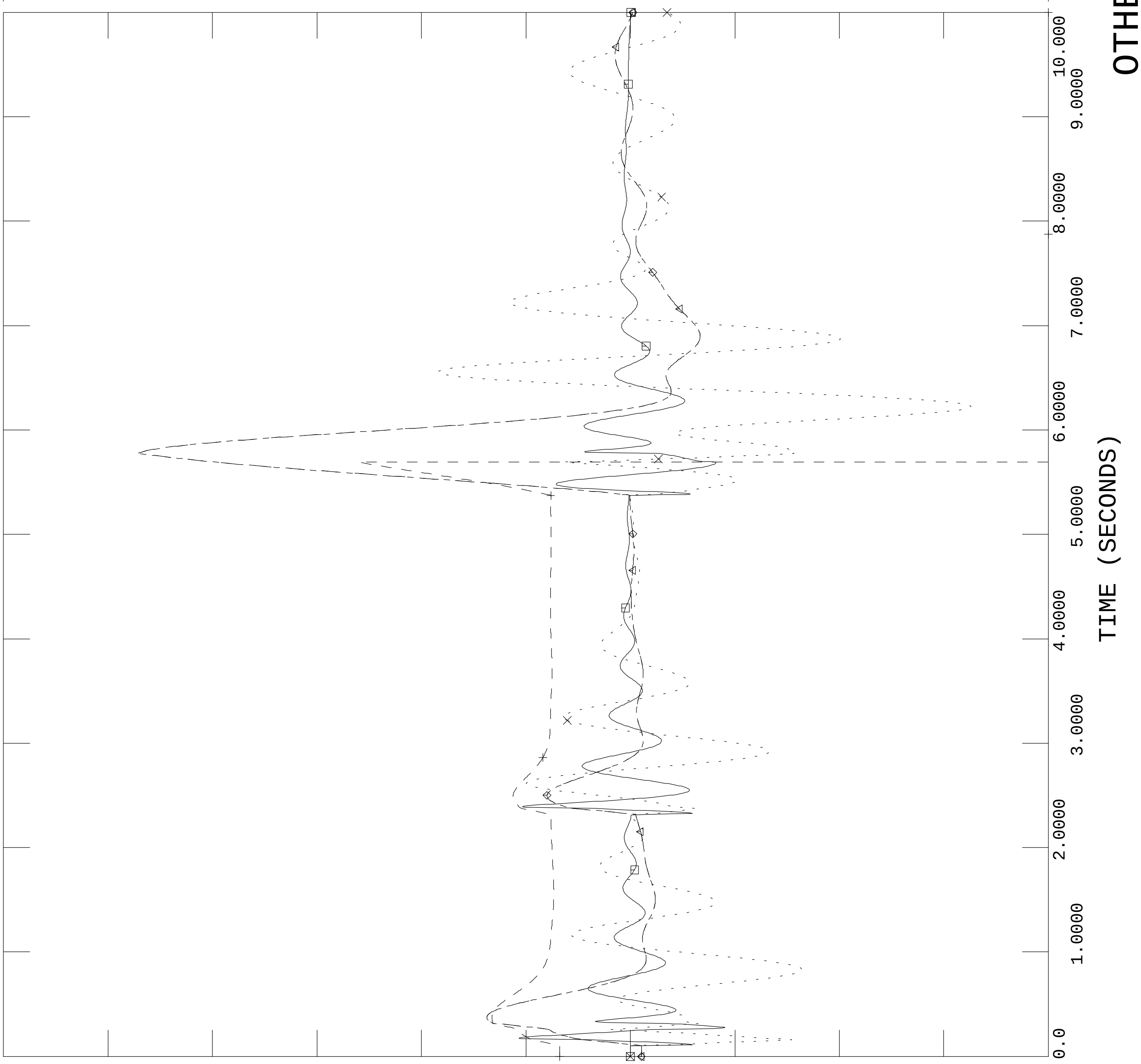
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 × · · · · · · · · × -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 + — — — — — — — + -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 ◇ - - - - - - - - ◇ 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 ◁ — — — — — ◁ 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 □———————□ 0.19900



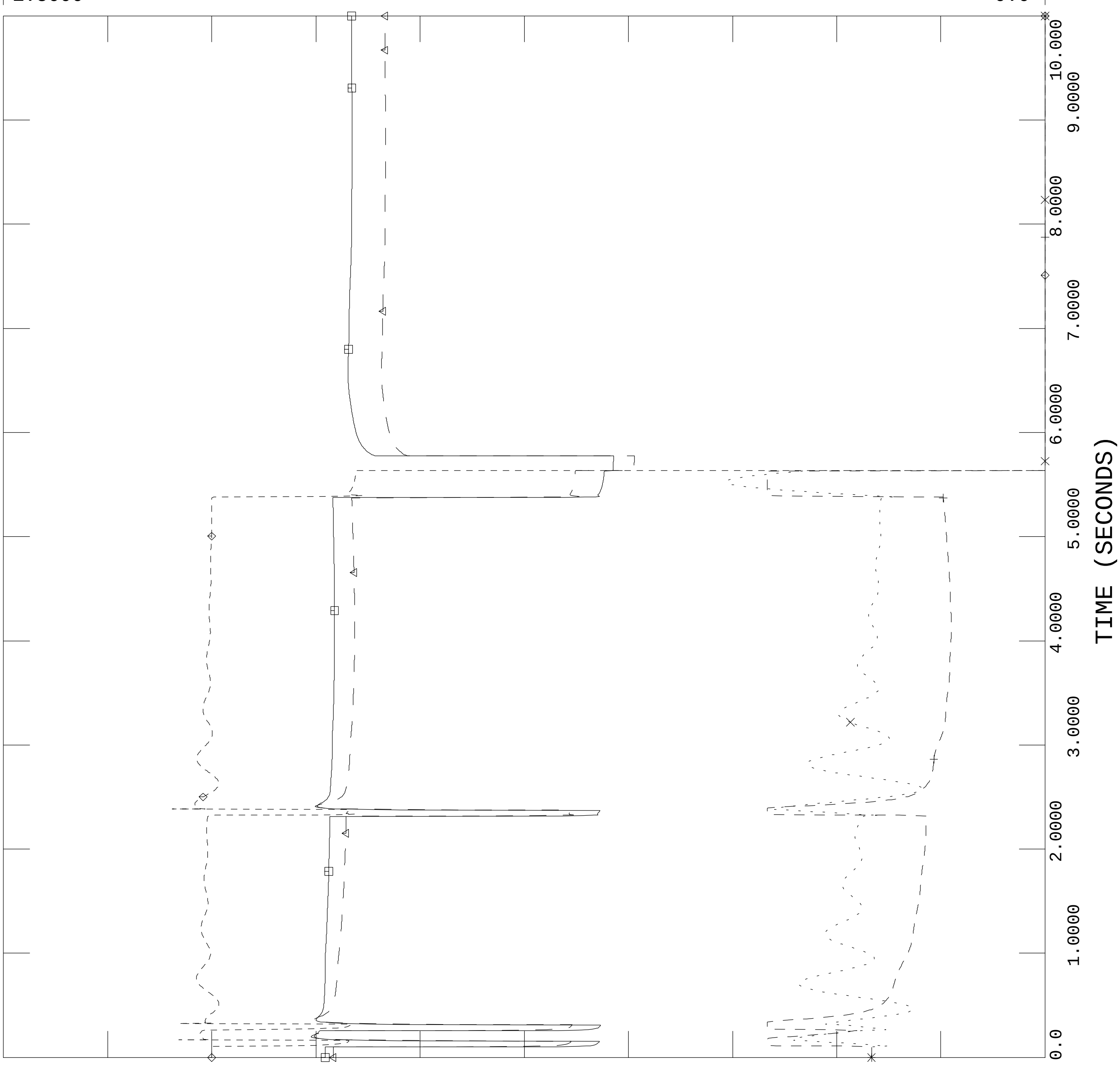
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

FILE: FLT21PH.out

NEW WIND GENERATOR

TUE, JUN 29 2004 14:51

CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.25000	0.19000
CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	1.5000	0.0
CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	1.5000	0.0



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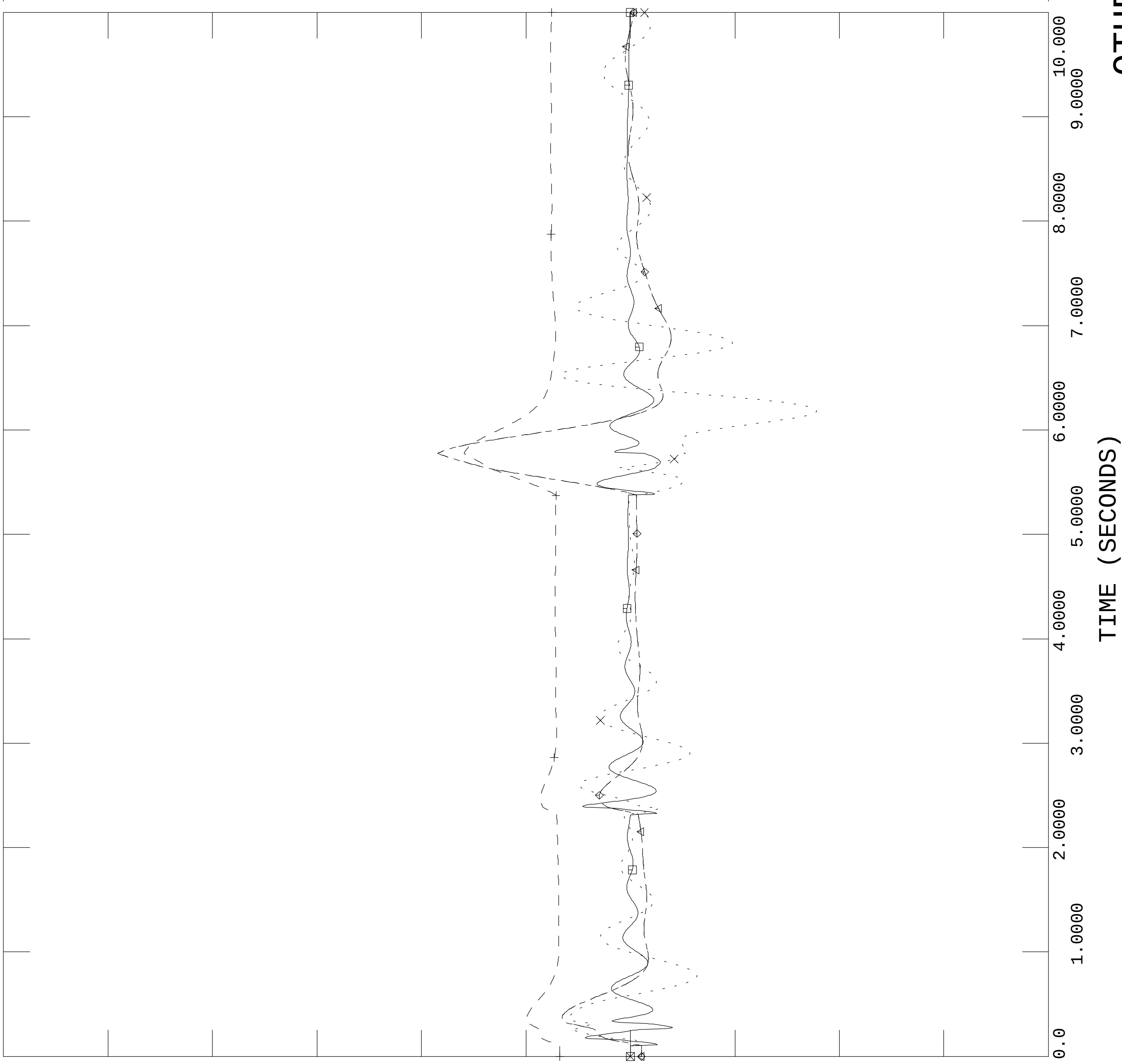
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT21PH.out

CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]	0.00150	-0.0010
CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]	0.04000	-0.0100
CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]	0.02000	0.01000
CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]	0.02000	0.01000
CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]	0.20150	0.19900



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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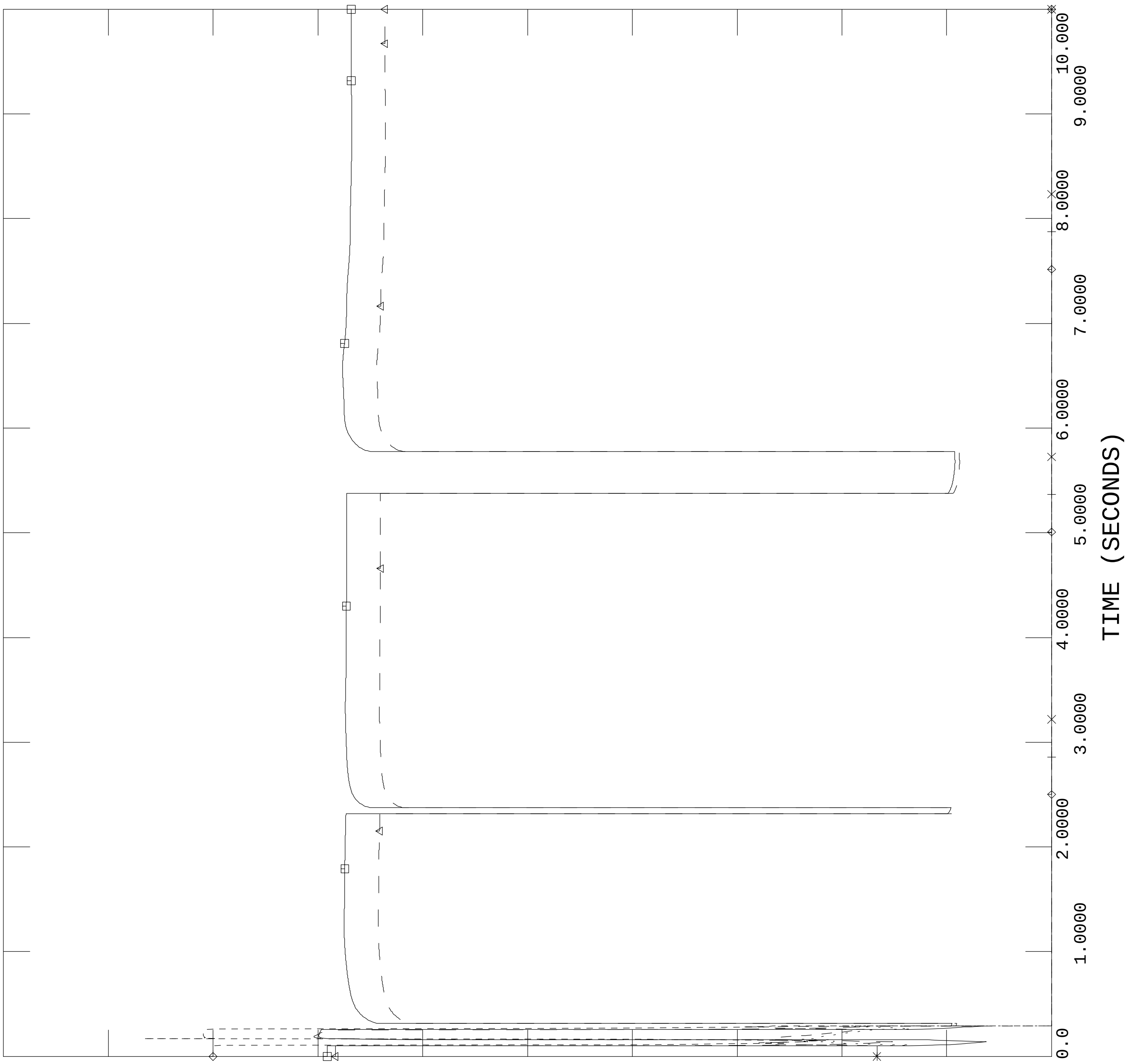
TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT33PH.out

0.25000	CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.19000
1.5000	CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	0.0
1.5000	CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	0.0
1.5000	CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	0.0
1.5000	CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	0.0



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SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT33PH.out

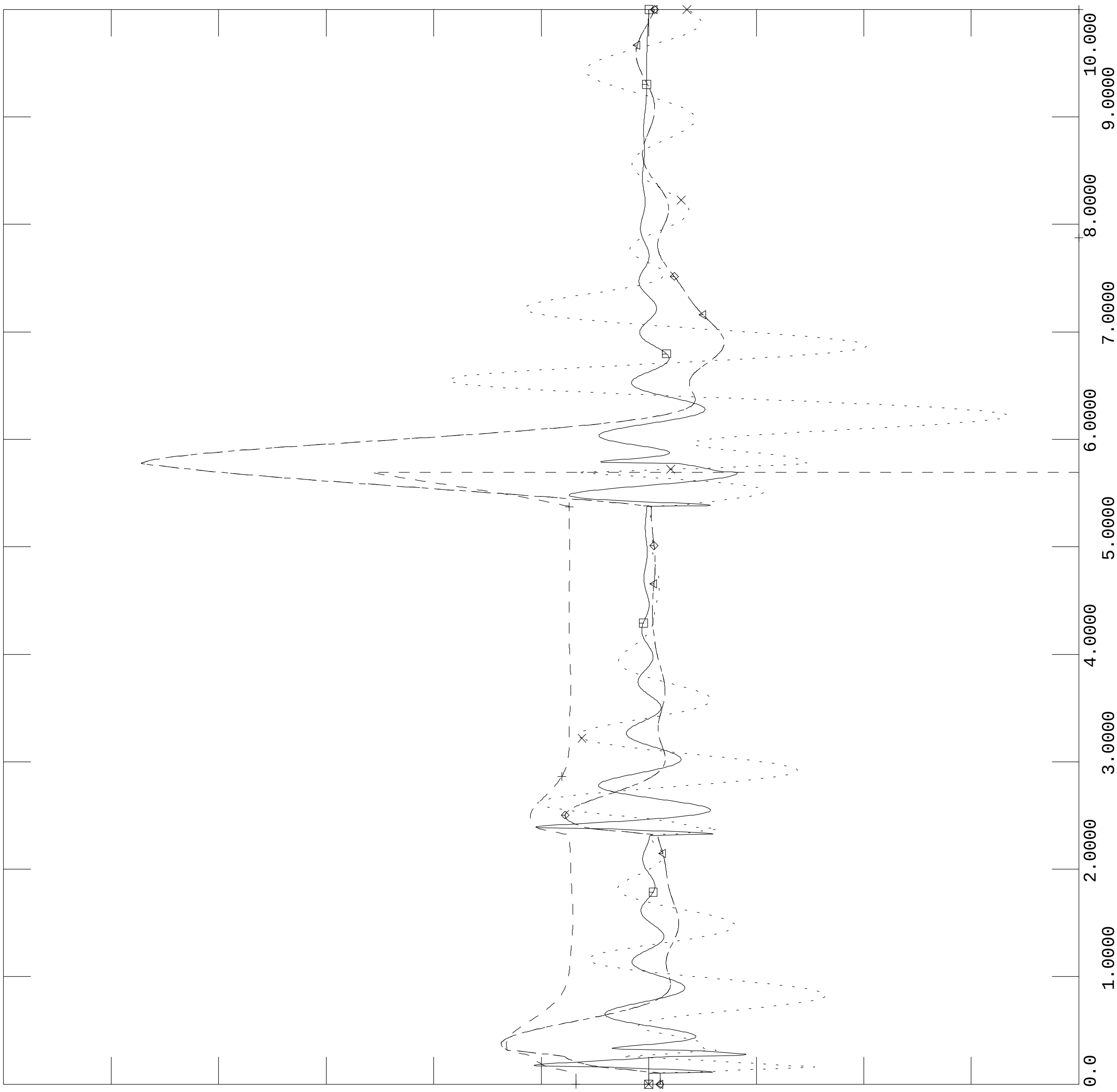
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 0.19900



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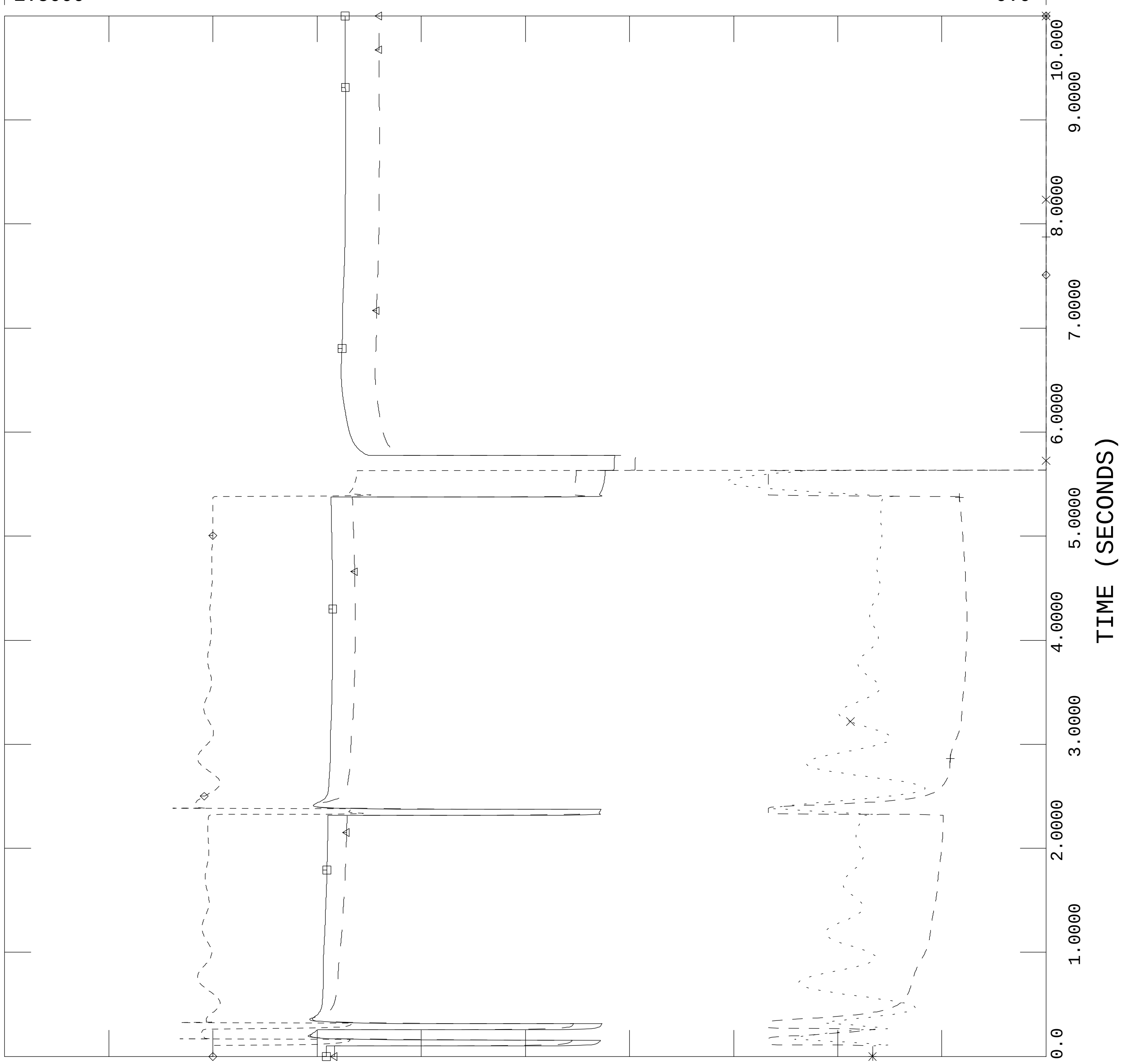
FILE: FLT41PH.out

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

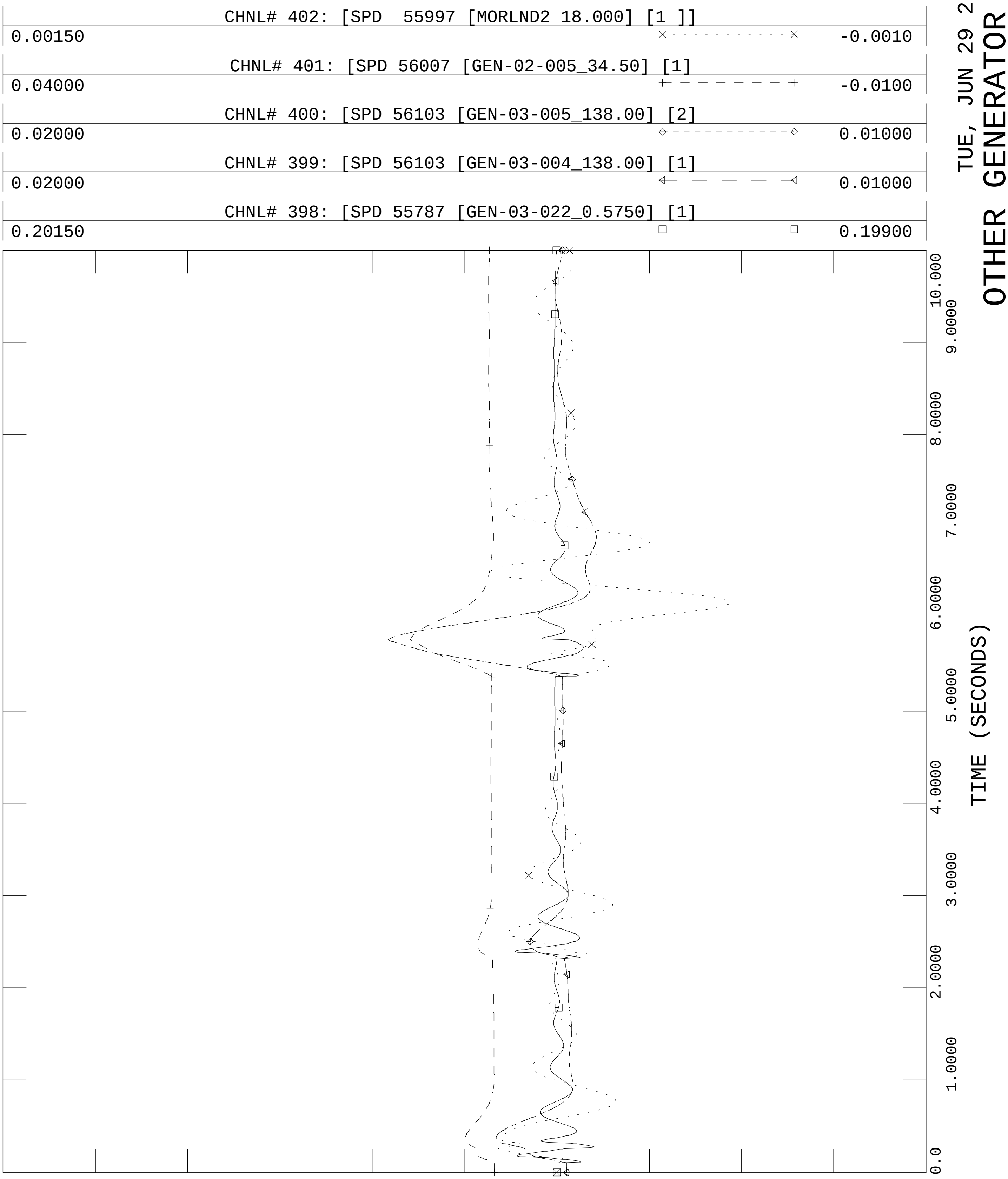
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.25000	0.19000
CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	1.5000	0.0
CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	1.5000	0.0



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT41PH.out



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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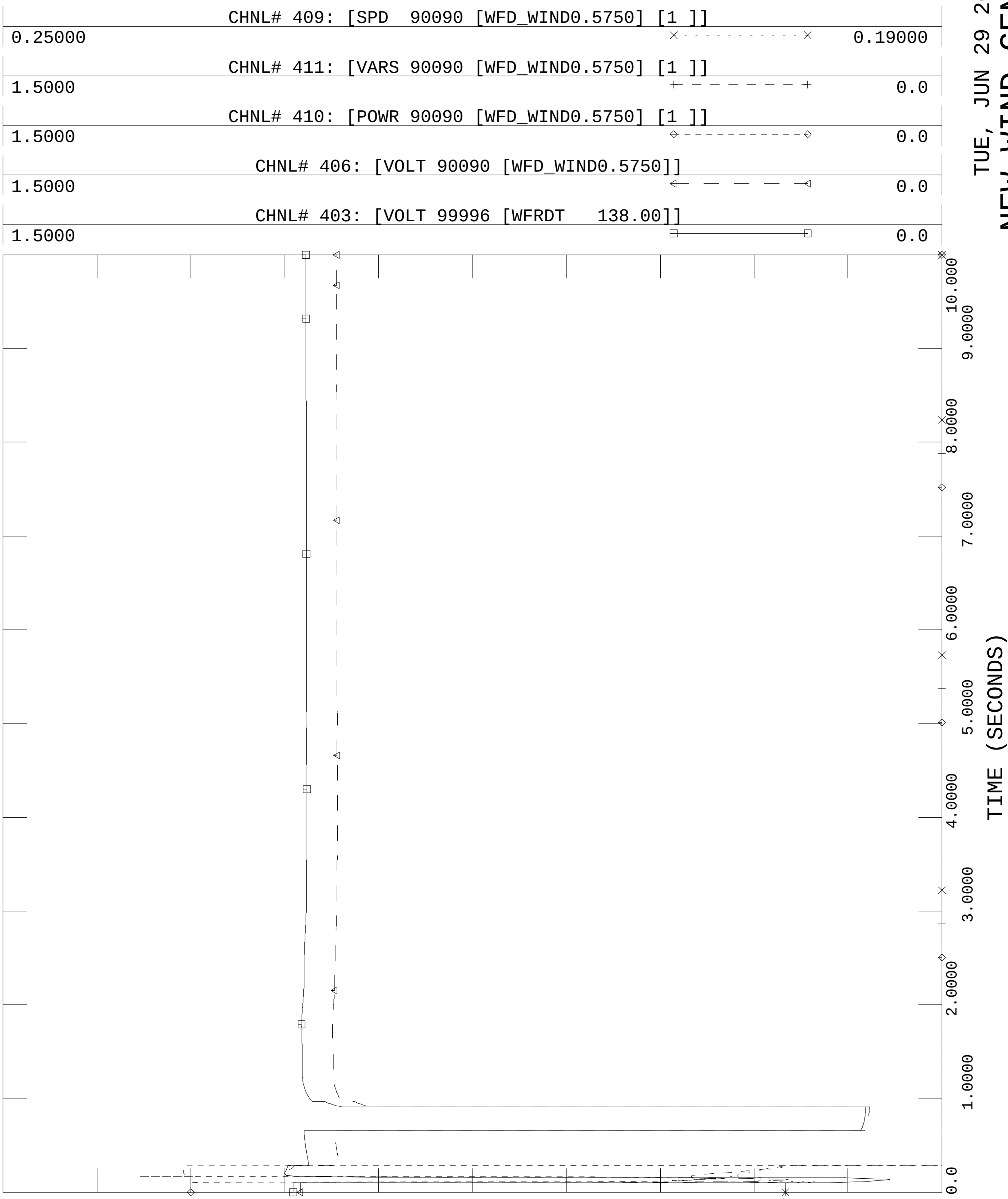
FILE: FLT53PH.out

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
(C) 2004 SOUTHWEST POWER POOL, INC. (SEE DISCLAIMER BELOW)

FILE: FLT53PH.out

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

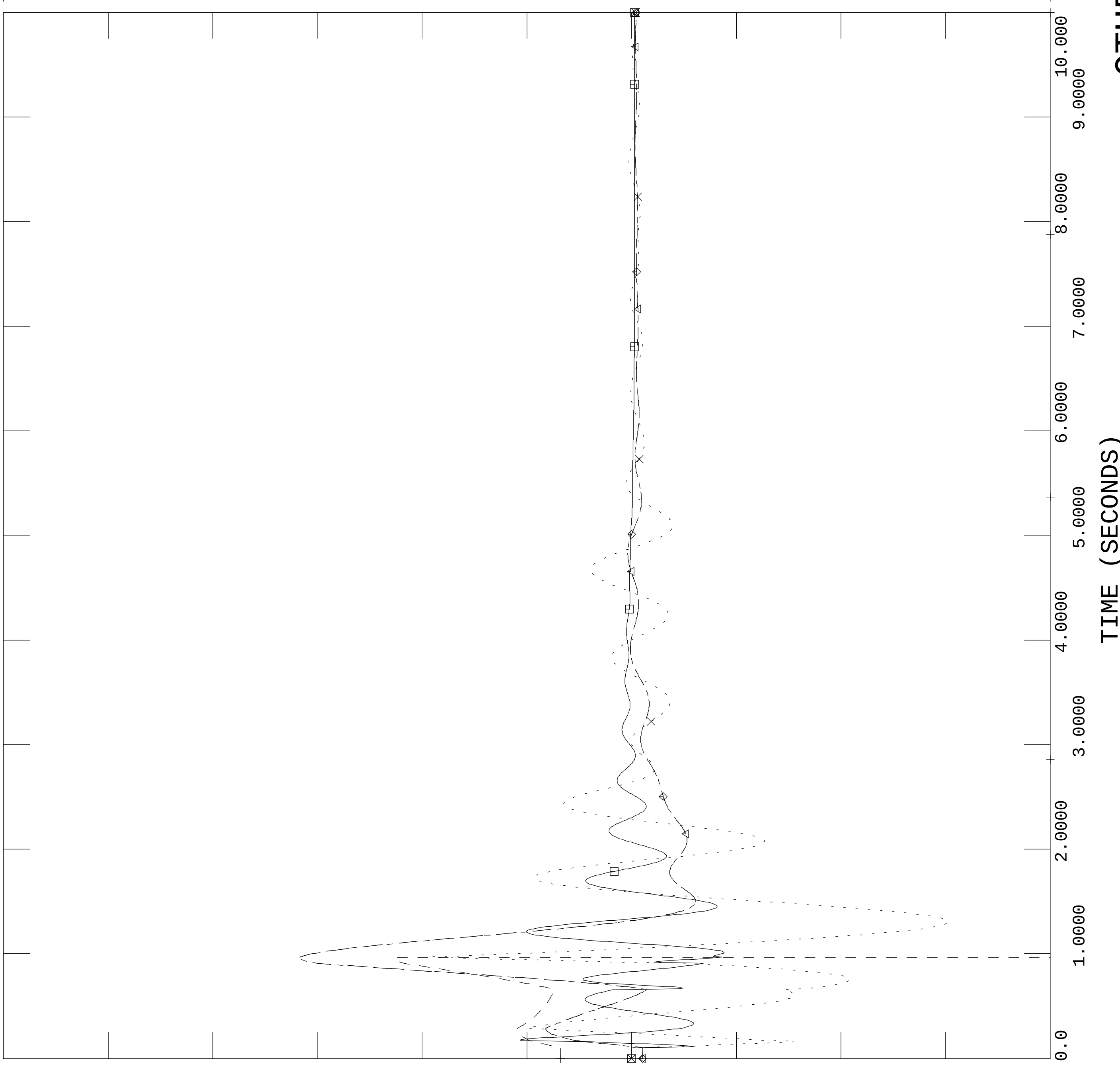
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 — -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 — -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 — 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 — 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 — 0.19900



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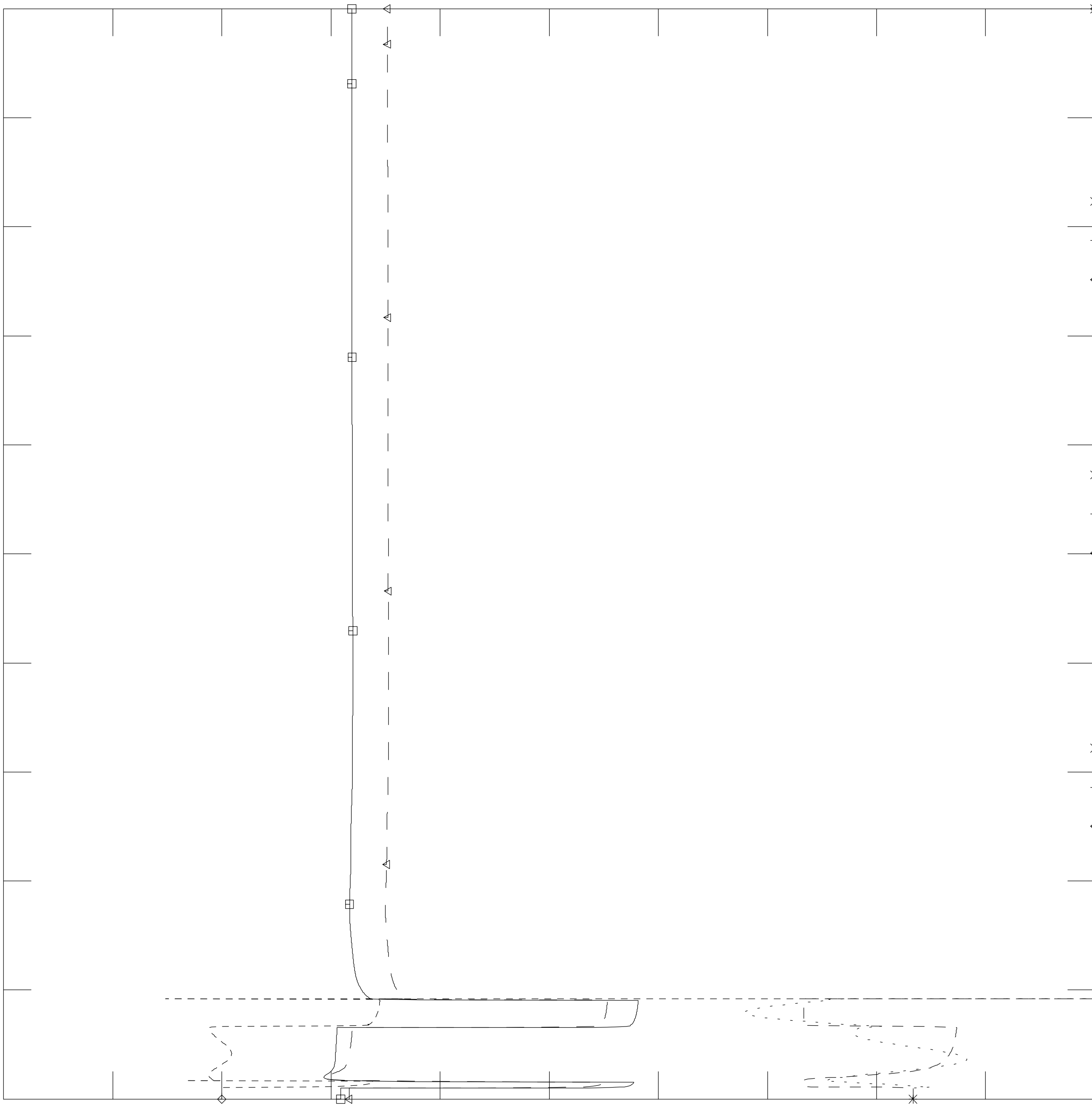
FILE: FLT61PH.out

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.25000	0.19000
CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	1.5000	0.0
CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	1.5000	0.0



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

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FILE: FLT61PH.out

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

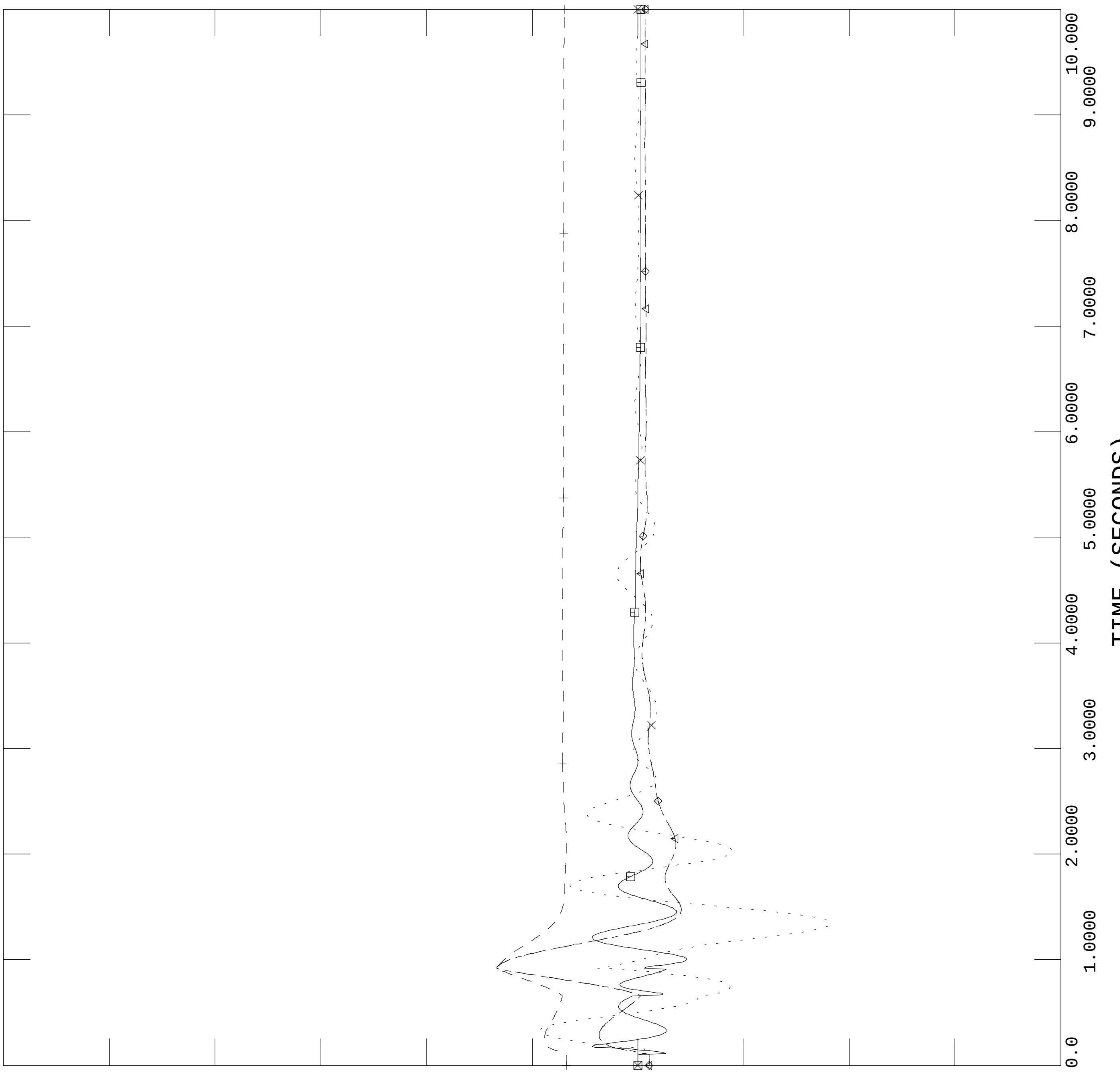
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 0.19900



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

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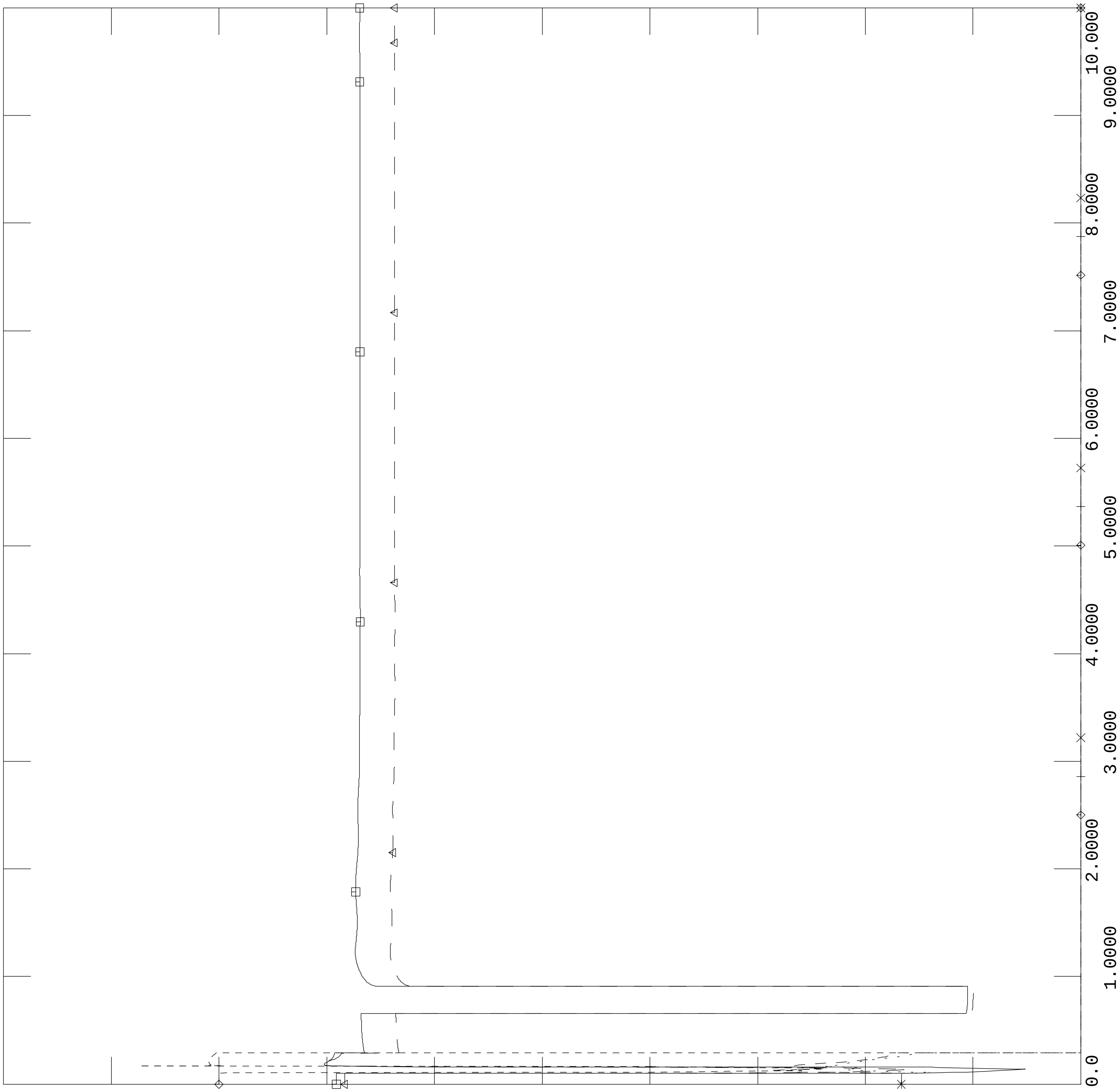
FILE: FLT73PH.out

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.25000	0.19000
CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	1.5000	0.0
CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	1.5000	0.0



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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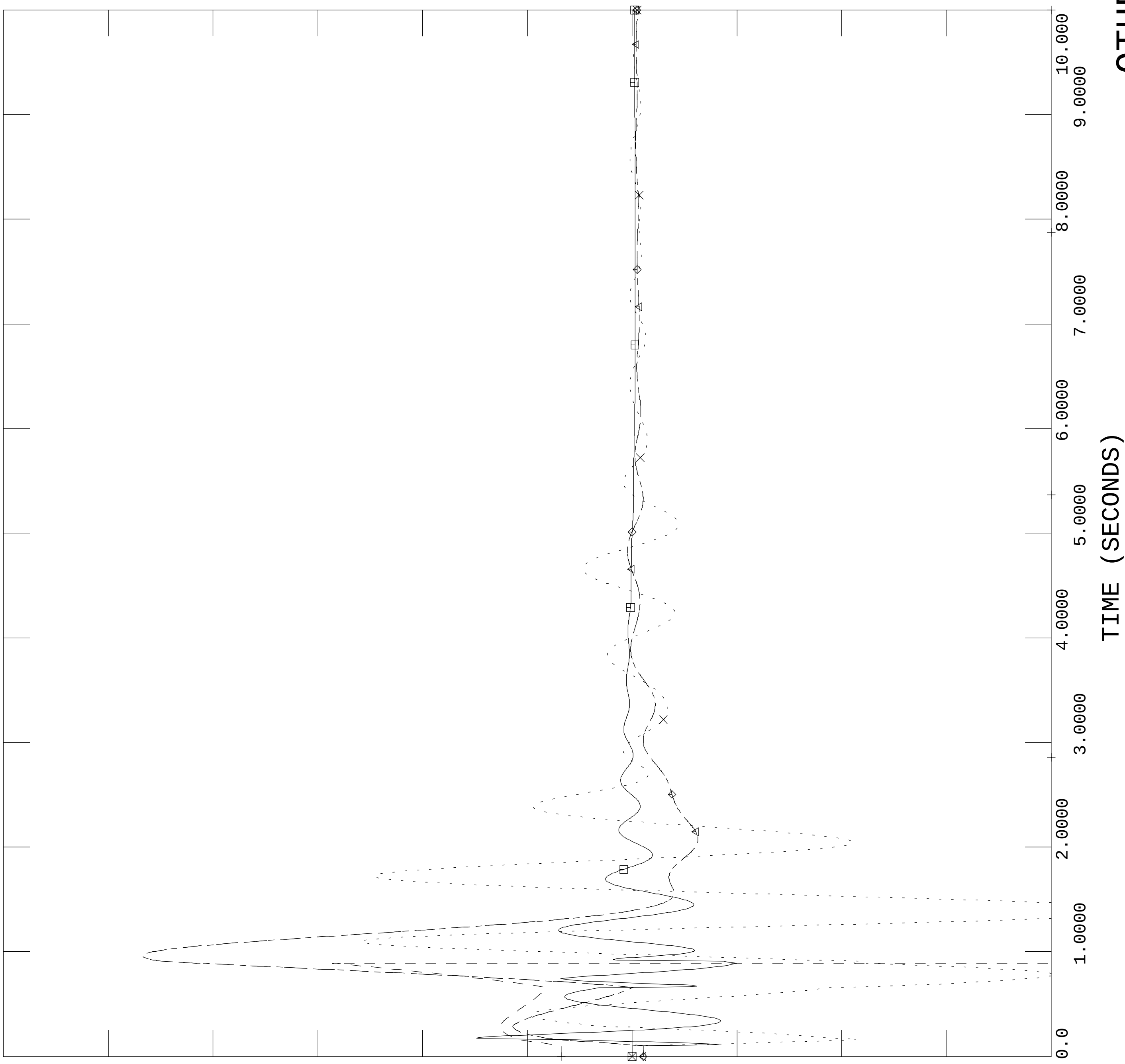
FILE: FLT73PH.out

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]		
0.00150	× · · · · · · · · ×	-0.0010
CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]		
0.04000	+ — — — — — — — +	-0.0100
CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]		
0.02000	◇ - - - - - - - - ◇	0.01000
CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]		
0.02000	◁ — — — — ◁	0.01000
CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]		
0.20150	□———————□	0.19900



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TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT81PH.out

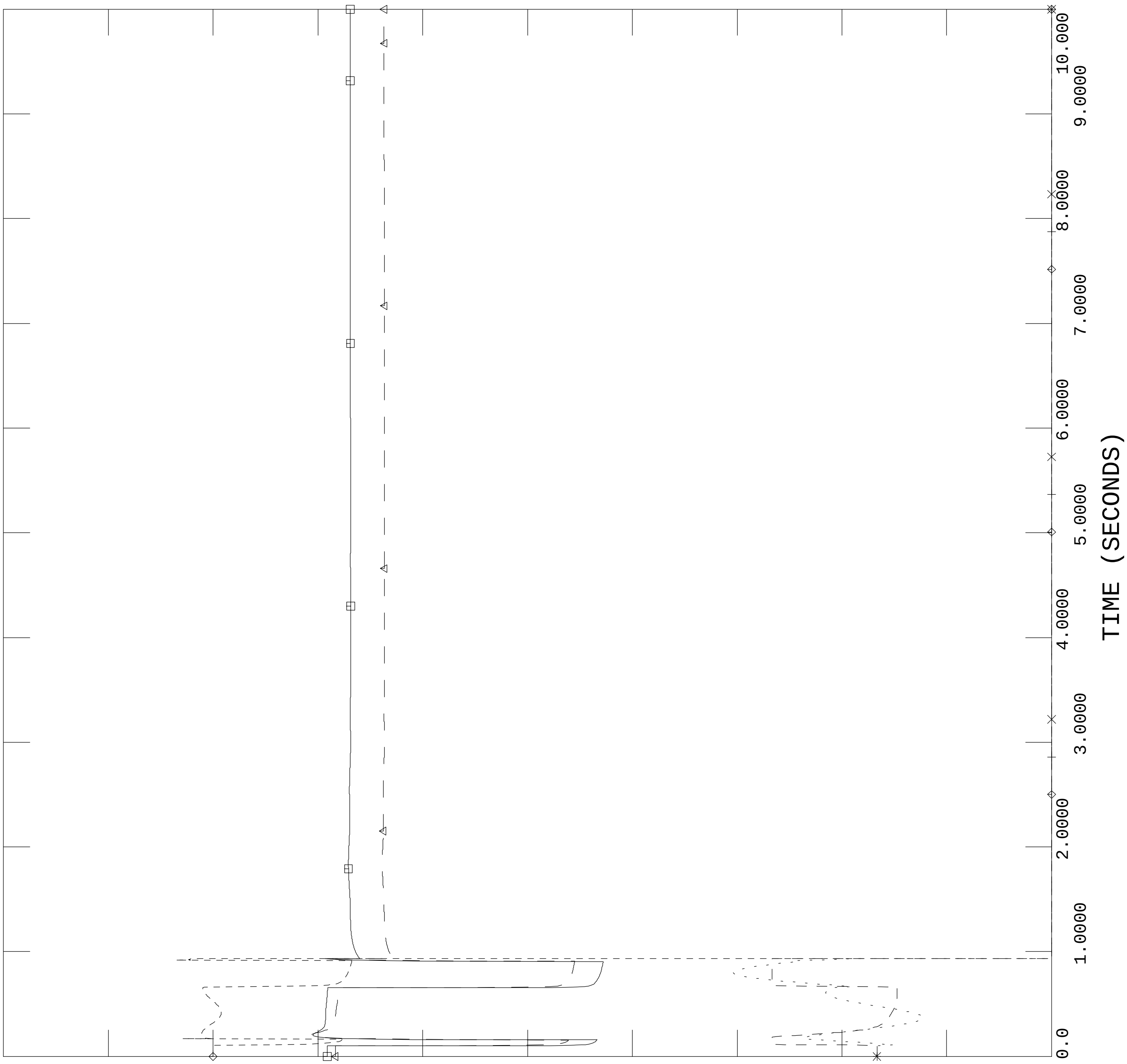
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 0.0



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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FILE: FLT81PH.out

OTHER GENERATOR SPEEDS

TUE, JUN 29 2004 14:51

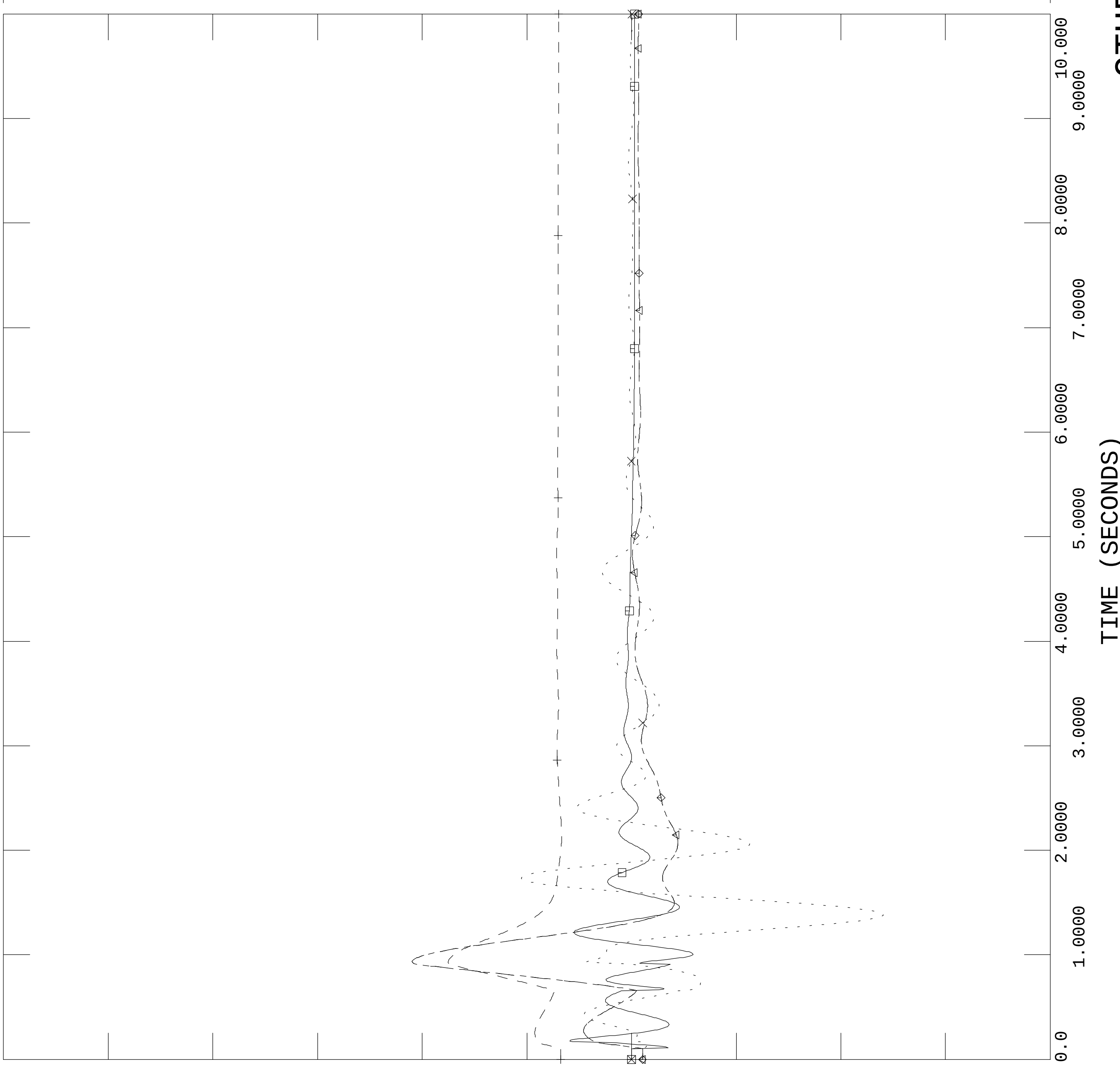
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 0.19900



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

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TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT93PH.out

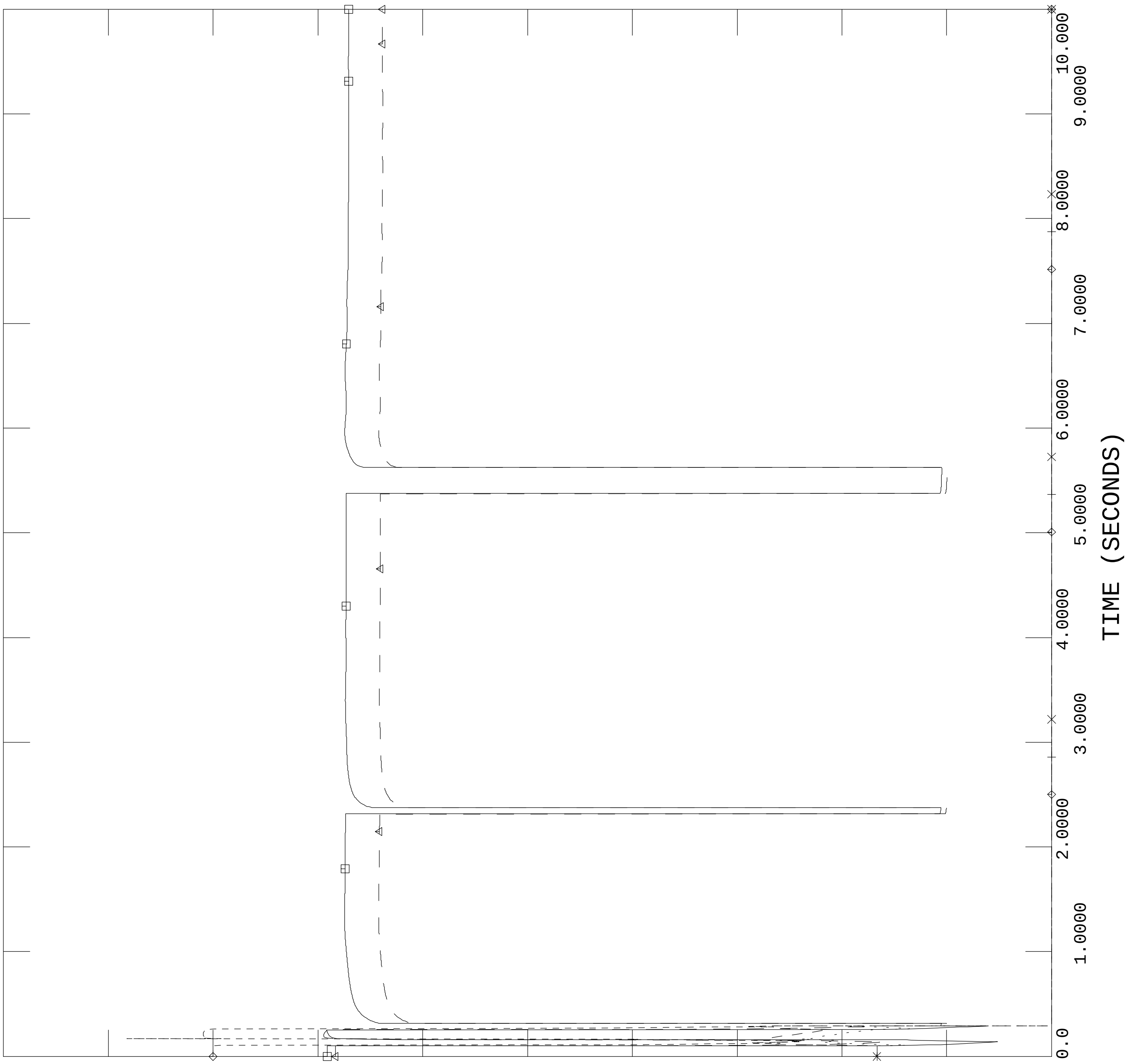
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 0.0



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TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT93PH.out

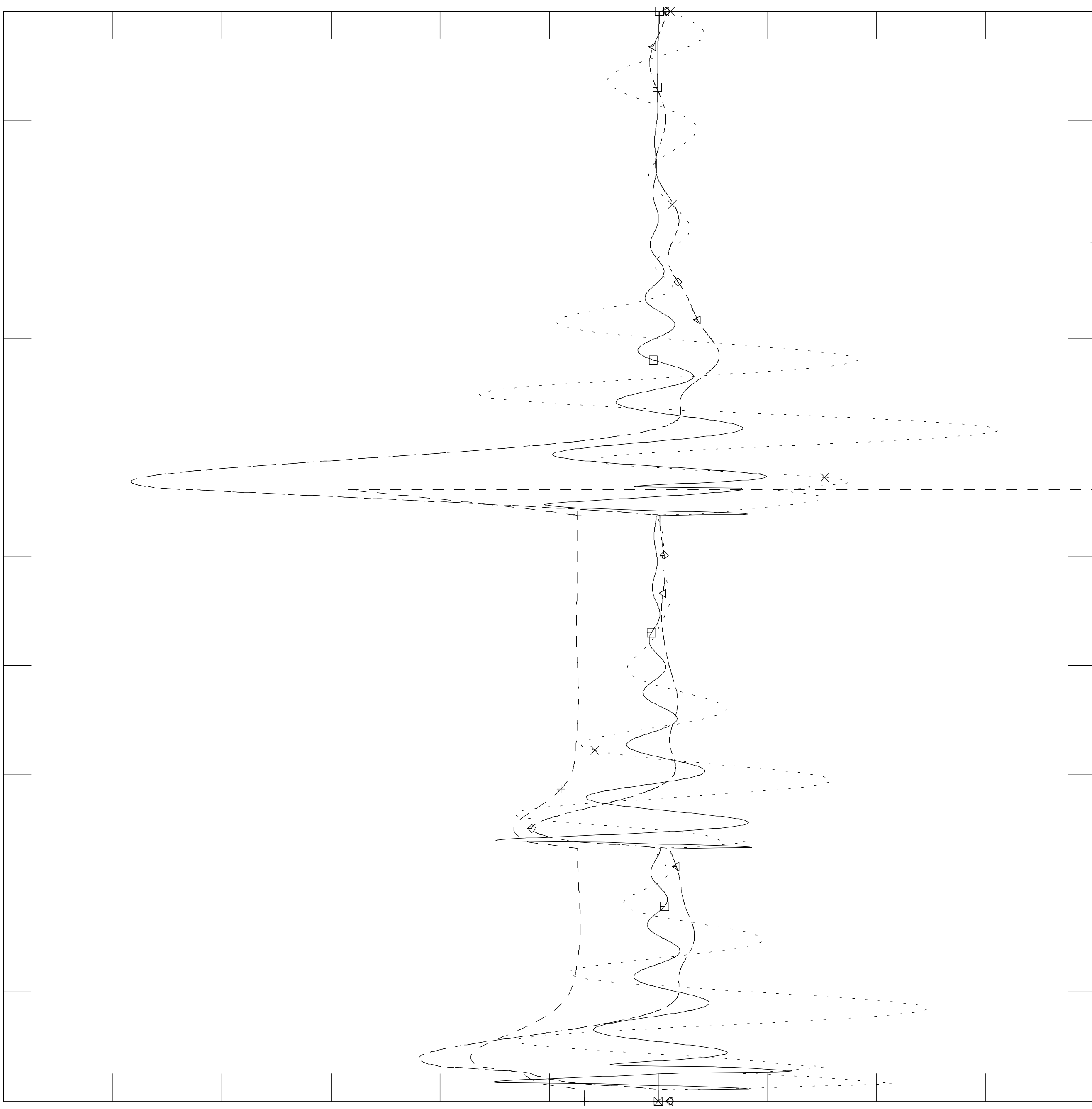
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 — -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 — -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 — 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 — 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 — 0.19900



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TUE, JUN 29 2004 14:51
NEW WIND GENERATOR

FILE: FLT101PH.out

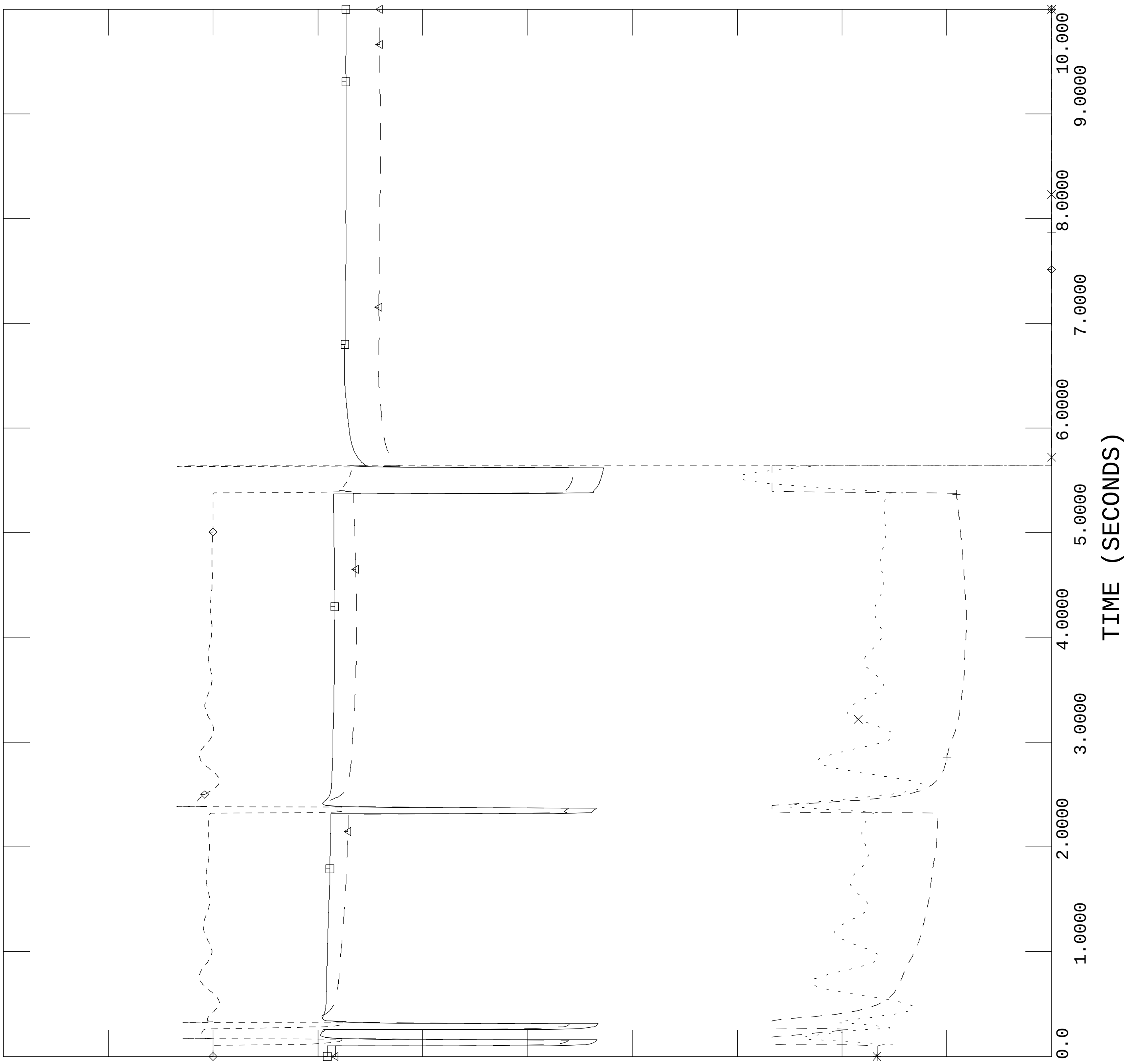
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 0.0



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT101PH.out

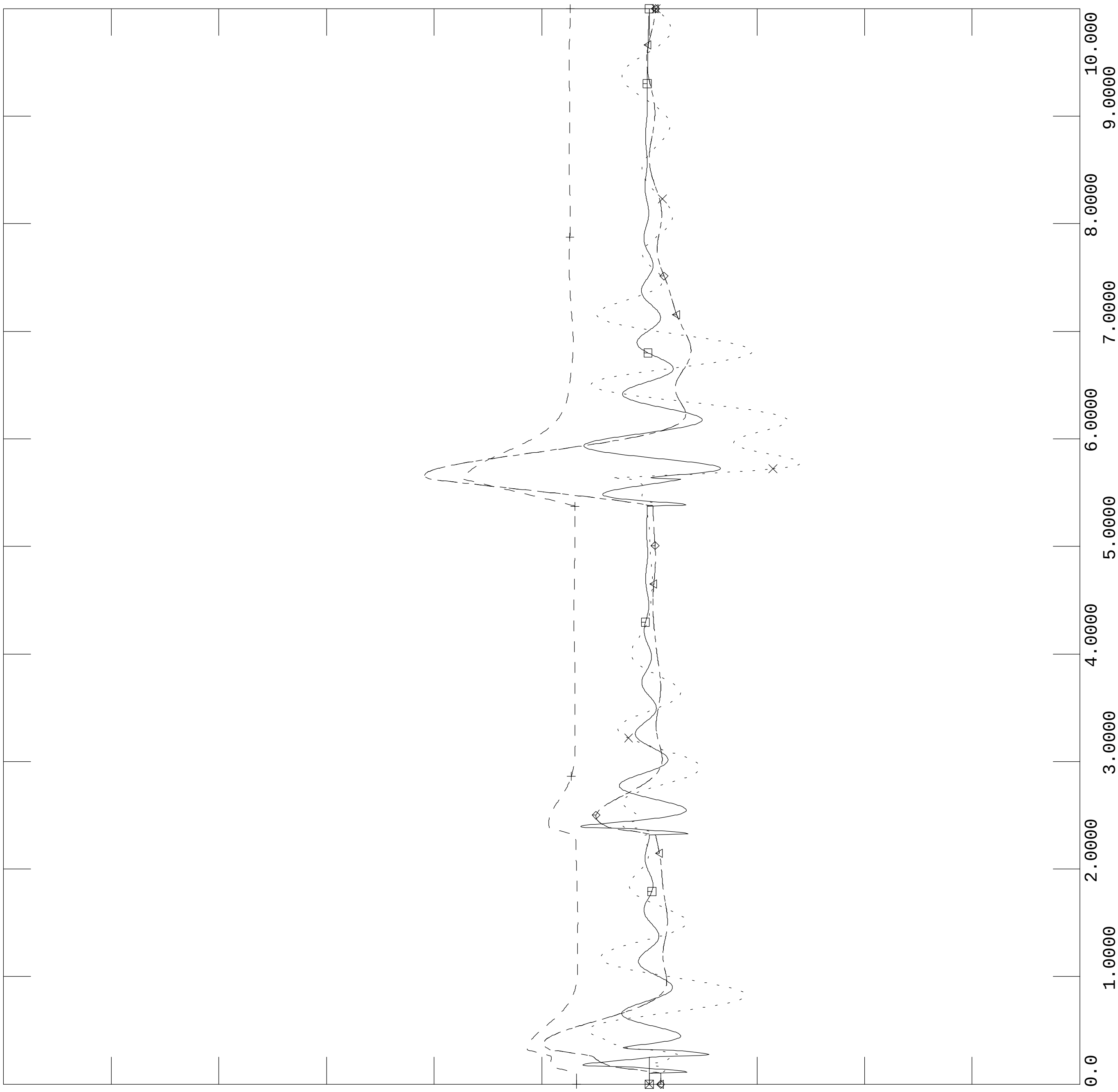
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 0.19900



TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

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FILE: FLT113PH.out

TUE, JUN 29 2004 14:51
NEW WIND GENERATOR

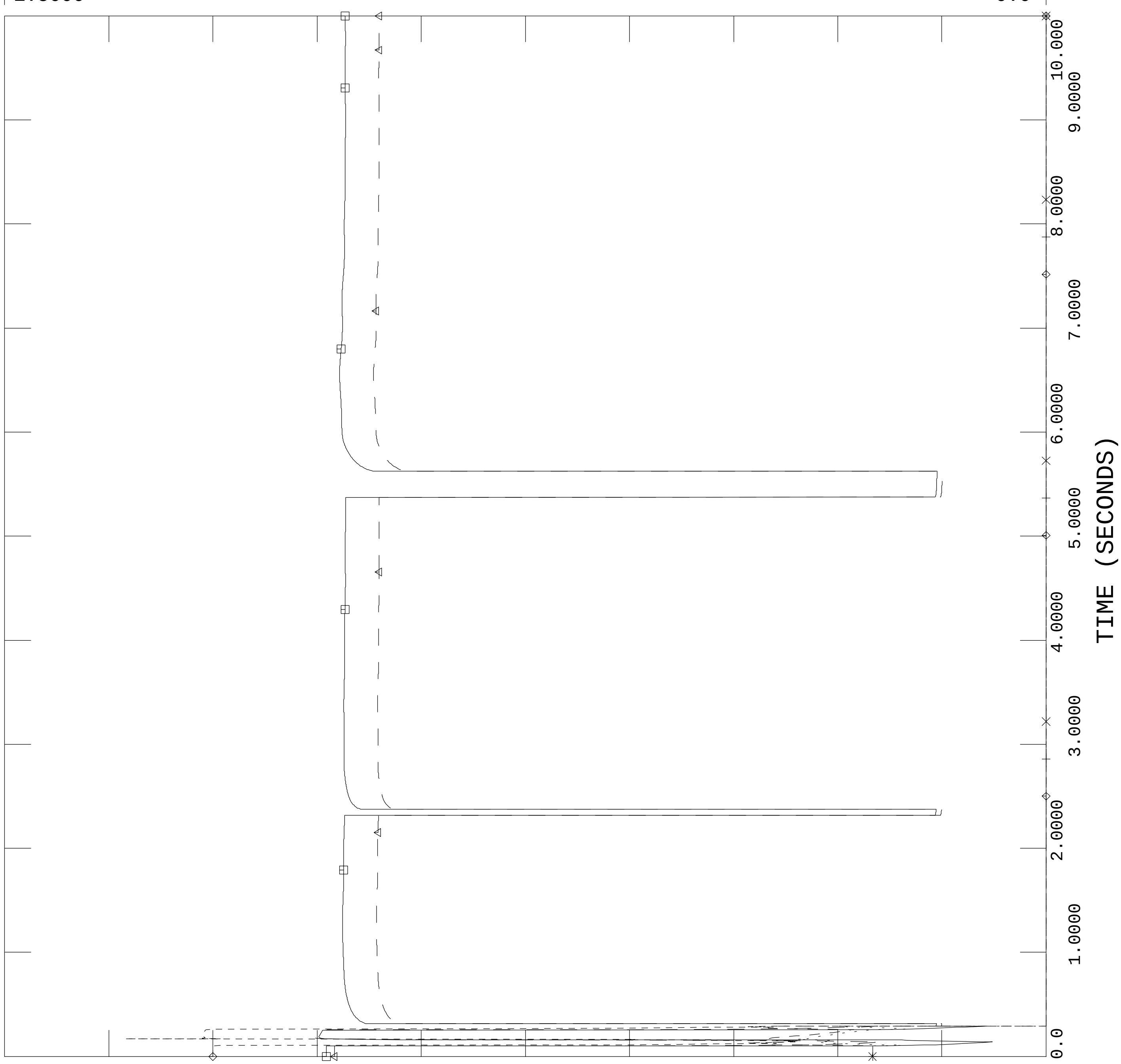
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 ... 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 ... 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 ... 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 ... 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 ... 0.0



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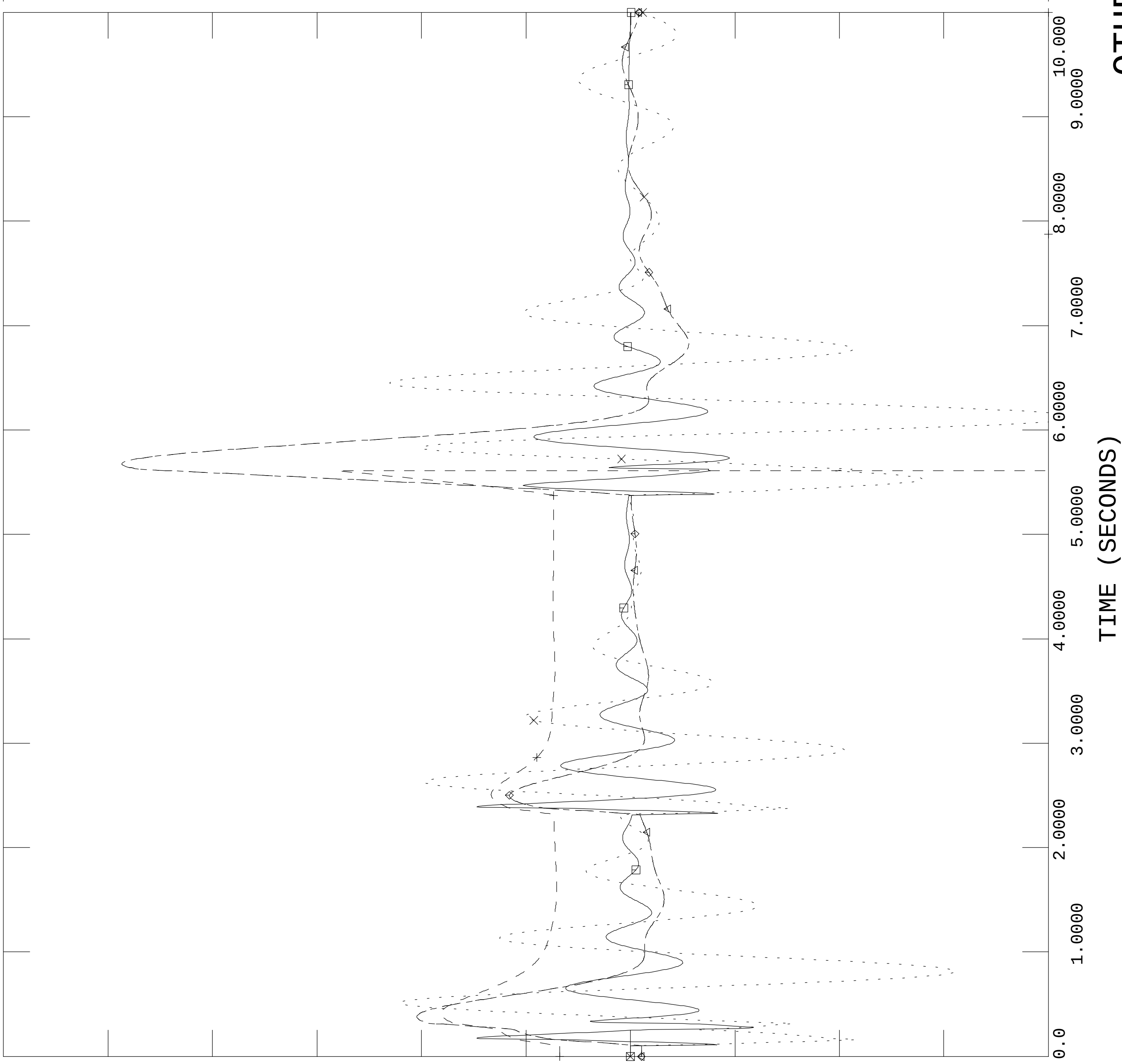
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT113PH.out

CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]	0.00150	-0.0010
CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]	0.04000	-0.0100
CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]	0.02000	0.01000
CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]	0.02000	0.01000
CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]	0.20150	0.19900



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SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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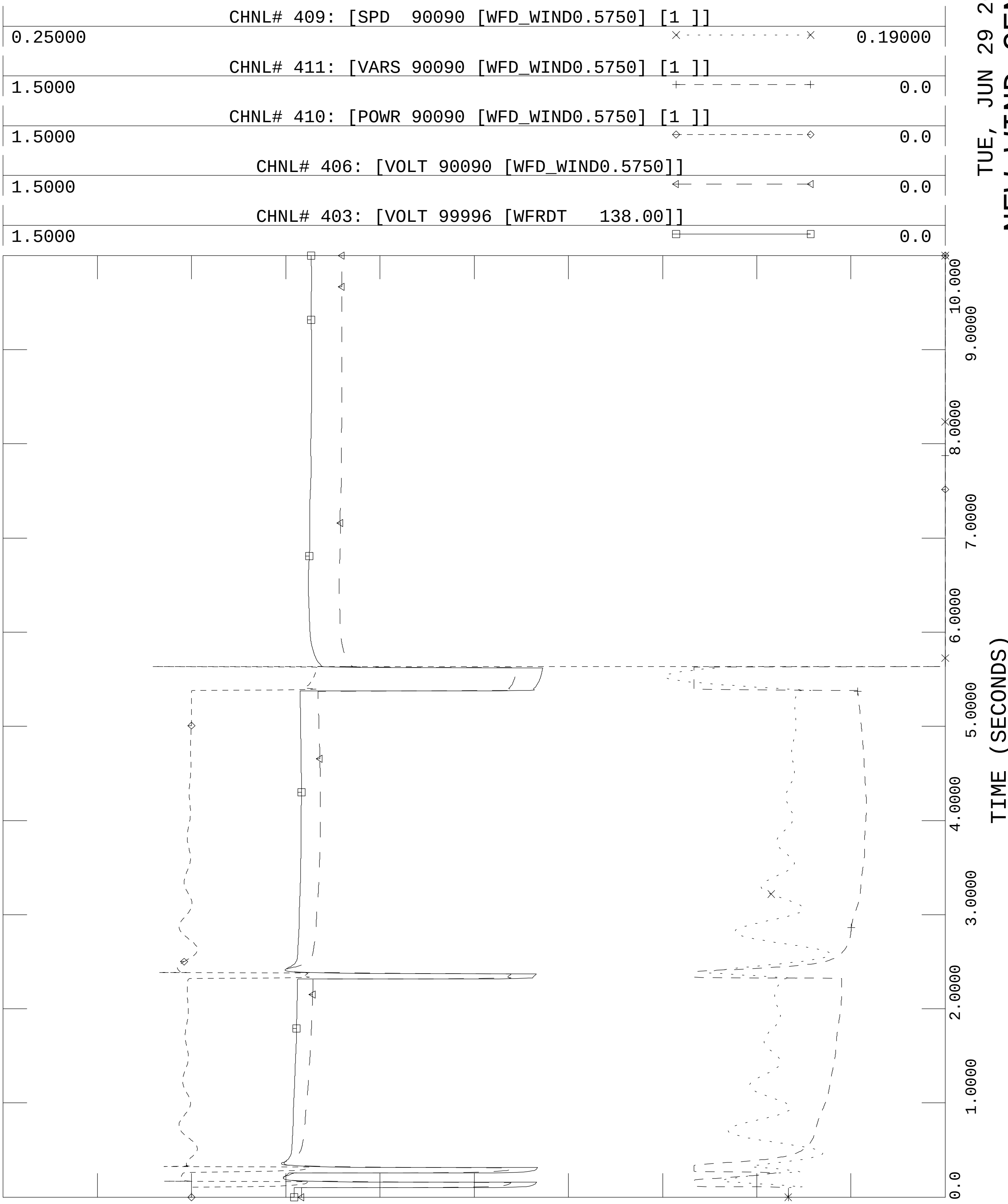
FILE: FLT121PH.out



TUE, JUN 29 2004 14:51
NEW WIND GENERATOR

POWER TECHNOLOGIES INC.®

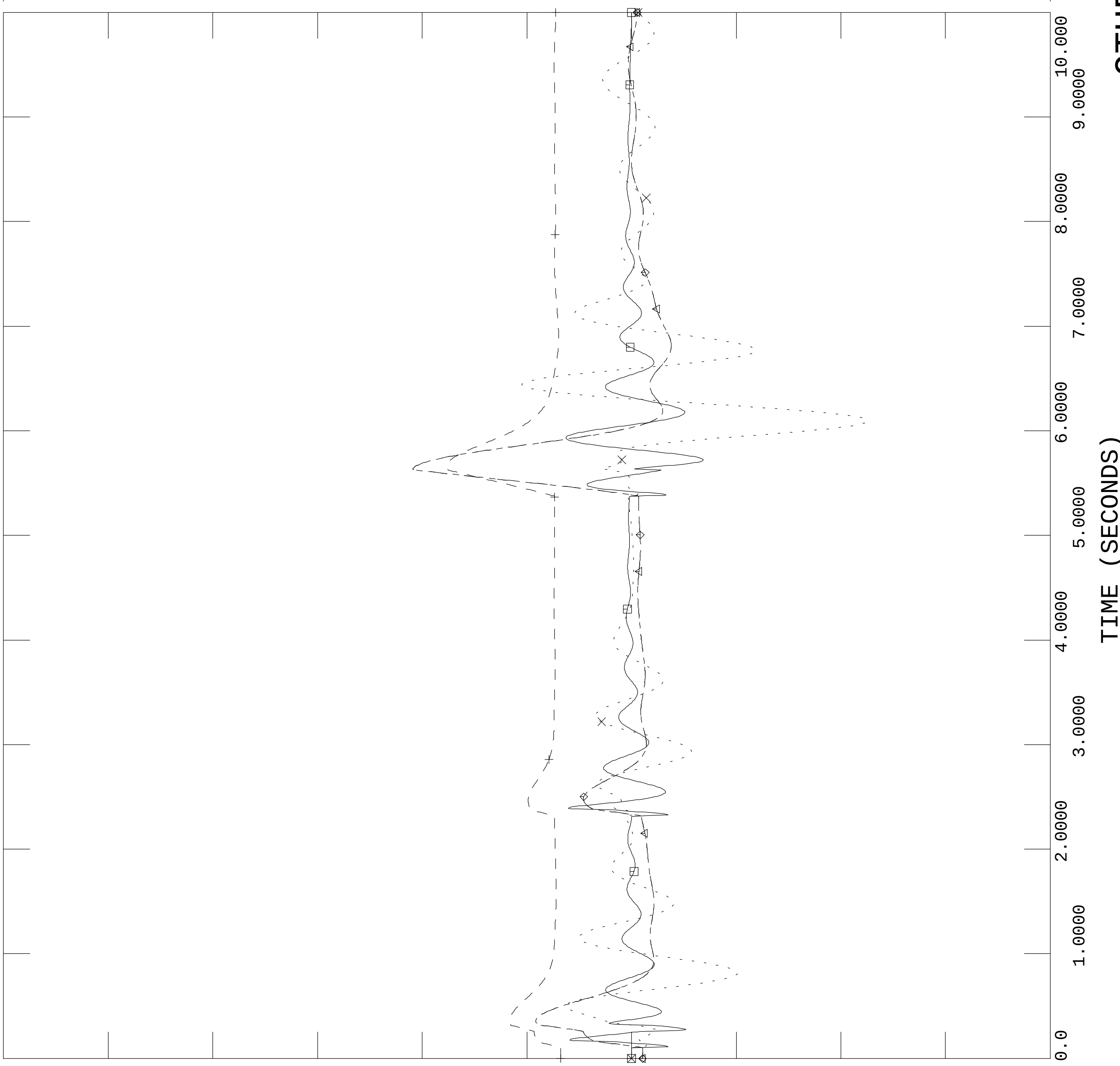
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

FILE: FLT121PH.out

OTHER GENERATOR SPEEDS

TUE, JUN 29 2004 14:51

CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]	0.00150	-0.0010
CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]	0.04000	-0.0100
CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]	0.02000	0.01000
CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]	0.02000	0.01000
CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]	0.20150	0.19900



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
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TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT133PH.out

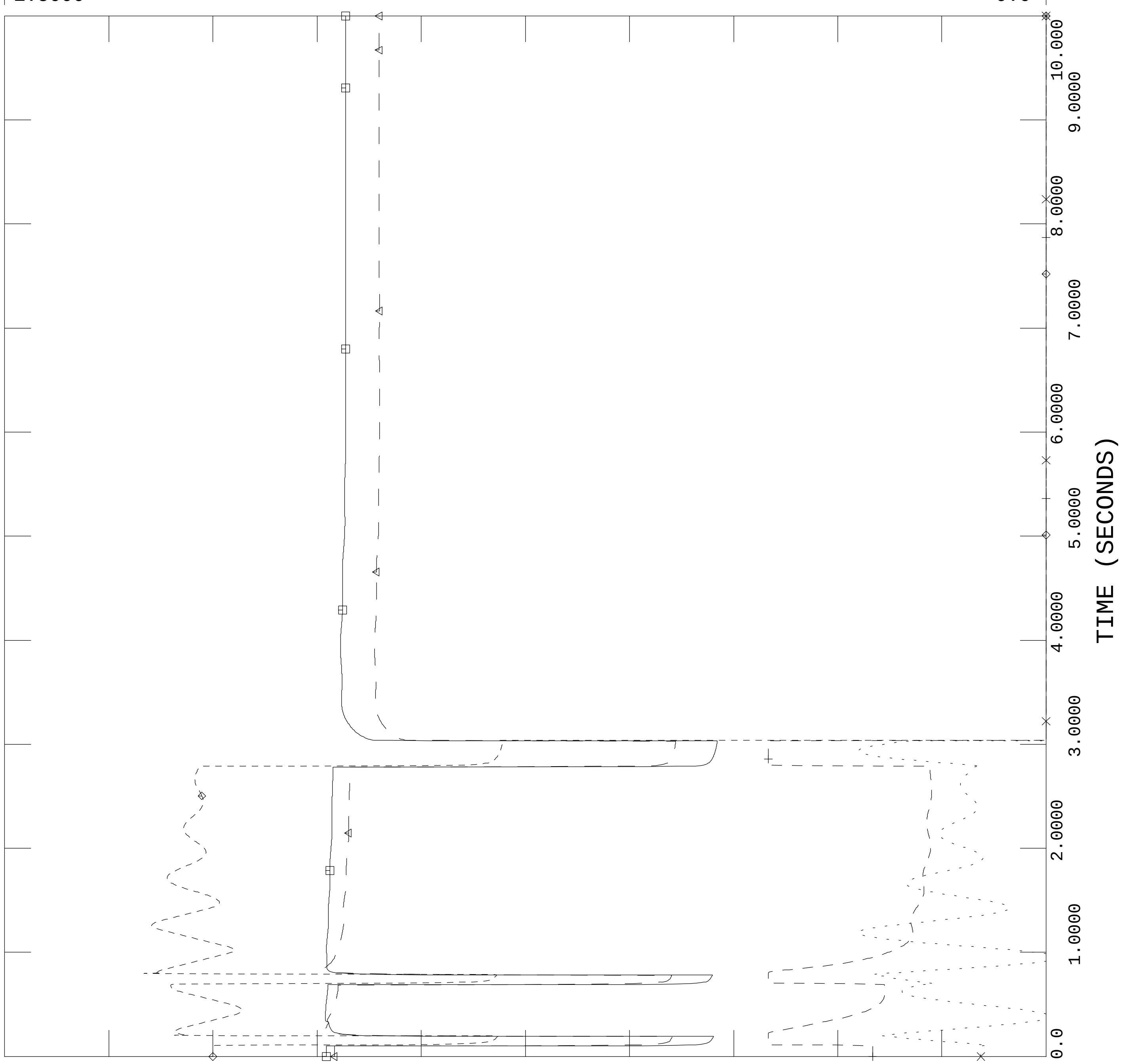
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.35000 — 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 — 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 — 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 — 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 — 0.0



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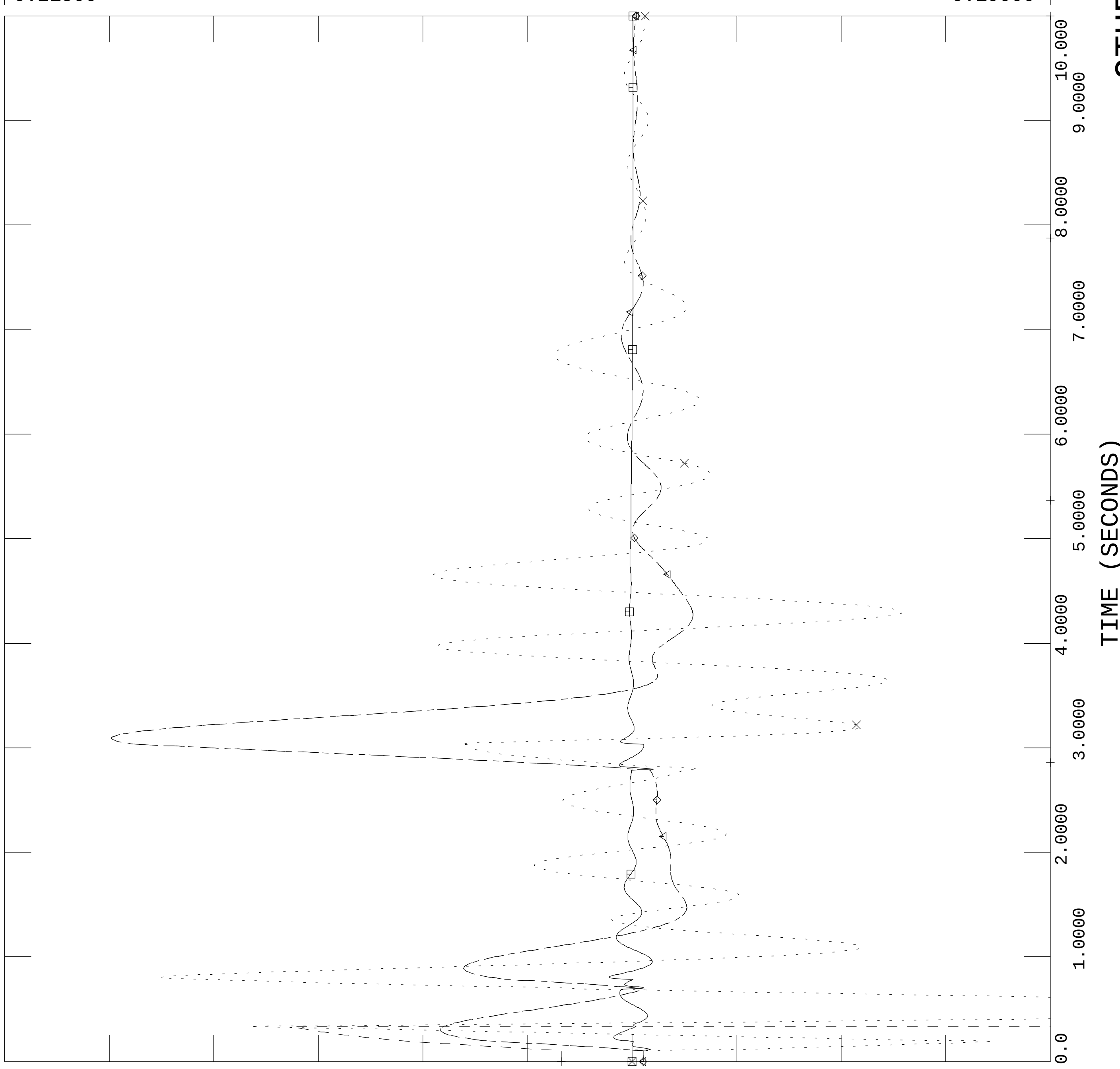
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT133PH.out

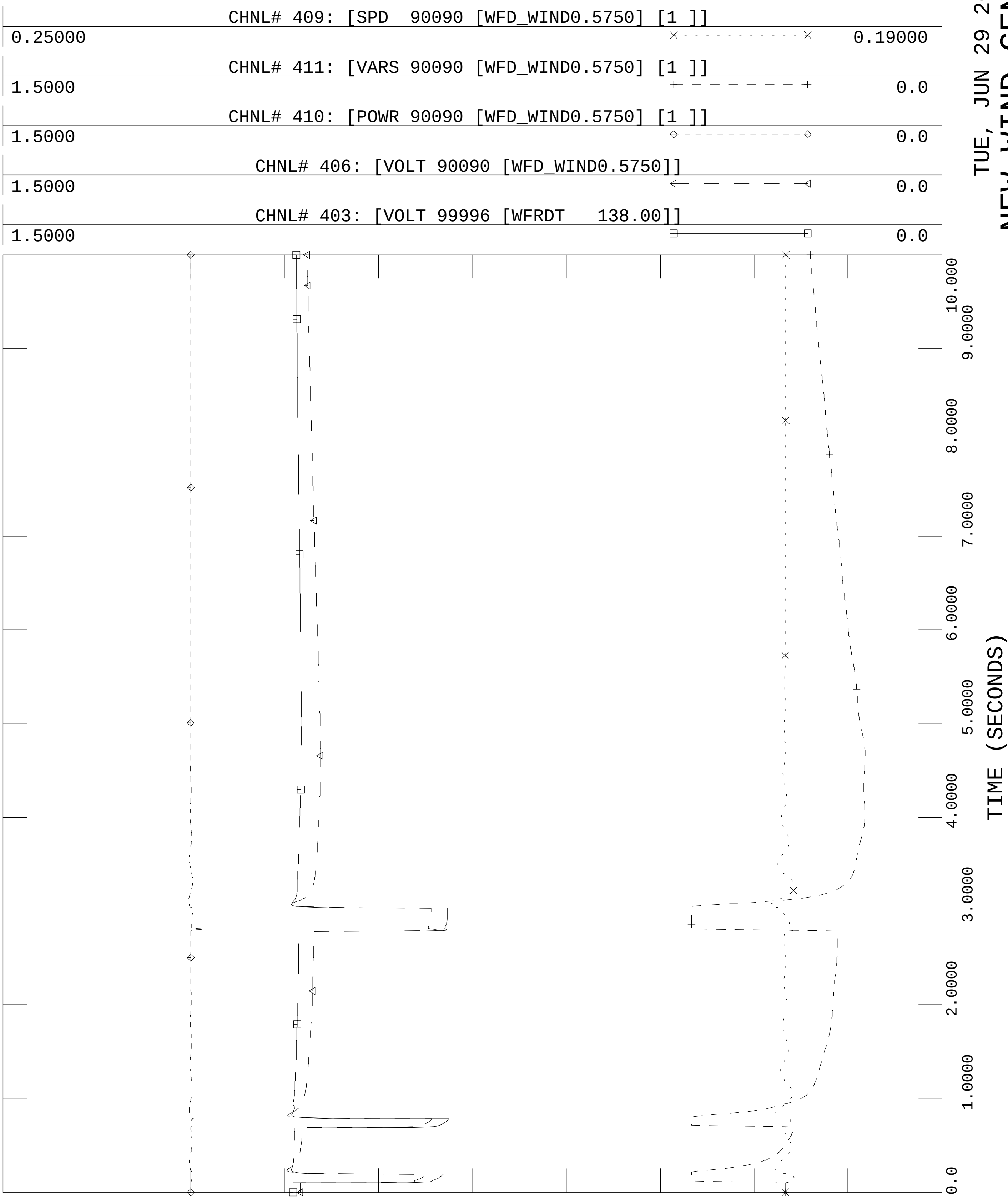
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]	0.00150	-0.0010
CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]	0.04000	-0.0100
CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]	0.02000	0.01000
CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]	0.02000	0.01000
CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]	0.21500	0.19000



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT141PH.out



TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

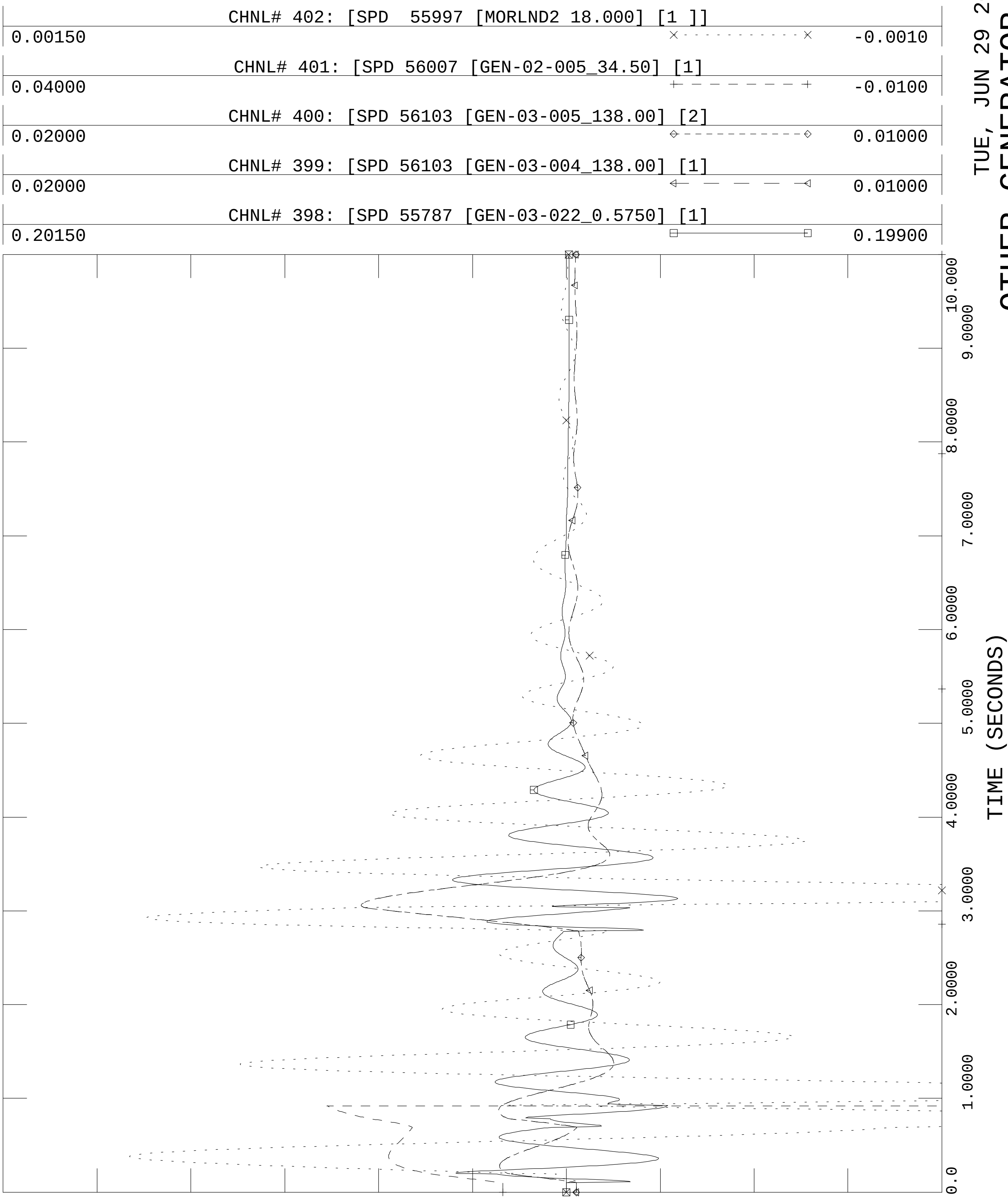
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT141PH.out

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS



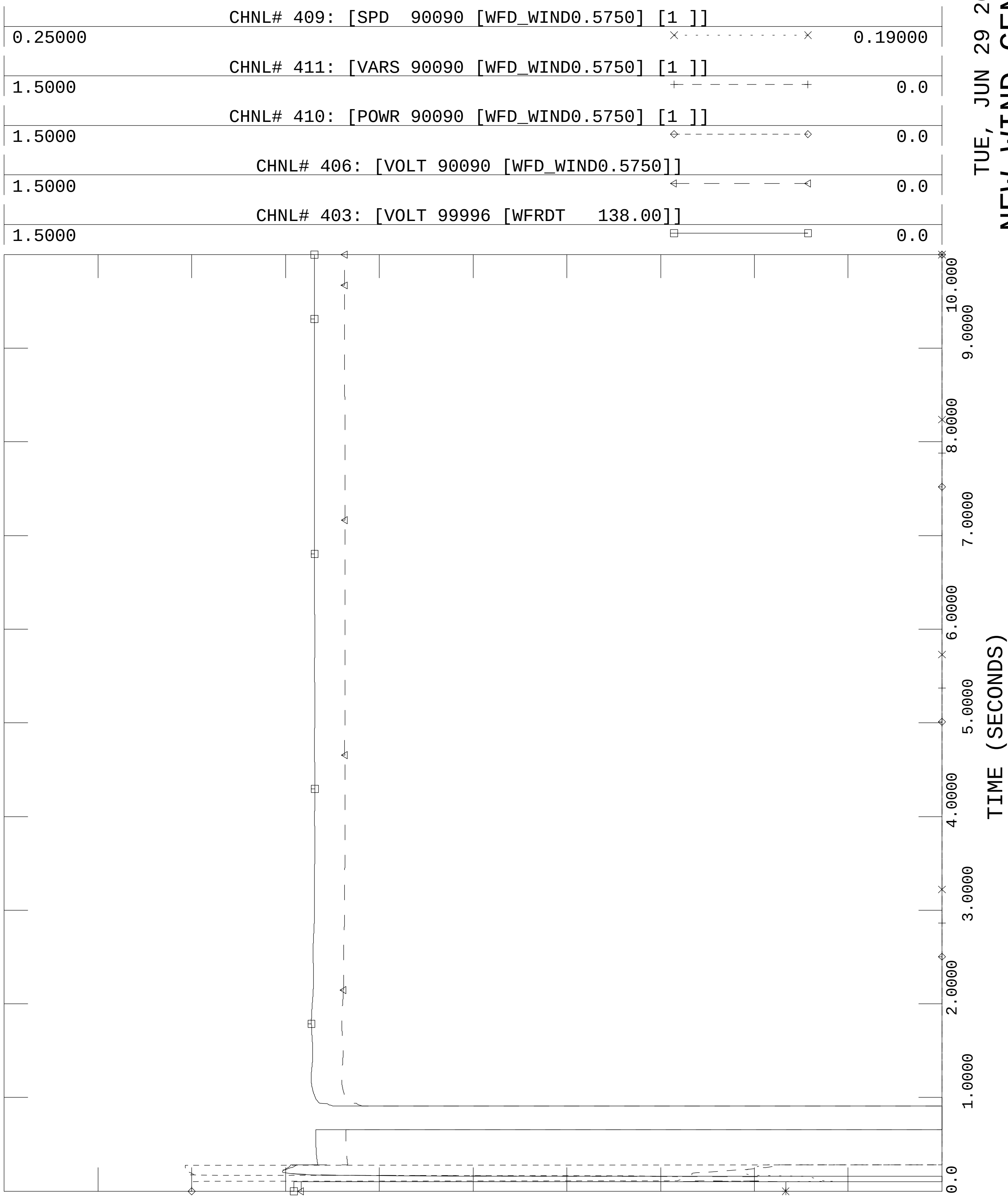
POWER TECHNOLOGIES INC.®

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT153PH.out



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT153PH.out

OTHER GENERATOR SPEEDS

TUE, JUN 29 2004 14:51

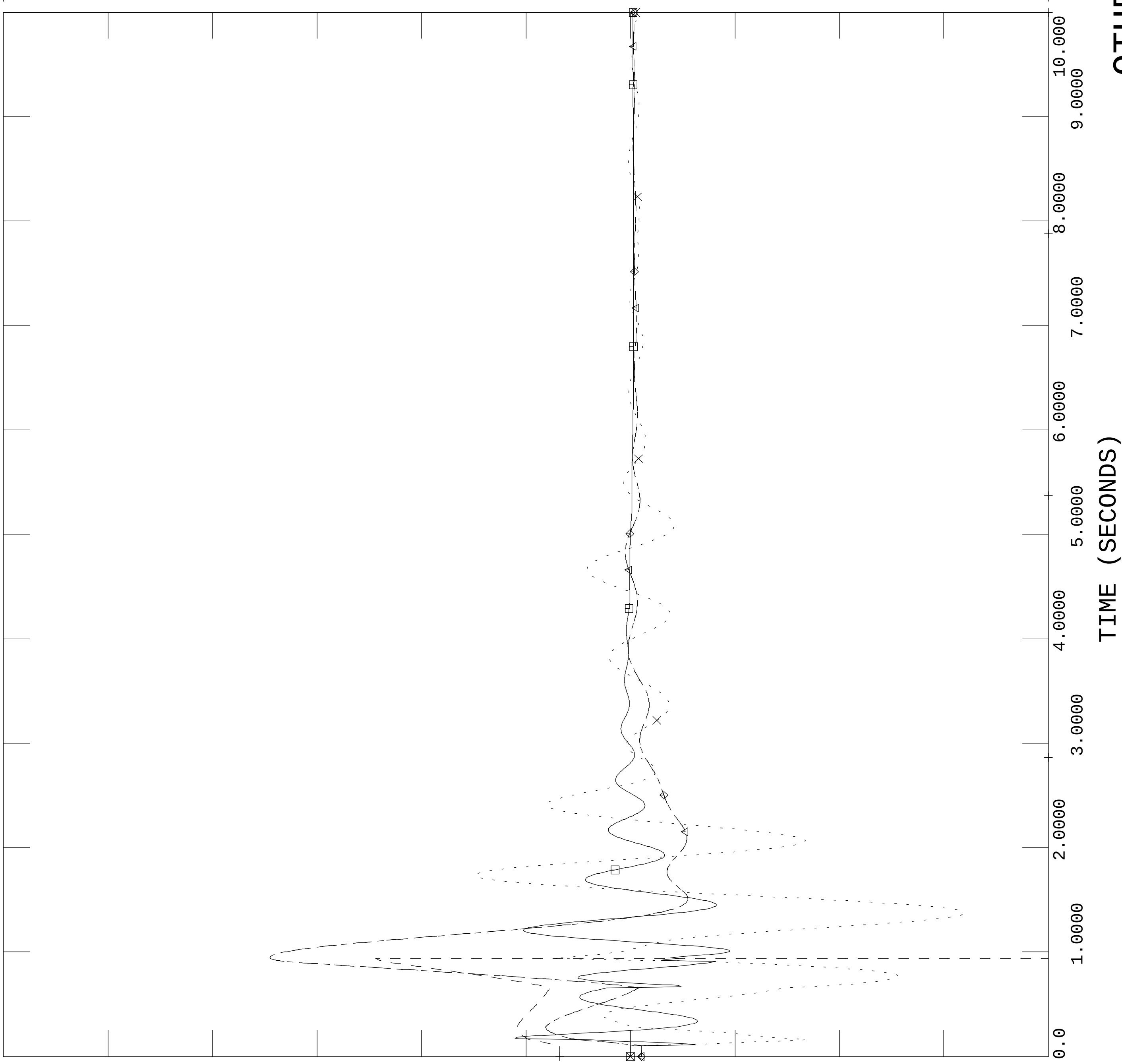
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 0.19900

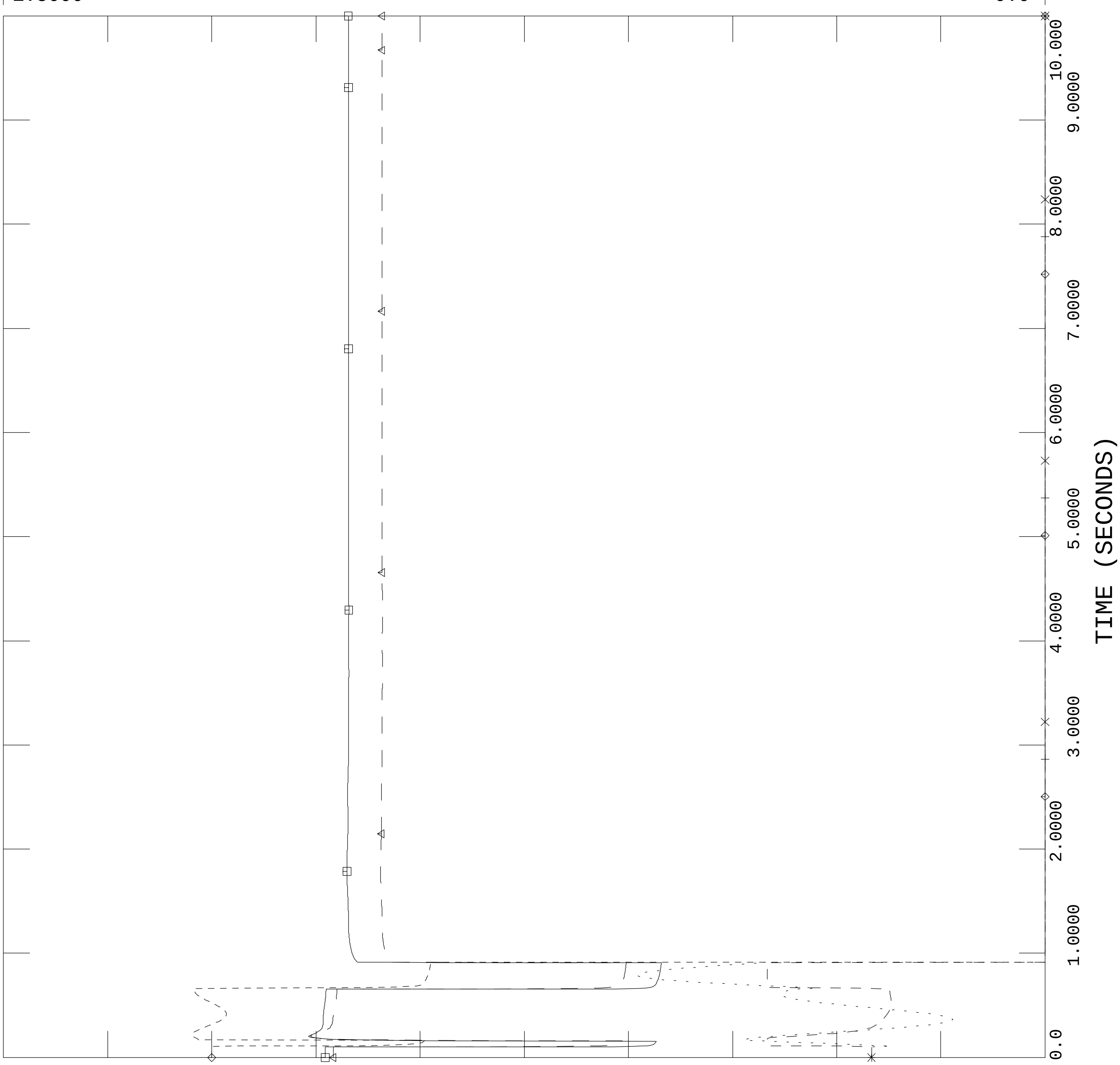


POWER TECHNOLOGIES INC.®

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

FILE: FLT161PH.out

CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]	0.25000	0.19000
CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]	1.5000	0.0
CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]	1.5000	0.0
CHNL# 403: [VOLT 99996 [WFRDT 138.00]]	1.5000	0.0



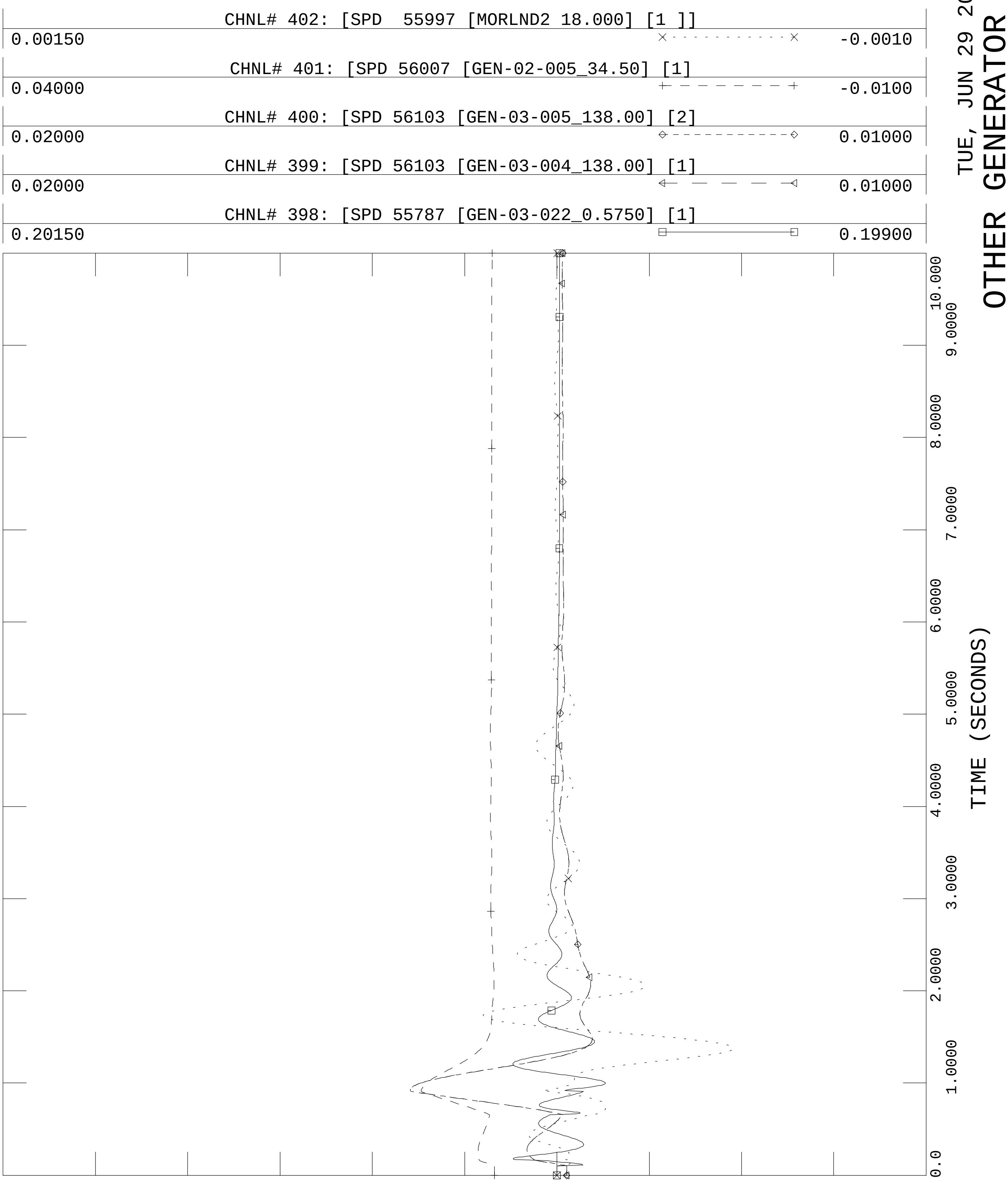
TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

FILE: FLT161PH.out



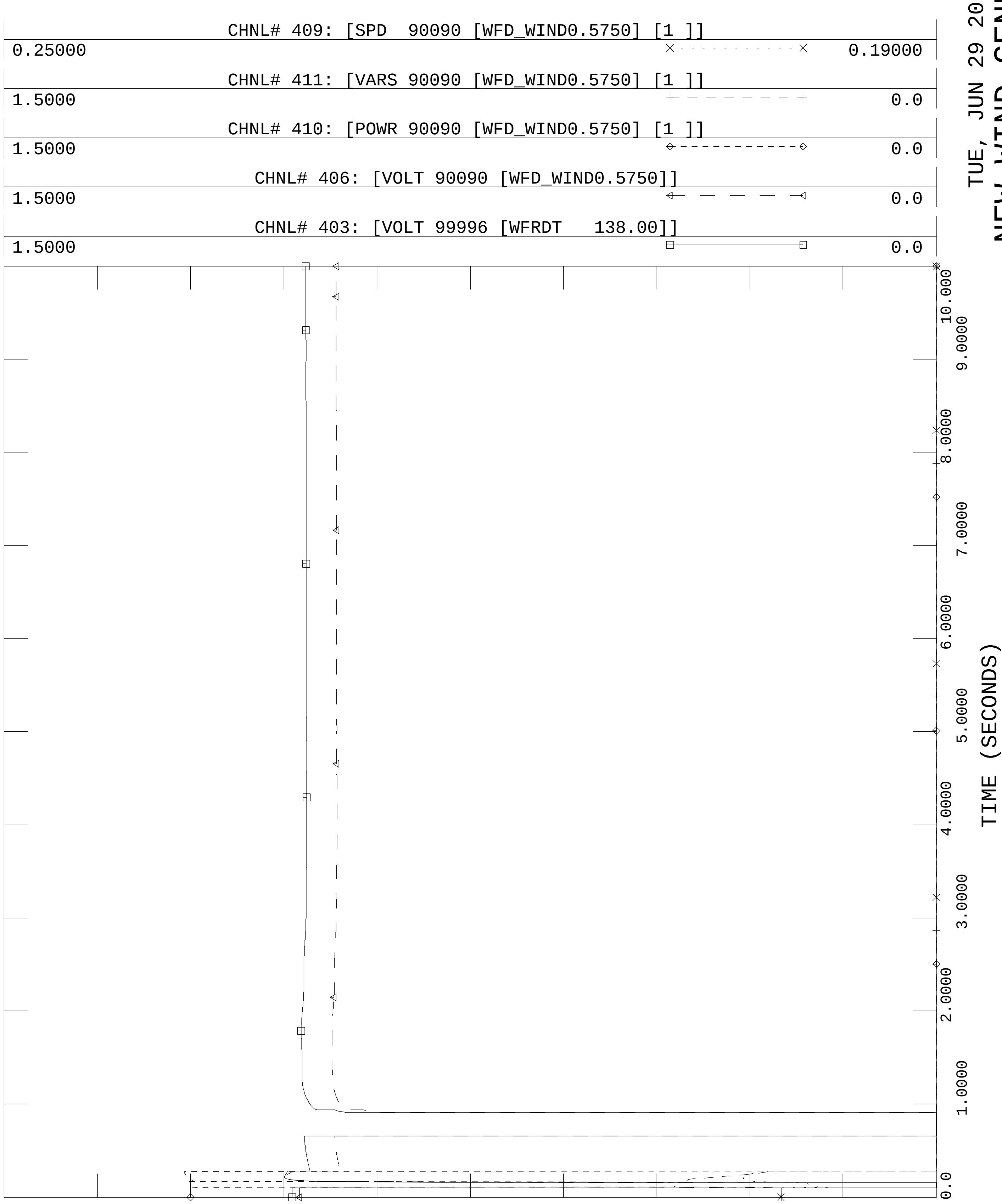
SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04
(C) 2004 SOUTHWEST POWER POOL, INC. (SEE DISCLAIMER BELOW)

POWER TECHNOLOGIES INC.®

FILE: FLT173PH.out

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR



SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

POWER TECHNOLOGIES INC.®

TUE, JUN 29 2004 14:51

OTHER GENERATOR SPEEDS

FILE: FLT173PH.out

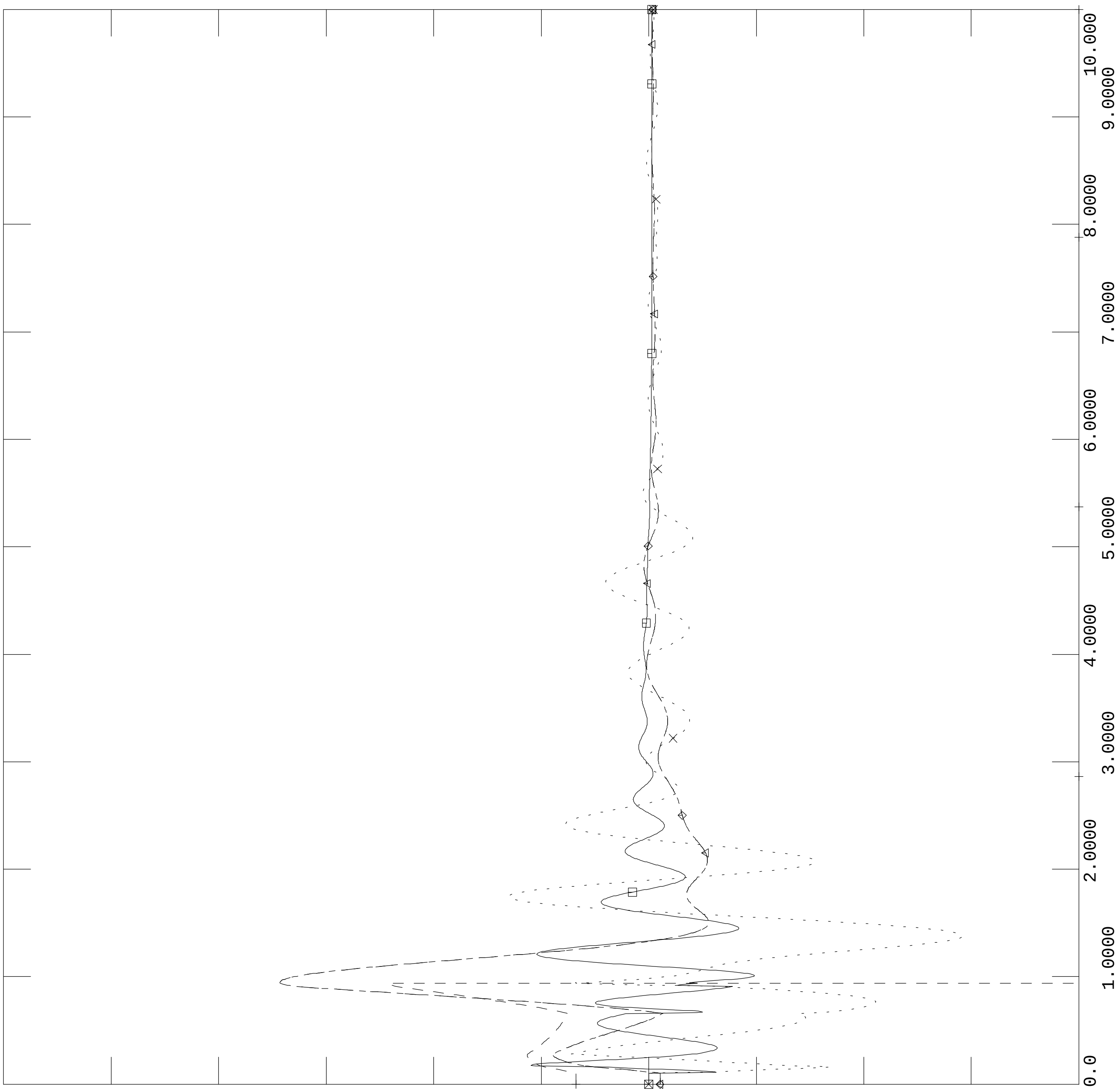
CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 × · · · · · · × -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 + — — — — + -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 ◇ - - - - ◇ 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 ◁ — — — ◁ 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 □———□ 0.19900



POWER TECHNOLOGIES INC.®

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

TUE, JUN 29 2004 14:51

NEW WIND GENERATOR

FILE: FLT181PH.out

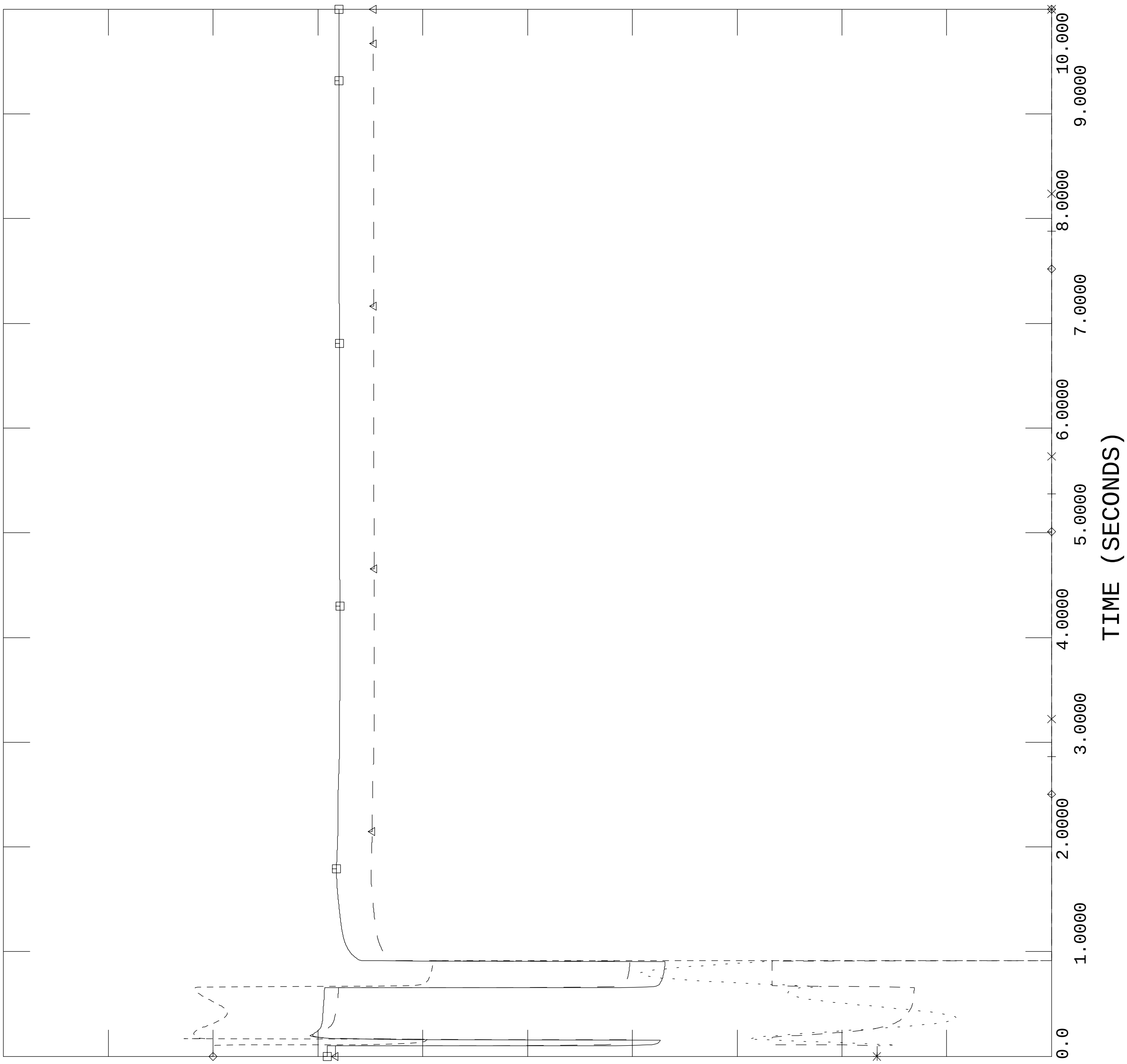
CHNL# 409: [SPD 90090 [WFD_WIND0.5750] [1]]
0.25000 0.19000

CHNL# 411: [VARS 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 410: [POWR 90090 [WFD_WIND0.5750] [1]]
1.5000 0.0

CHNL# 406: [VOLT 90090 [WFD_WIND0.5750]]
1.5000 0.0

CHNL# 403: [VOLT 99996 [WFRDT 138.00]]
1.5000 0.0



POWER TECHNOLOGIES INC.®

SPP MDWG 04 STABILITY;2005 SUMMER PEAK;S05SP-28.CNL;3-12-04

FILE: FLT181PH.out

CHNL# 402: [SPD 55997 [MORLND2 18.000] [1]]
0.00150 × · · · · · · · · · · × -0.0010

CHNL# 401: [SPD 56007 [GEN-02-005_34.50] [1]
0.04000 + — — — — — — — — + -0.0100

CHNL# 400: [SPD 56103 [GEN-03-005_138.00] [2]
0.02000 ◇- - - - - - - - - - -◇ 0.01000

CHNL# 399: [SPD 56103 [GEN-03-004_138.00] [1]
0.02000 ◁— — — — —◁ 0.01000

CHNL# 398: [SPD 55787 [GEN-03-022_0.5750] [1]
0.20150 ⊡————————⊡ 0.19900