215 South Cascade Street
PO Box 496
Fergus Falls, Minnesota 56538-0496
218 739-8200
www.otpco.com (web site)

UTILITIES COMMISSION

VIA EMAIL AND REGULAR DELIVERY

OTTER TAIL POWER COMPANY

November 8, 2005

Deb Gregg, Consumer Affairs Representative
South Dakota Public Utilities Commission
State Capitol
500 East Capitol Street
Pierre, SD 57501-5070

Re: In the Matter of the Complaint filed by Larry Fliss, Hendricks, Minnesota, against Otter Tail Power Company Regarding Voltage Fluctuations, Docket No. CE05-001.

Dear Ms. Gregg:

On September 12, 2005, Otter Tail Power Company ("Otter Tail") and the Hendricks Golf Club ("Golf Club") entered into an agreement to install "soft-starts" on the irrigation motors at the Golf Club. Otter Tail installed variable frequency drives ("VFD") on the irrigation motors at the Golf Club. Please see Attachment 1 for an explanation of the difference between a soft-start and VFD and the rational for using VFD in this situation.

Section 7 of the Basic Agreement between Otter Tail and the Golf Club stated, "The Company shall continue to monitor voltage fluctuations at three locations, one of which shall be on the Golf Club, before and following the installation of the soft-start equipment." Otter Tail has monitored the voltage in accordance with the agreement with the Golf Club and the results from the voltage recording are shown in the report in Attachment 2. The voltage recording was taken at the following locations; the Hendricks Golf Club, the home of Mr. Larry Fliss and the home of Mr. Val Whipple, who is the last customer served by the distribution line serving all three customers.

The VFD were installed on October 14, 2005 with the final programming configuration completed on October 21, 2005. As the report in Attachment 2 shows, the installation of the VFD's solves the voltage flicker problem experienced by Mr. Fliss.

Otter Tail believes its actions and the information contained in the attached report will close the formal complaint filed by Mr. Fliss against Otter Tail.

If should have any questions, please contact me at 218-739-8838 or rlspangler@otpco.com

Sincerely,

Ron Spangler Jr.
Regulatory Services

C: Jim Mehlhaff, Consumer Affairs Representative
Sara Greff, South Dakota Public Utilities Commission Attorney
Larry Fliss, Complainant
Bruce Gerhardson, Associate General Counsel, Otter Tail Corporation
Kevin Kouba, Area Manager, Otter Tail
Bernadeen Brutlag, Manager, Regulatory Services, Otter Tail
Al Bierbaum, Engineer, Minnesota Public Utilities Commission
Janet Gonzalez, Energy Manager, Minnesota Public Utilities Commission
Tracy Smetana, Consumer Affairs Mediator, Minnesota Public Utilities Commission

From: **Hanson, Chuck**
Sent: Wednesday, November 02, 2005 11:30 AM
To: Spangler, Ron
Cc: Braun, Joe
Subject: VFD vs. Soft Start

Ron -

The technology that has been installed at Hendricks "converts" the incoming utility power from 60 cycle AC to a DC source. This DC power is then "inverted" back to AC with the ability to vary the frequency of the power. Here is a laymen explanation of how things work.

When a standard motor starter applies AC voltage at 60 cycles to a motor that is at a stand-still there is an inrush of current required to match the motor rotation to the 60 cycle frequency of the incoming power. Depending on the load attached to the motor this inrush can be as much as 3 times the current needed to run the motor once it has reach it's operating speed.

A "soft start" uses the conversion / inversion technology to overcome the inrush problem. When the drive is turned on it initially provides AC power to the motor at a frequency of 0 cycles and slowly increases the frequency over time until it reaches 60 cycles. This allows the rotation of the motor to initially match the frequency of the incoming power at 0 cycles and stays matched until it reaches 60 cycles and the motor is at full speed. Once the soft start reaches 60 cycles the drive will transfer the power from the converter/inverter unit and back to the utility power while the motor is in service.

A "VFD" or variable frequency drive operates just like a soft start except that it stays in the circuit and uses continuous feed back technology that is capable of varying the output frequency of the drive to match the needs of the process. In the case of Hendricks the drive is monitoring the pressure in the pumping system and continually matching the speed of the motor to the output pressure of the system.

Prior to installing the new system, the motor at Hendricks would come on at full speed build excessive pressure in the surge tank of the system, shut off while the pressure in the tank drops and turn on again when more pressure is needed. If we had installed a soft start in this system, the motor would come on, ramp up to full speed, build pressure in the tank, shut off while the pressure drops and ramp up again to rebuild the pressure. Although a soft start may have reduced the impact on the utility voltage it did not reduce the number of starts to the motor.

A decision was made to install VFD technology at Hendricks to not only eliminate the voltage drop during the motor starts, but to also limit the number of motor starts during a watering cycle. With the new system in place the drive ramps up the motor start when the system is turned on and by varying the frequency to the motor adjusts the speed to a point that matches the pressure needed. This results in only one motor start during any one watering cycle.

Let me know if you need any additional information.

Chuck Hanson
Manager, Technical Services & Customer Service Development
Otter Tail Power Company

OTTER TAIL POWER COMPANY

November 4, 2005
Morris, MN 56267

Mr. Ron Spangler, Jr
Regulatory Services

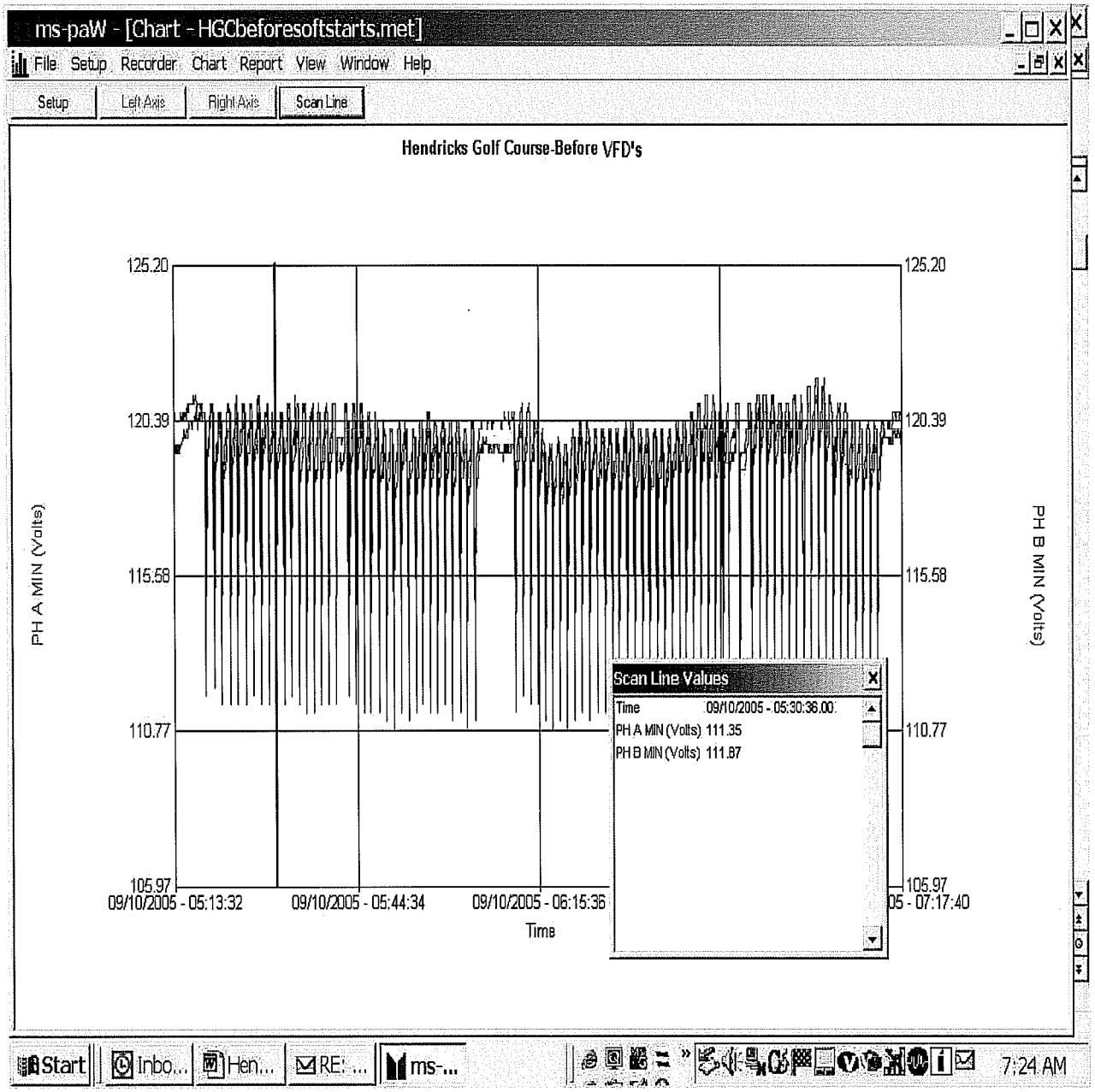
RE: Hendricks Golf Course Update

The following is a brief summary of the "before and after" comparisons of the service voltage flicker caused by the motors at the Hendricks Golf Course. Voltage monitoring was performed at the Hendricks Golf Course and the lake homes of Larry Fliss and Val Whipple. Lonney Tomlinson, Performance Systems Control Specialist, installed the VFDs on October 14th. A weeks worth of data is shown on the following plots at these locations. Lonney reconfigured the VFD set-up in a lead (25hp)-lag (15hp) control system on Oct. 21st. Approximately seven hours worth of data was collected on the 21st to show multiple motor starts during this time period.

Prior correspondence discussed adding soft starts to the motors at the Hendricks Golf Course. For clarification, A "VFD" or variable frequency drive operates just like a soft start except that it stays in the circuit and uses continuous feed back technology that is capable of varying the output frequency of the drive to match the needs of the process. In the case of Hendricks, the drive is monitoring the pressure in the pumping system and continually matching the speed of the motor to the output pressure of the system.

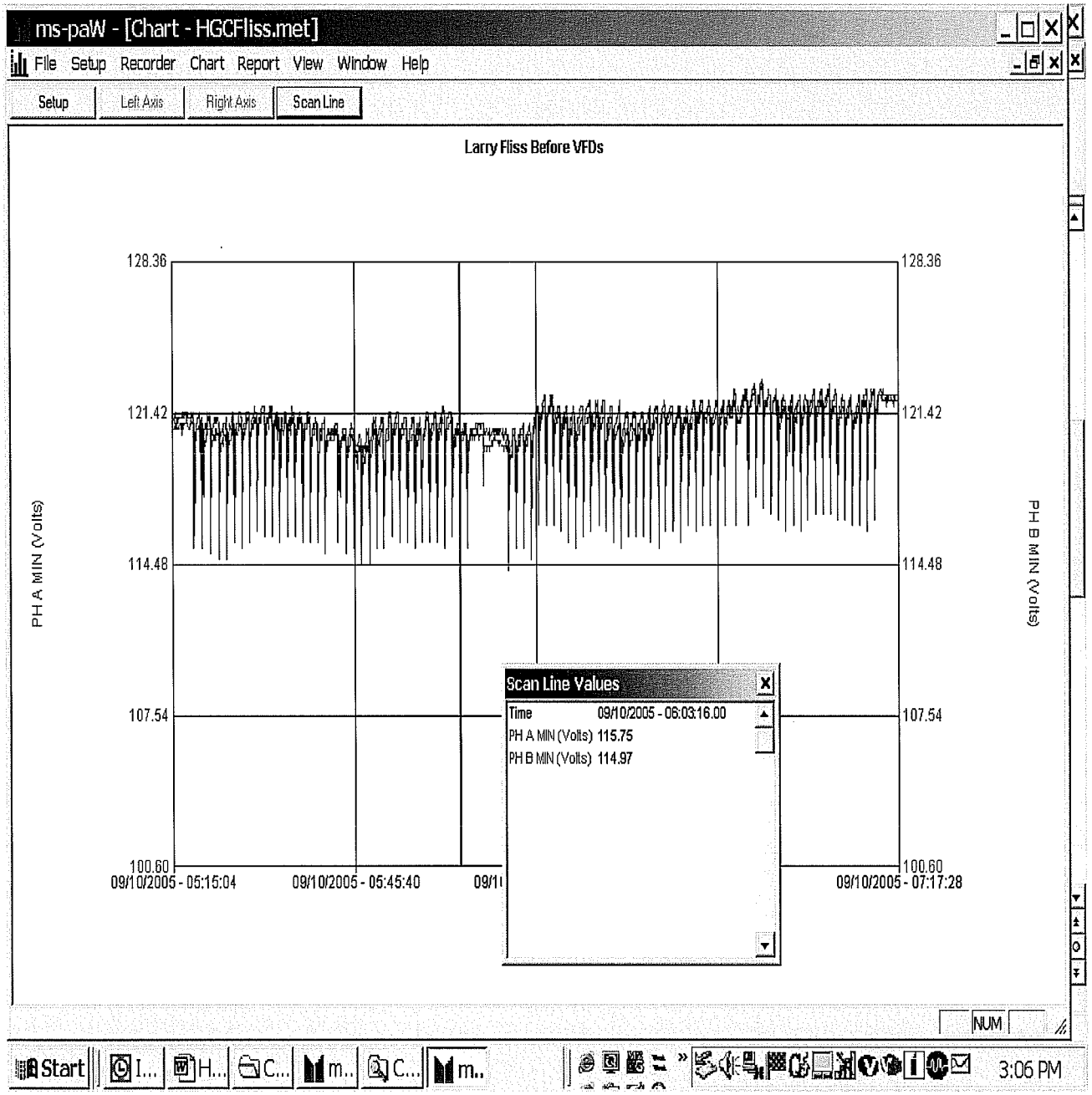
The following voltage plots A, B, and C represent data captured at three locations prior to the VFDs being installed. Plots D, E, and F are plots at the same three locations but after the VFDs were added. Mr. Larry Fliss is in close proximity to the golf course and Val Whipple is the last residence on Otter Tail Power Company's lake line. On plots A, B, and C there is a scan line box showing the exact voltage where the vertical (blue) line appears in the plot. This representative voltage dip value was used to calculate the severity of the voltage dip; e.g. 7% at the Hendricks Golf Course. Plots G and H provide voltage information following the Oct. 21st reconfiguration performed by Lonney.

PLOTS



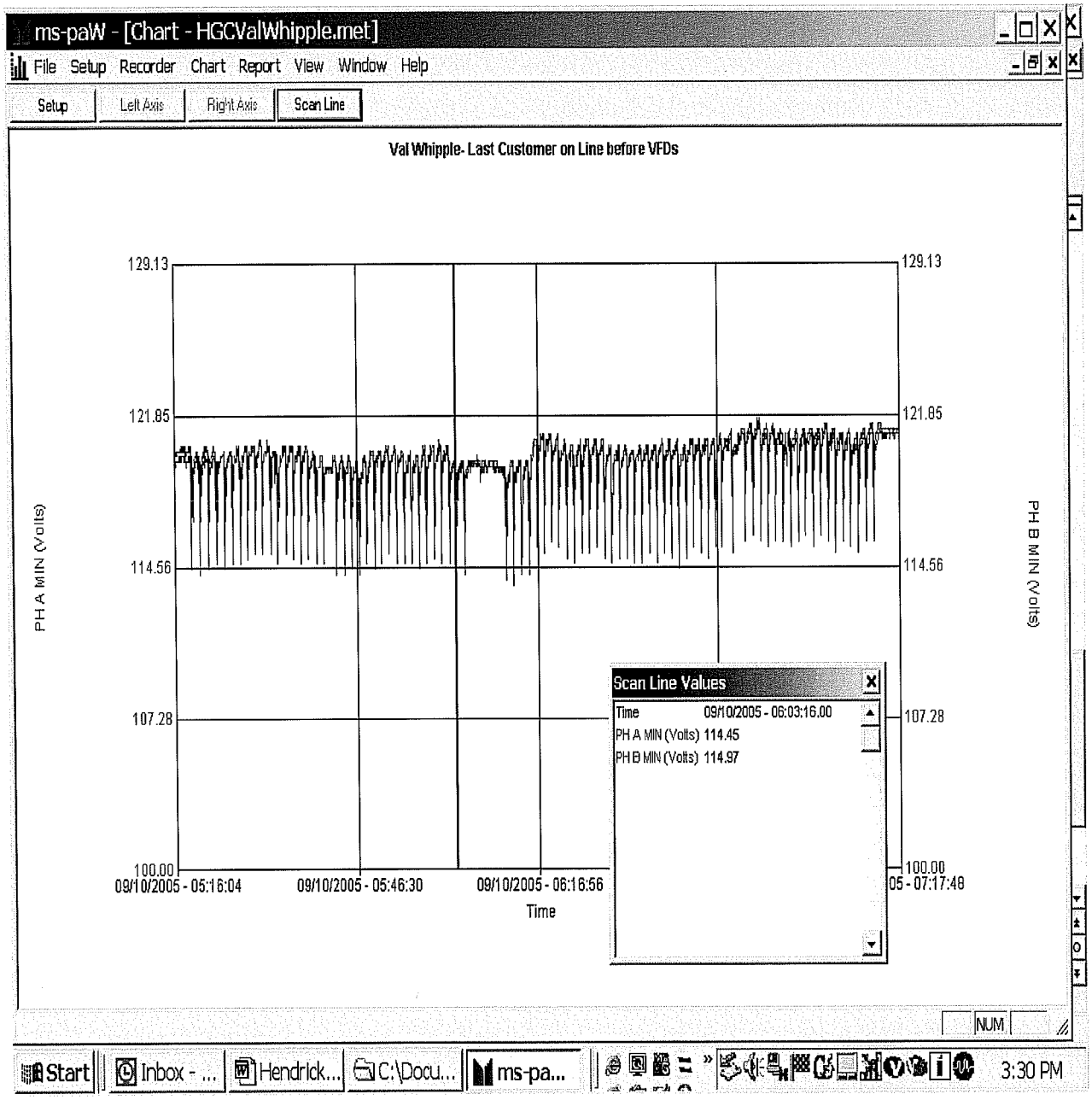
Voltage Plot A

(Hendricks Golf Course before the VFD's were added)
(Note: Frequent 7% dips)



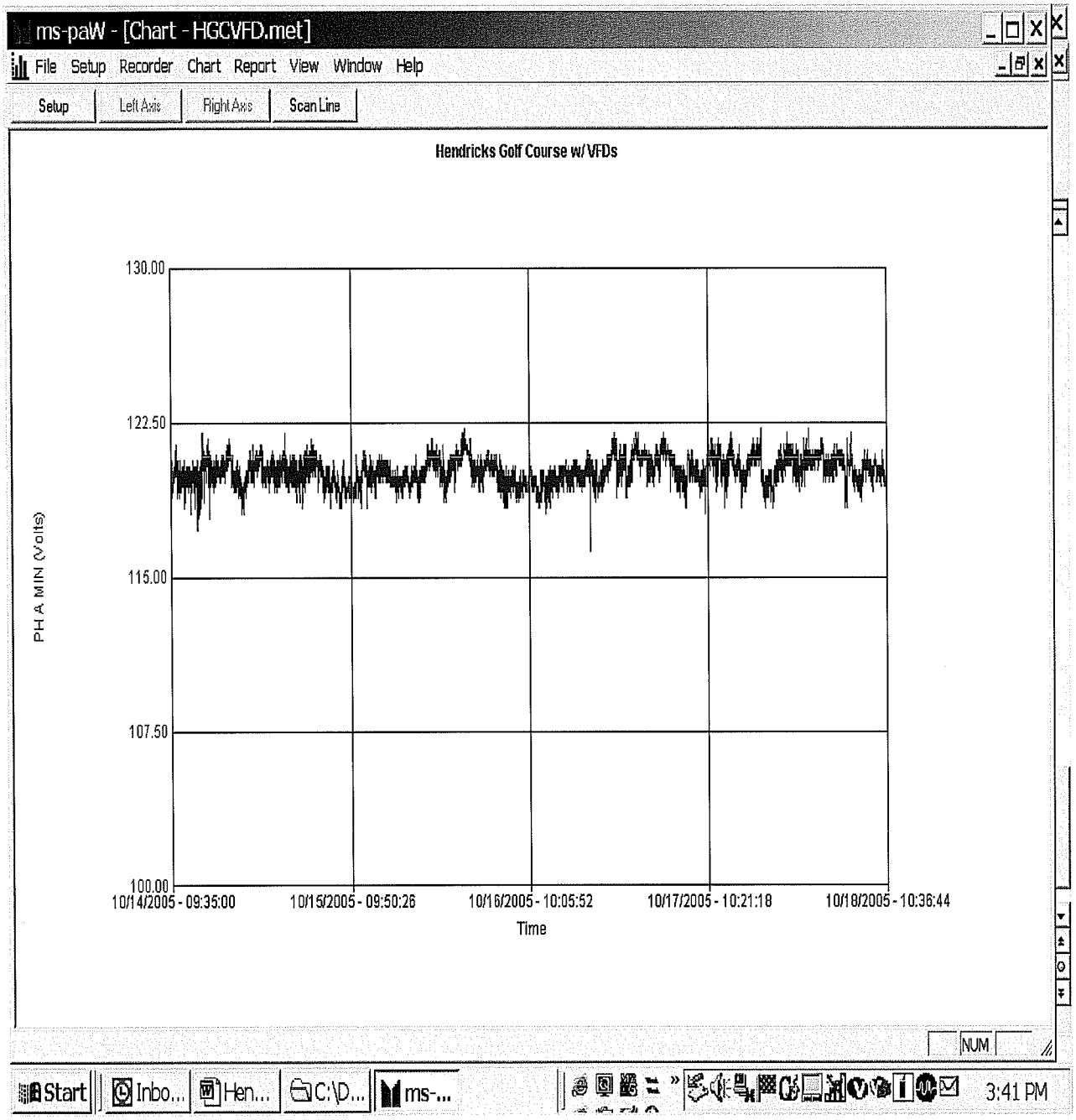
Voltage Plot B

(Larry Fliss before the VFDs were added)
(Note: Frequent 4% dips)



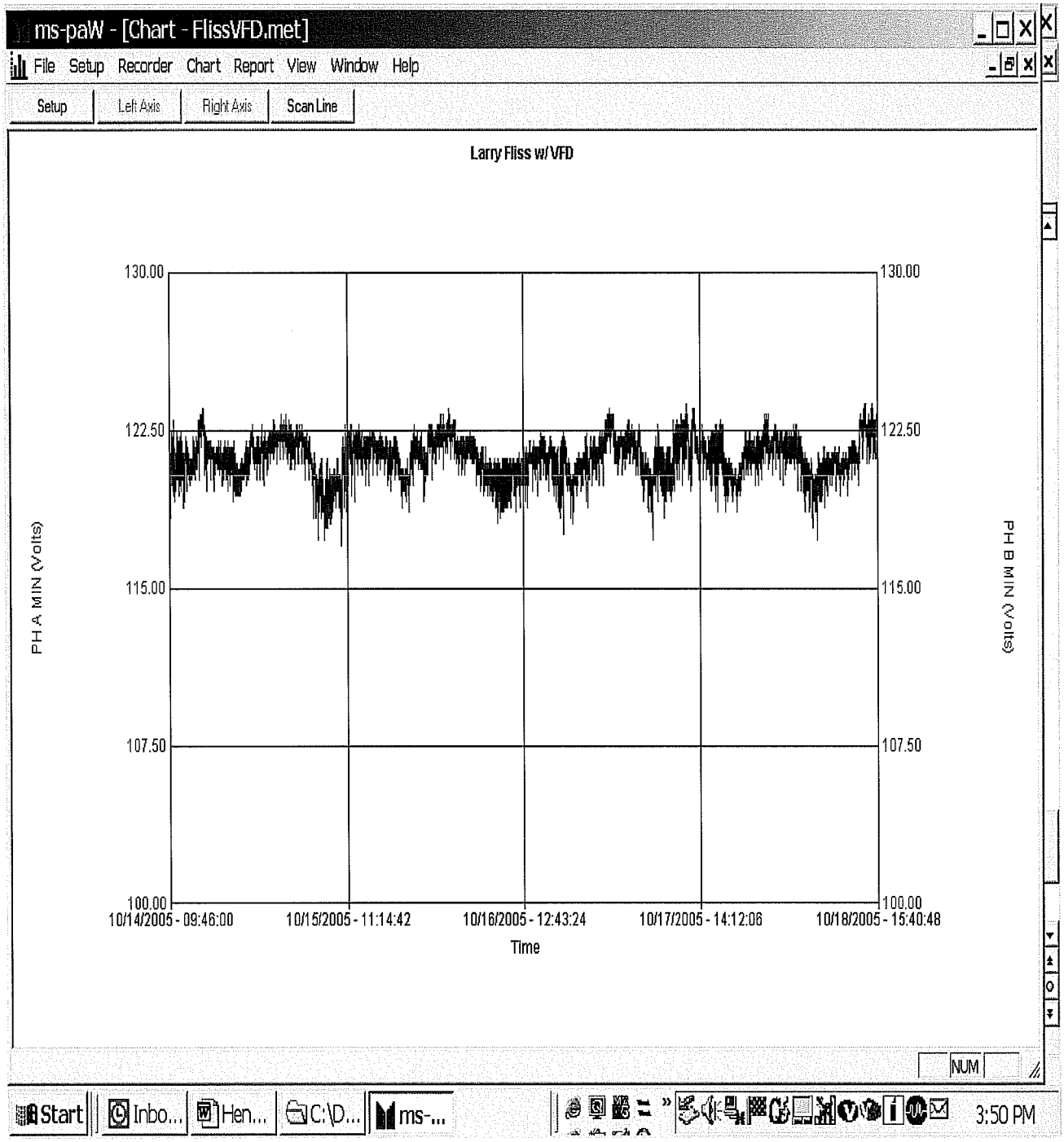
Voltage Plot C

(Val Whipple before the VFDs were added)
(Note: Frequent 4% dips)



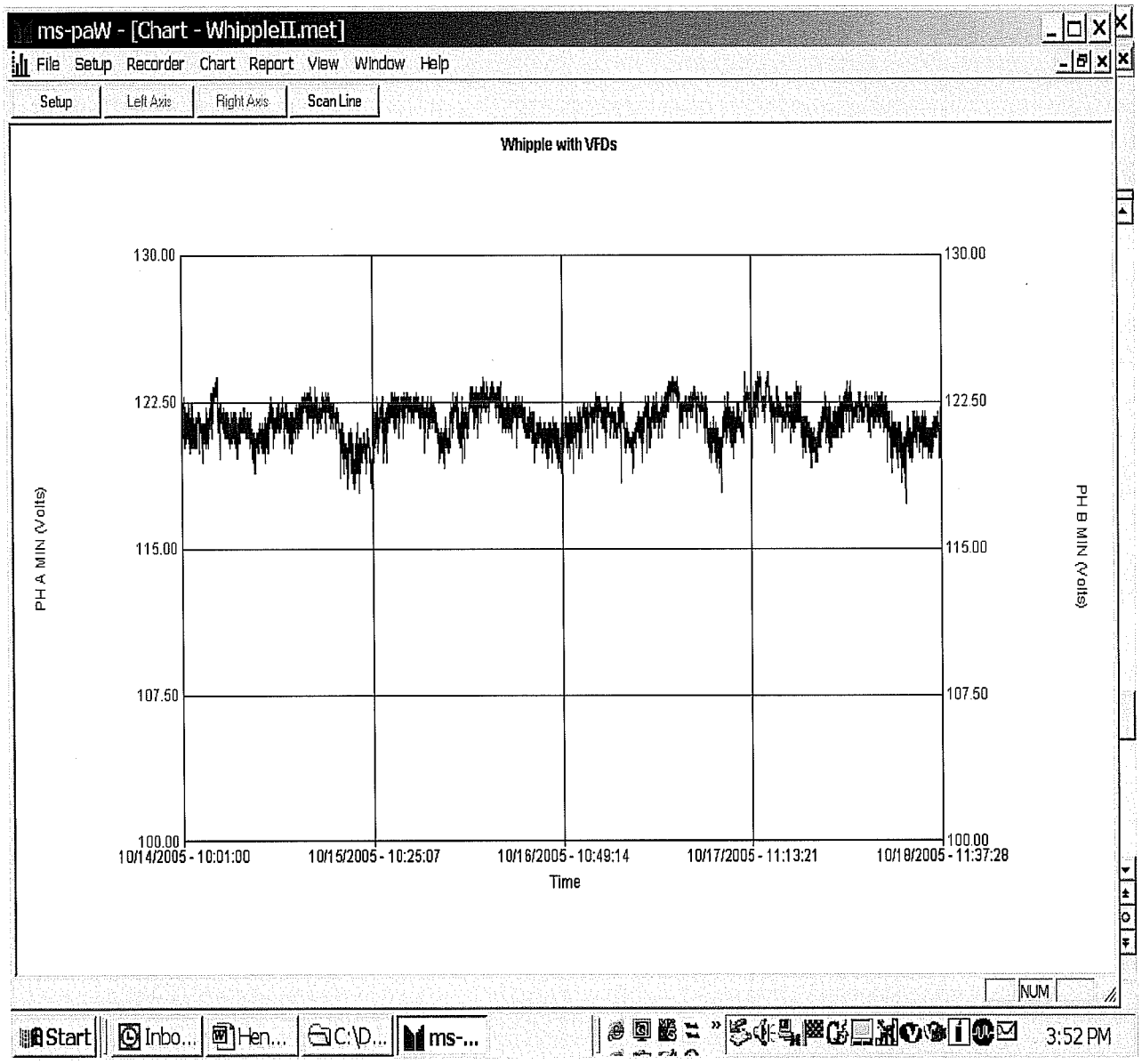
Voltage Plot D

(Hendricks Golf Course plot after the VFDs were added)
(Note: No flicker)



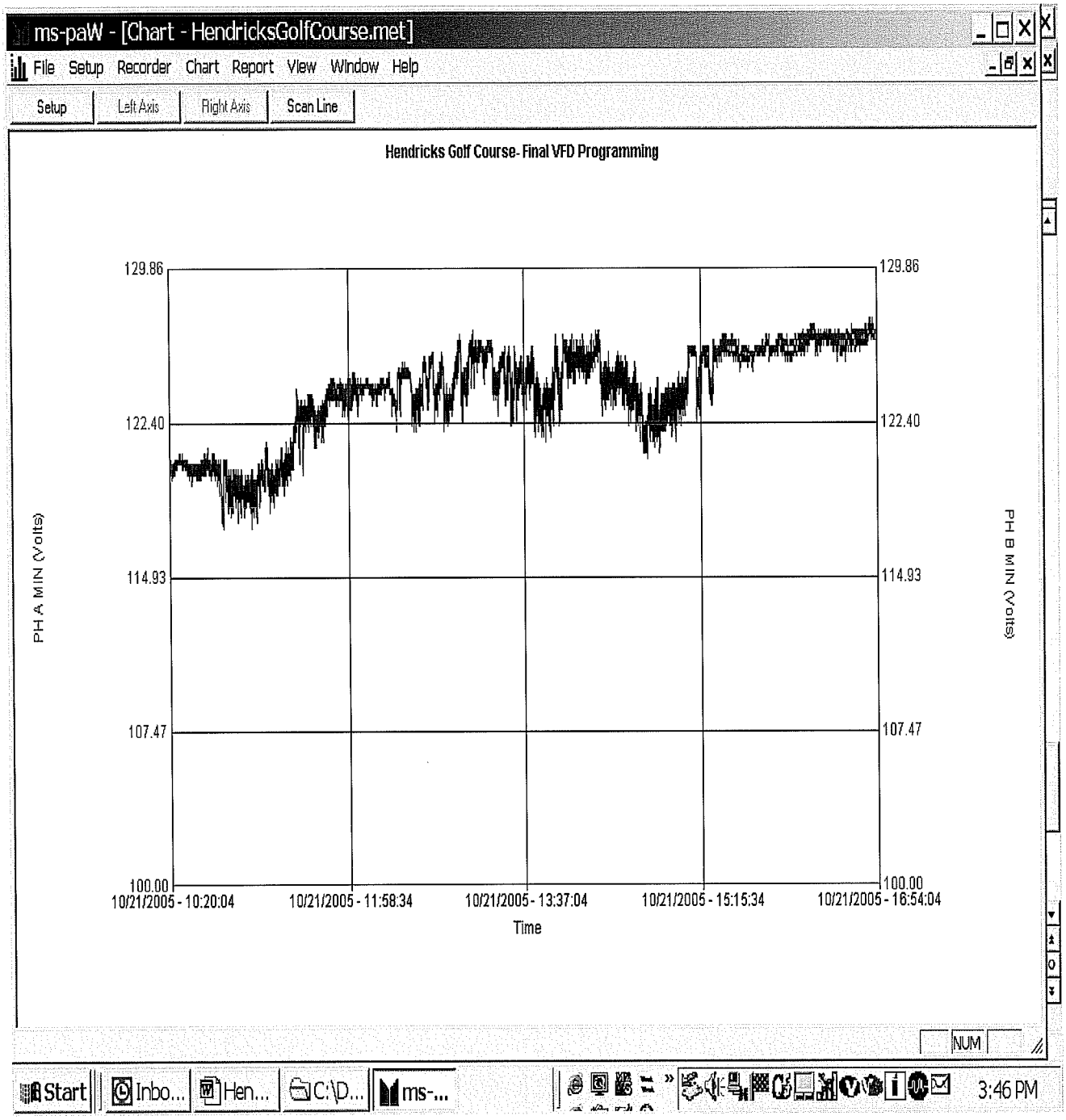
Voltage Plot E

(Larry Fliss plot <u>after</u> the VFDs were added)
(Note: No flicker)



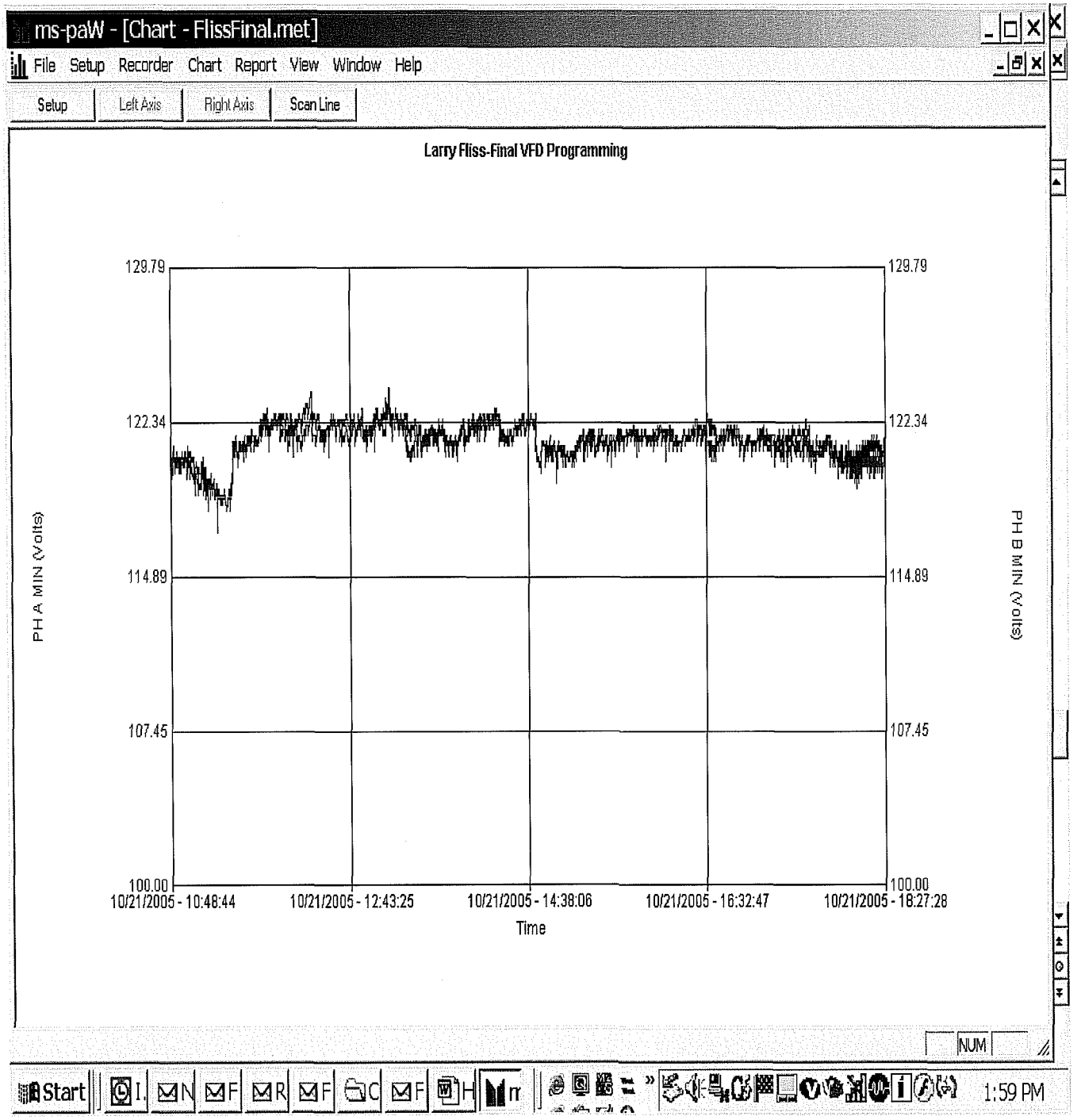
Voltage Plot F

(Val Whipple after VFDs added)
(Note: No Flicker)



Voltage Plot G

(Oct. 21st Hendricks Golf Course plot after the VFDs were reconfigured)
(Note: No flicker)



Voltage Plot H

(Oct. 21st Larry Fliss plot after the VFDs were reconfigured)
(Note: No flicker)

Conclusion

When examining the recorded before and after coincidental data after the VFDs were added, it was concluded that the VFDs prevented any significant motor starting inrush current so **no flicker voltage** was recorded at any of the three locations.

Joe Braun, P.E.
Senior Area Engineer