TOPEX/POSEIDON BATTERY PERFORMANCE DURING THE FIRST YEAR OF OPERATION

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OUTLINE

- CELL / BATTERY HISTORY
- OPERATIONAL STRATEGY
- SPACECRAFT DATA

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CELL DESIGN

- GATES MANUFACTURED CELLS
  NASA STANDARD 50 Ah NiCd DESIGN
- GATES CELL LOT DESIGNATION: 42B050AB35 LOT #6
- GATES JOB NUMBER: 1711
- SEPARATOR: GOVERNMENT FURNISHED EP-2505
- ELECTROLYTE QUANTITY: 160 cc
- 3 POSTS NEGATIVE PLATE
- 2 POSTS POSITIVE PLATE
- 113 CELLS

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CELL/BATTERY HISTORY

- PLATE BUYOFF: APRIL 4, 1991
- CELL ACTIVATION: APRIL 25, 1991
- CELL DELIVERY: AUGUST 1, 1991
- BATTERY BUYOFF: 4 BATTERIES FEBRUARY 5, 1992
- COLD STORAGE: FEBRUARY-JULY 1992
- LAUNCH-3 BATTERIES: AUGUST 10, 1992
- JPL RECEIVED SPARE: AUGUST 1992

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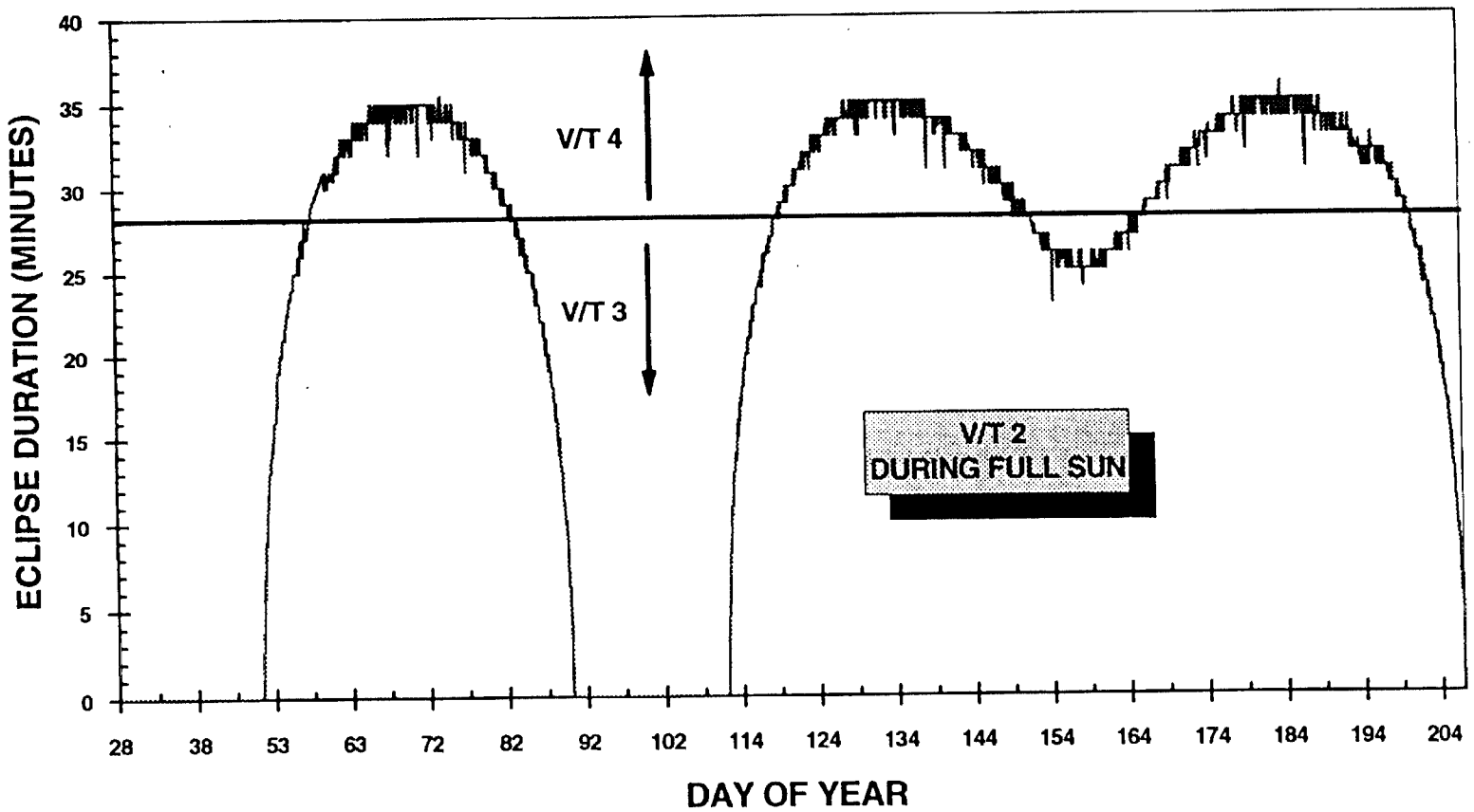
OPERATIONAL RECOMMENDATIONS

- LIMIT PEAK CHARGE CURRENT TO 20 A BY OFFSETTING THE SOLAR ARRAY
- LIMIT OVERCHARGE BY CONTROLLING THE RECHARGE FRACTION (C/D) BY OPERATING AT LOWER V/T LEVELS
- AVOID HIGH CHARGE CURRENTS DURING FULL SUN PERIODS BY OPERATING AT LOWER V/T LEVELS
- SWITCH TO LOWER CURRENT SENSOR FOR AMP-HOUR INTEGRATION TO IMPROVE C/D RATIO ACCURACY

BATTERY V/T LEVEL MANAGEMENT



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KEY BATTERY PARAMETERS MONITORED

- **DV - DIFFERENTIAL HALF BATTERY VOLTAGE**
  This parameter historically trended to evaluate battery state of health.

- **C/D - CHARGE/DISCHARGE RATIO**
  Monitors energy balance.

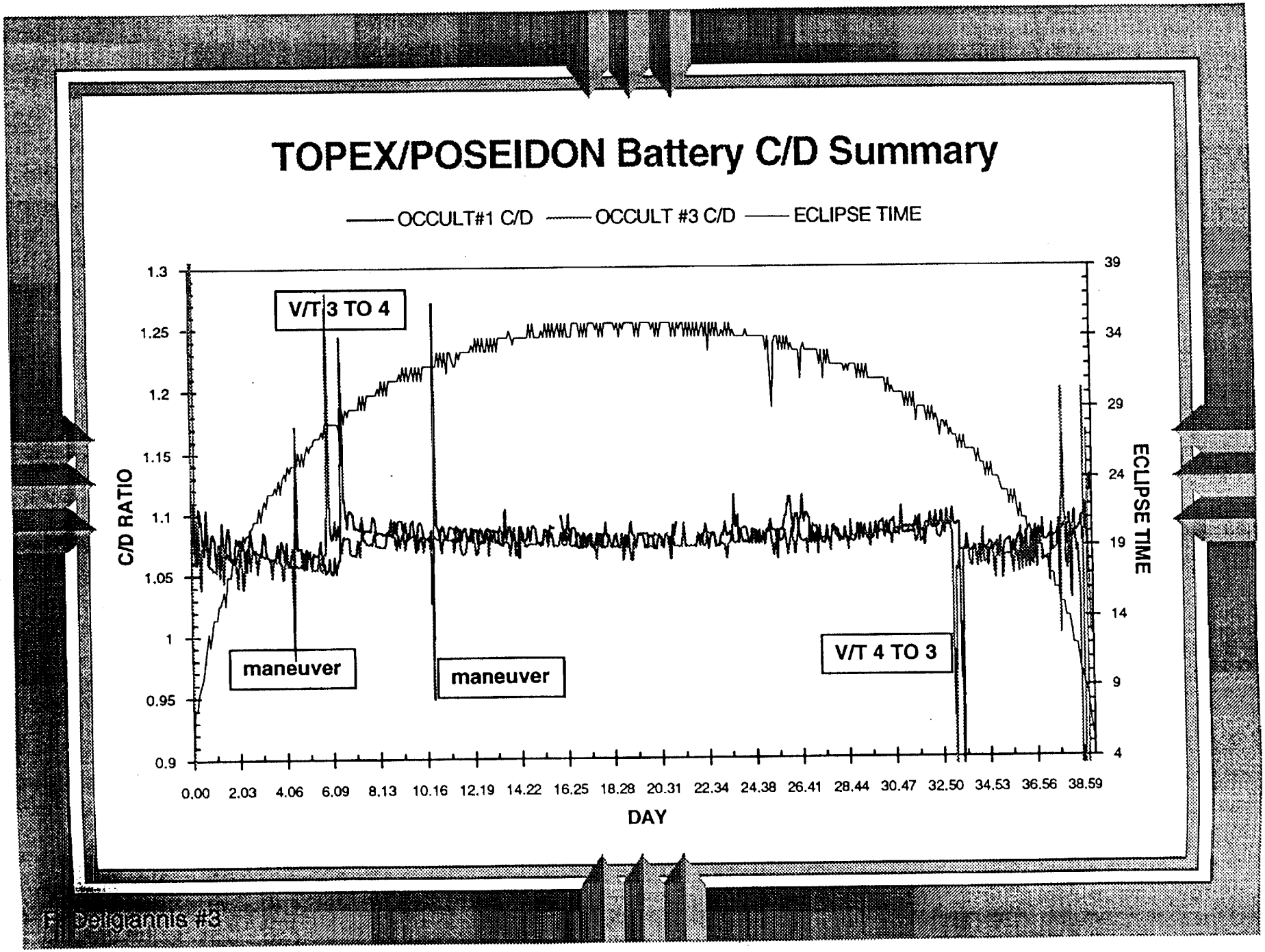
- **NET OVERCHARGE**
  Monitors total excess energy input to the batteries.

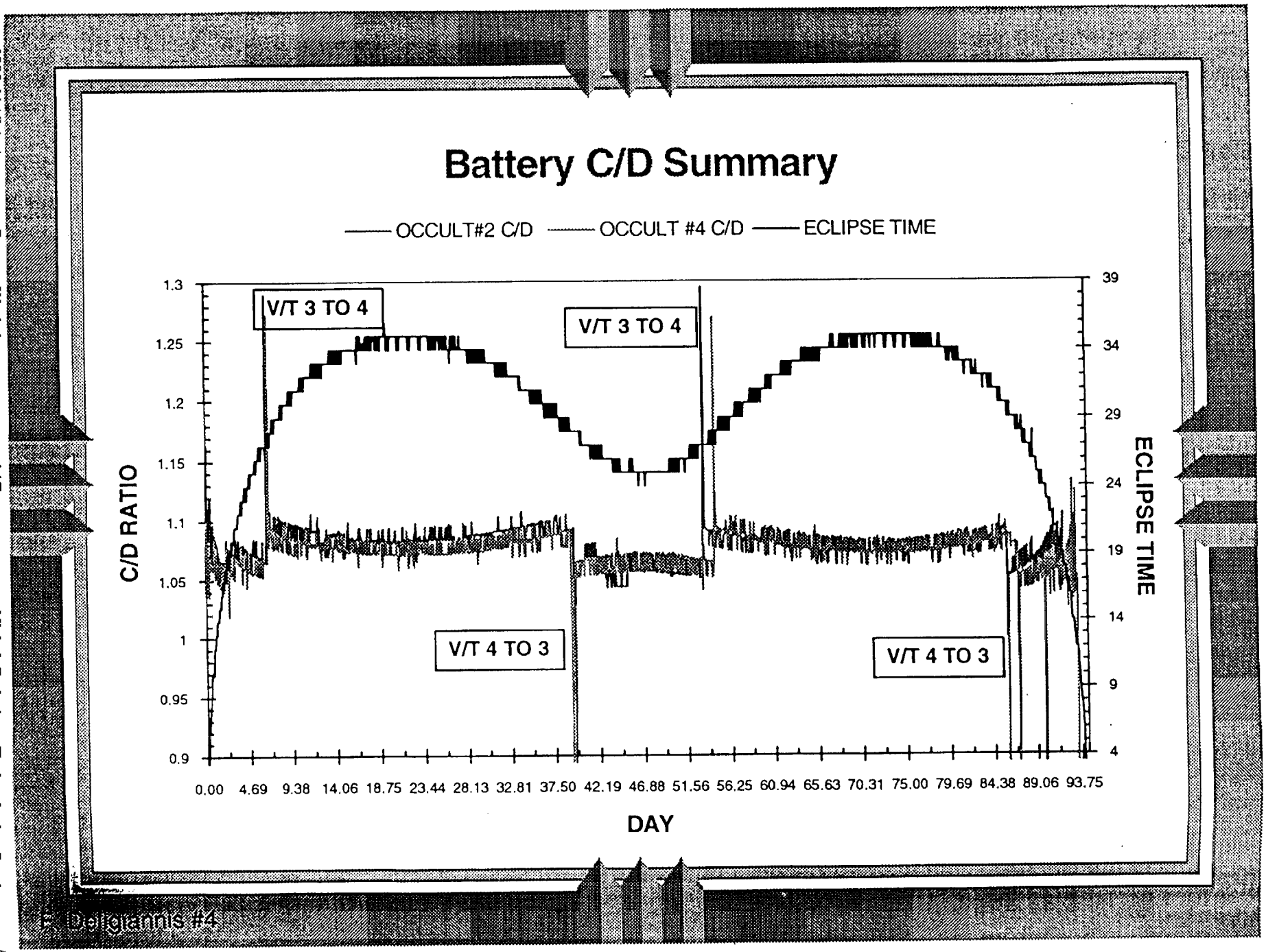
- **PEAK CHARGE CURRENT**
  Charge current during peak power mode / initial part of day.

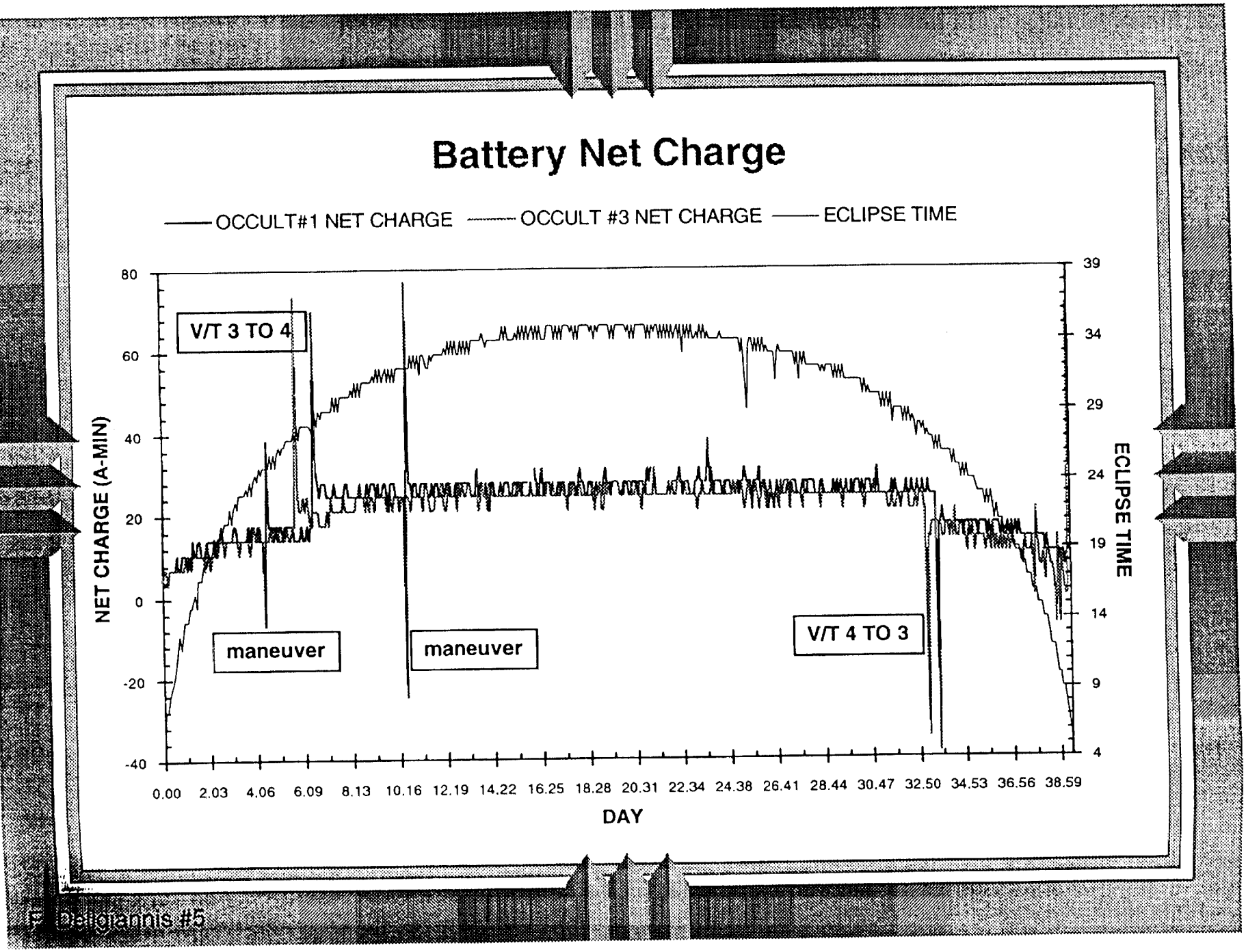
- **TAPER CURRENT**
  Charge current during the taper mode / later part of day.

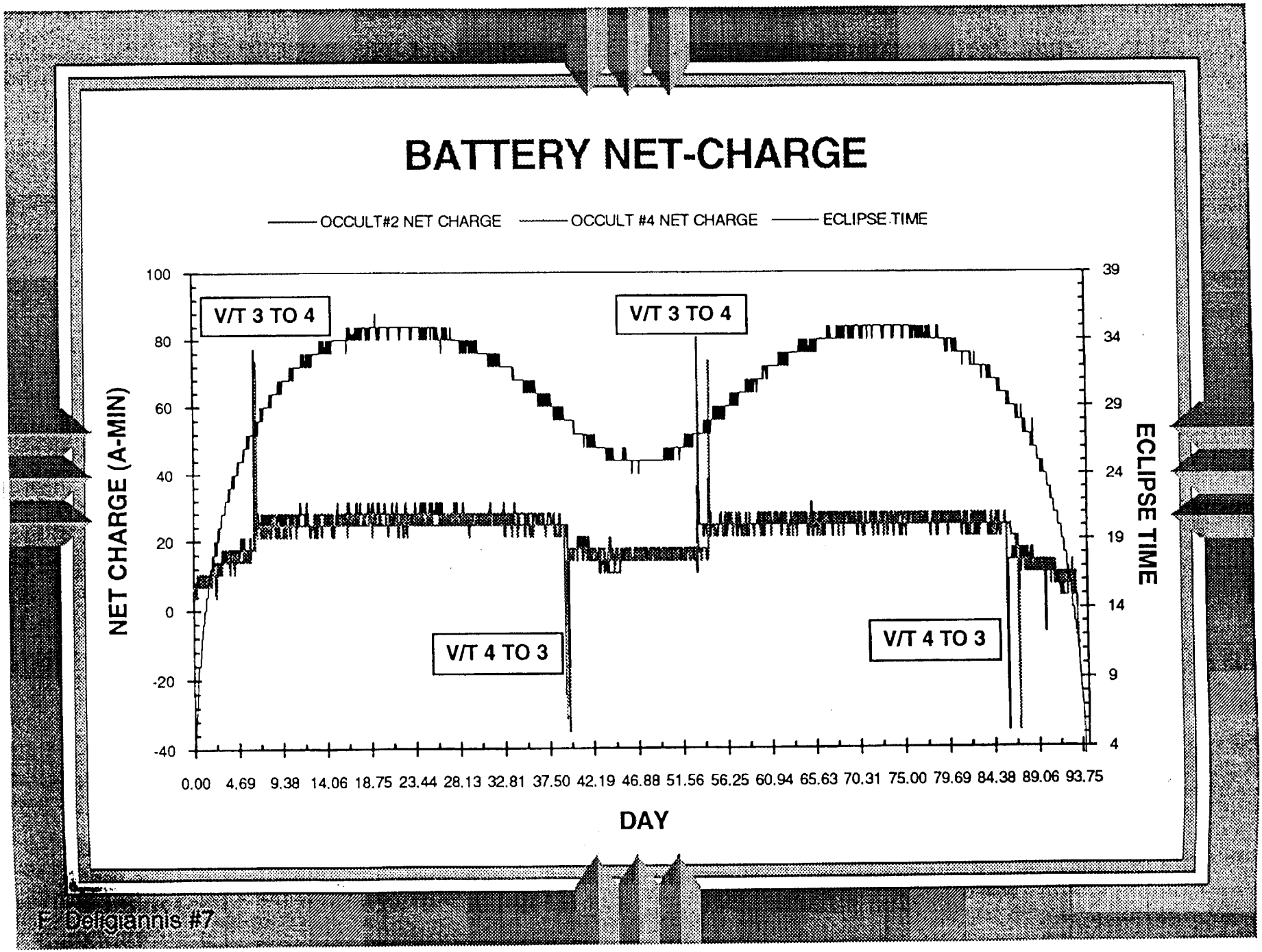
- **EONV - END OF NIGHT VOLTAGE**
  Battery voltage during the end of night.

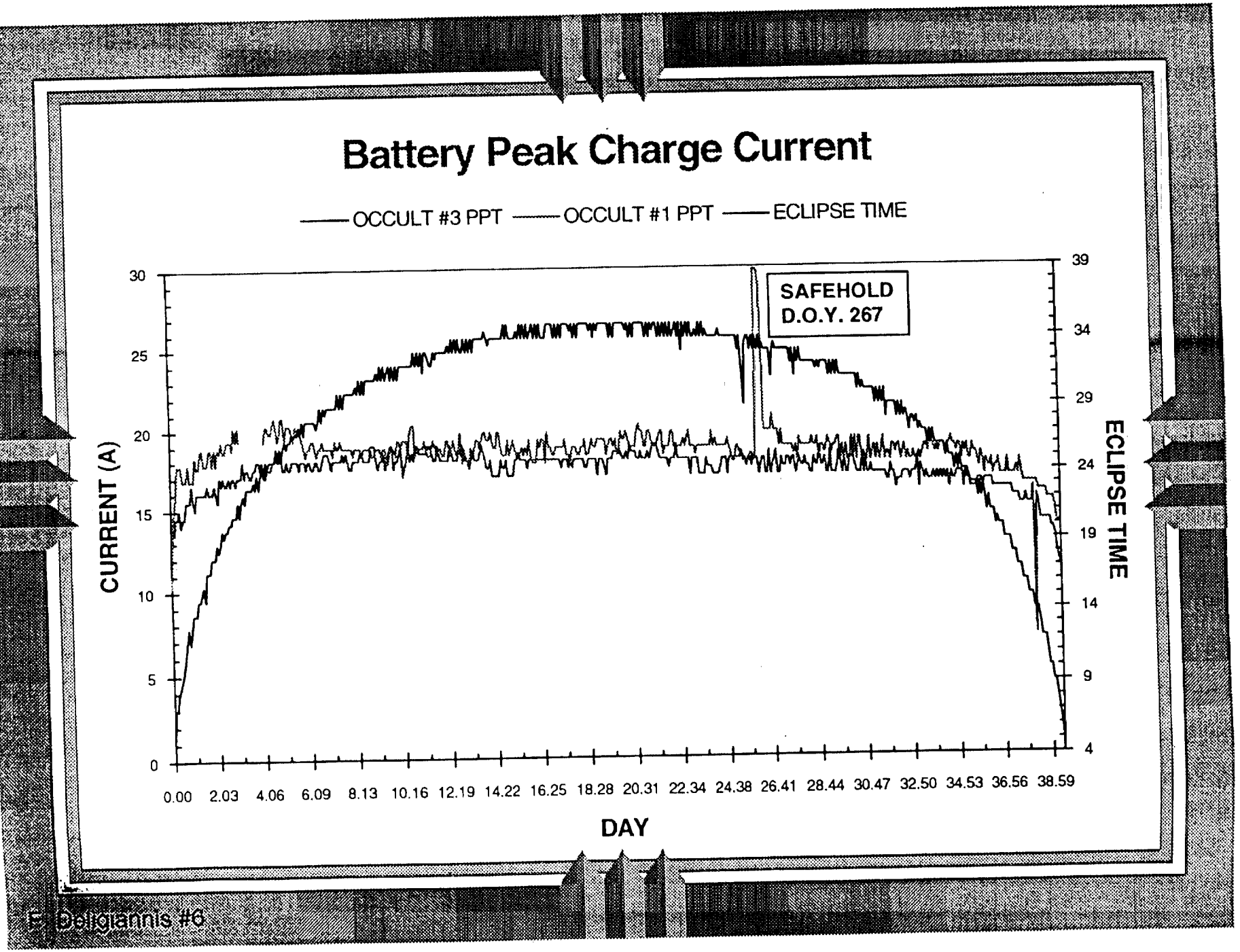
- **BATTERY TEMPERATURE**
  Battery temperature monitored on the top of each battery.

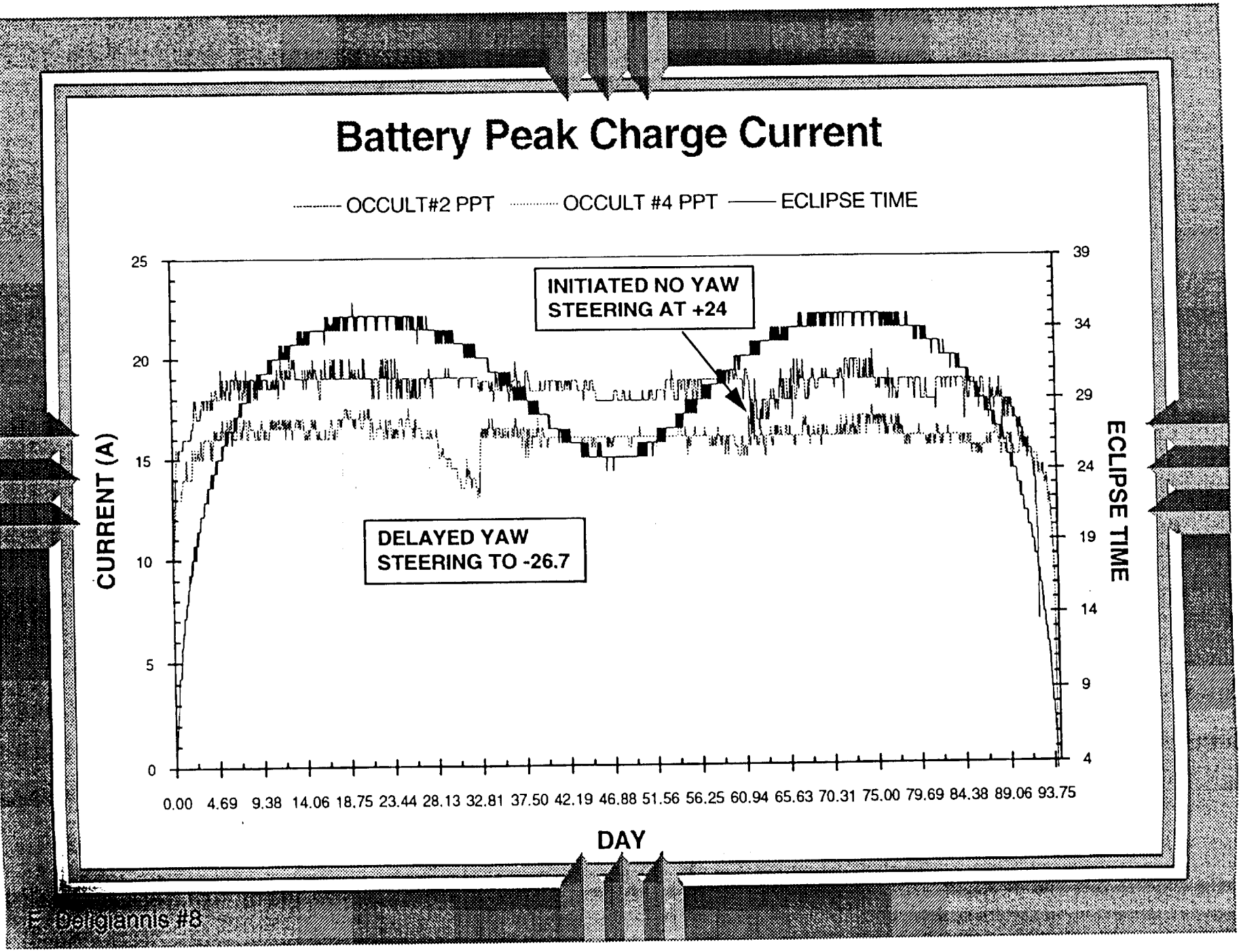

TOPEX/POSEIDON Battery C/D Summary
OCCULT#1 C/D
OCCULT #3 C/D
ECLIPSE TIME
C/D RATIO
ECLIPSE TIME
DAY
V/T 3 TO 4
V/T 4 TO 3
maneuver
maneuver
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
39
34
29
24
19
14
9
4
0.00 2.03 4.06 6.09 8.13 10.16 12.19 14.22 16.25 18.28 20.31 22.34 24.38 26.41 28.44 30.47 32.50 34.53 36.56 38.59

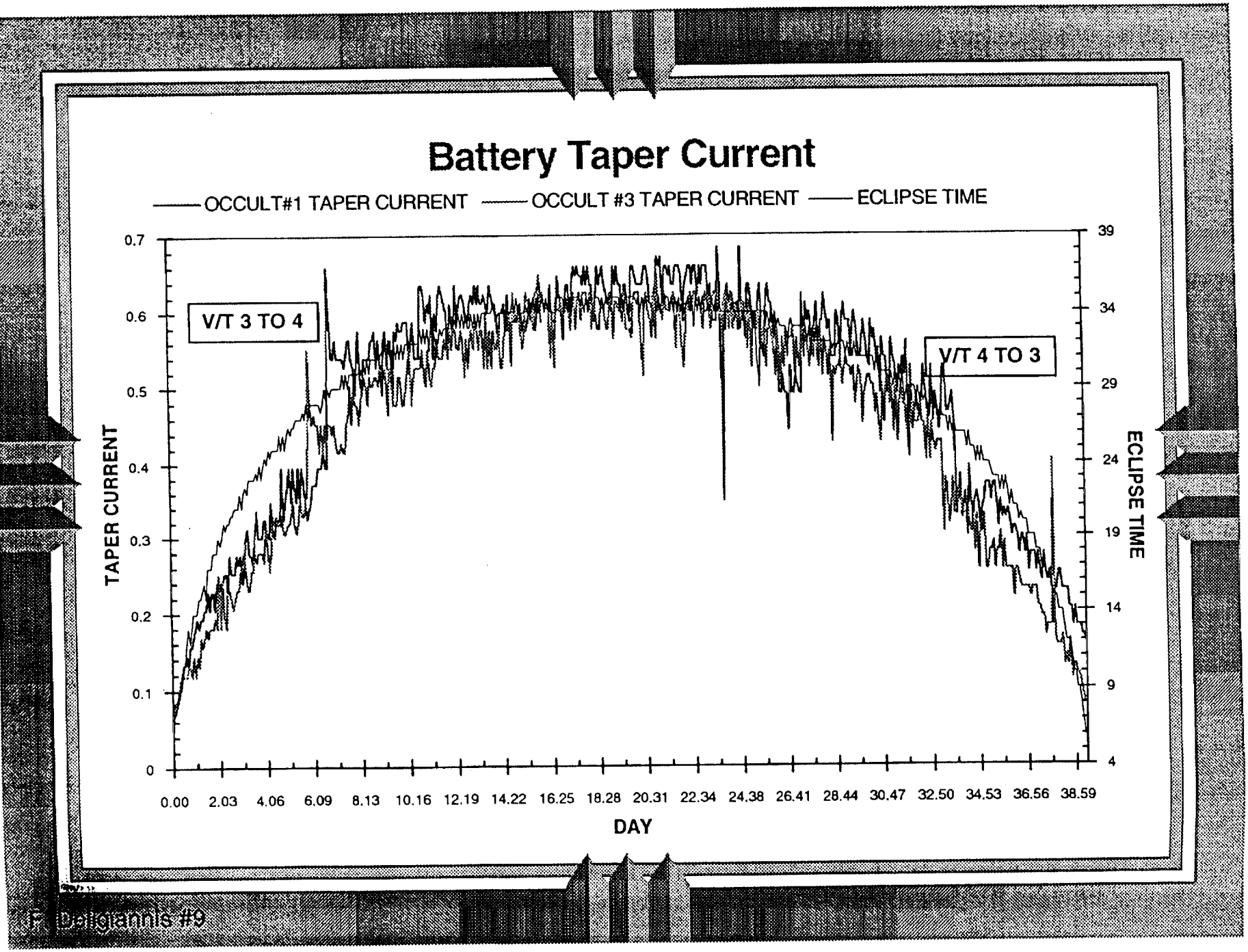

Battery C/D Summary
OCCULT#2 C/D
OCCULT #4 C/D
ECLIPSE TIME
V/T 3 TO 4
V/T 3 TO 4
V/T 4 TO 3
V/T 4 TO 3
C/D RATIO
ECLIPSE TIME
DAY
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
39
34
29
24
19
14
9
4
0.00 4.69 9.38 14.06 18.75 23.44 28.13 32.81 37.50 42.19 46.88 51.56 56.25 60.94 65.63 70.31 75.00 79.69 84.38 89.06 93.75
E. Deligiannis #4

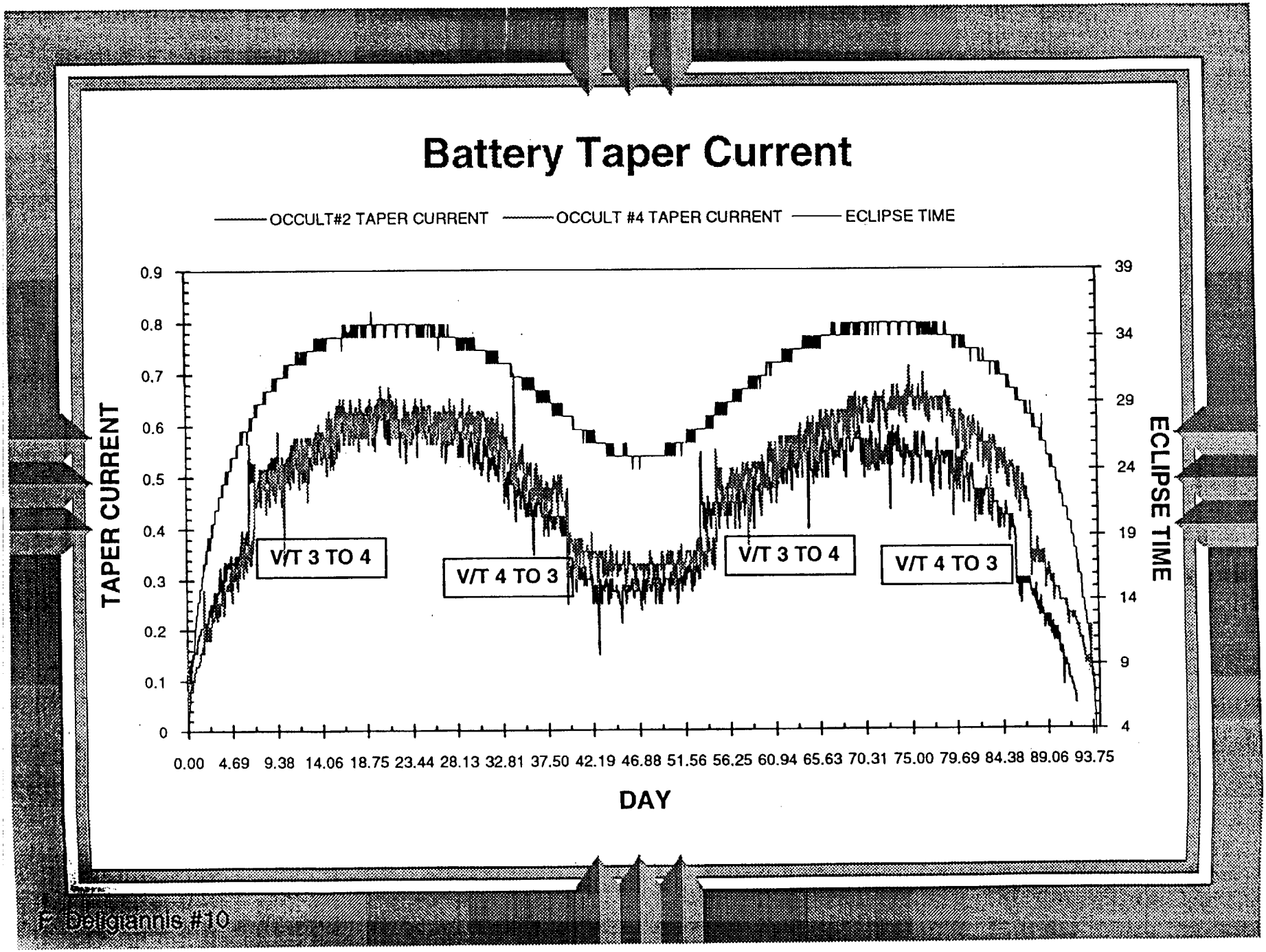

Battery Net Charge
OCCULT#1 NET CHARGE
OCCULT #3 NET CHARGE
ECLIPSE TIME
NET CHARGE (A-MIN)
ECLIPSE TIME
DAY
V/T 3 TO 4
maneuver
maneuver
V/T 4 TO 3
80
60
40
20
0
-20
-40
39
34
29
24
19
14
9
4
0.00 2.03 4.06 6.09 8.13 10.16 12.19 14.22 16.25 18.28 20.31 22.34 24.38 26.41 28.44 30.47 32.50 34.53 36.56 38.59

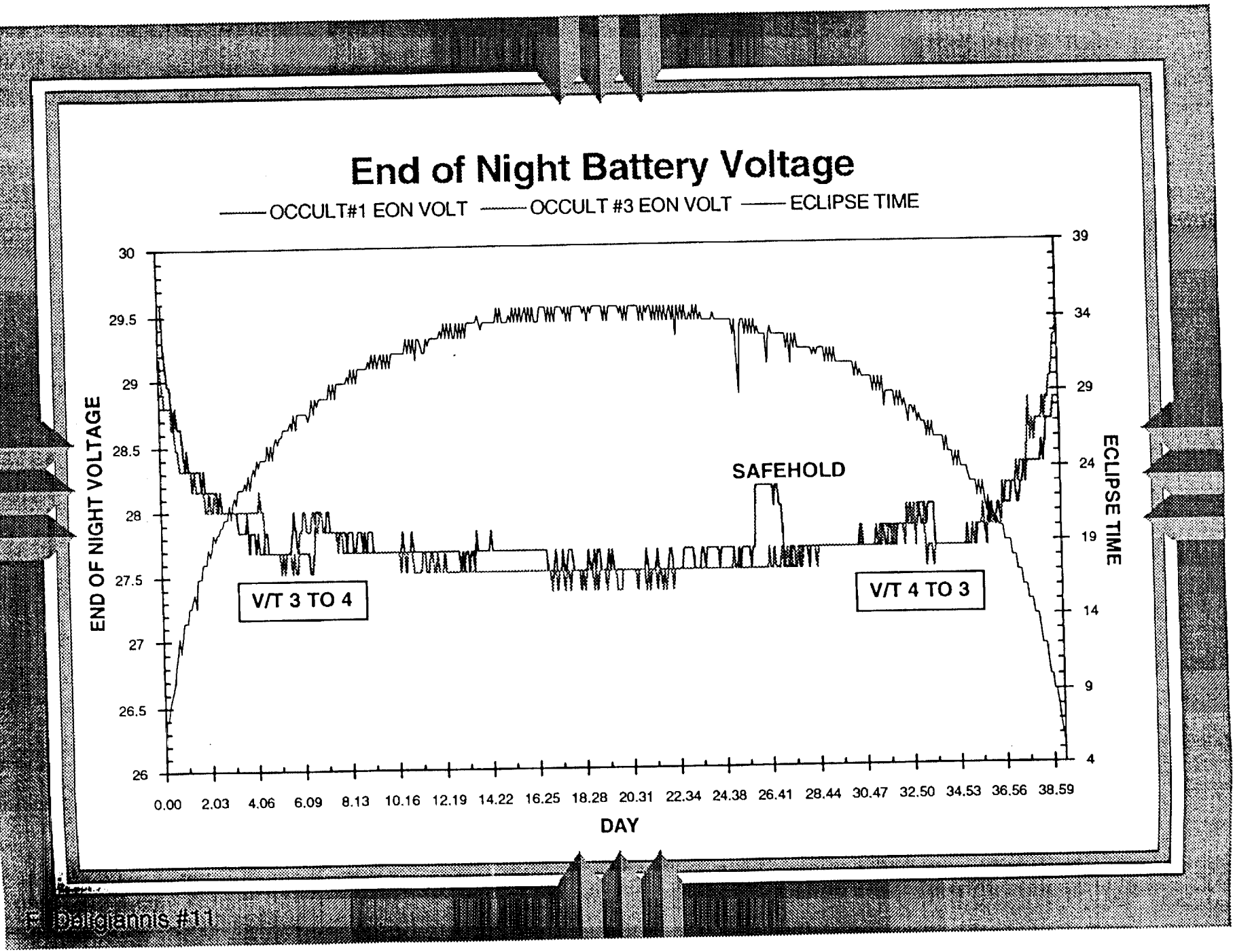

BATTERY NET-CHARGE
OCCULT#2 NET CHARGE
OCCULT #4 NET CHARGE
ECLIPSE TIME
V/T 3 TO 4
V/T 3 TO 4
V/T 4 TO 3
V/T 4 TO 3
NET CHARGE (A-MIN)
ECLIPSE TIME
DAY
100
80
60
40
20
0
-20
-40
39
34
29
24
19
14
9
4
0.00 4.69 9.38 14.06 18.75 23.44 28.13 32.81 37.50 42.19 46.88 51.56 56.25 60.94 65.63 70.31 75.00 79.69 84.38 89.06 93.75
F. Deligiannis #7

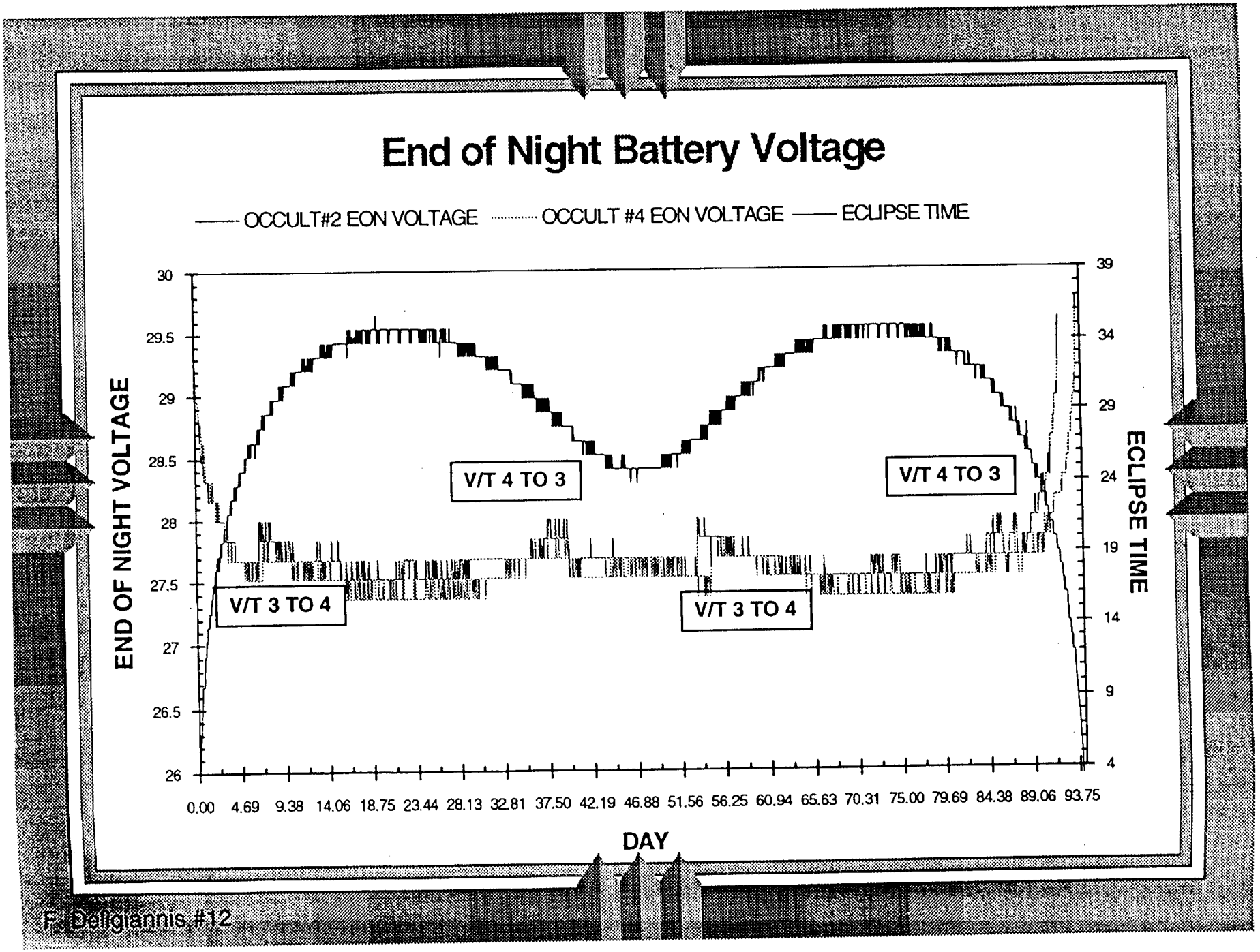

Battery Peak Charge Current
OCCULT #3 PPT
OCCULT #1 PPT
ECLIPSE TIME
SAFEHOLD
D.O.Y. 267
CURRENT (A)
ECLIPSE TIME
DAY
0
5
10
15
20
25
30
4
9
14
19
24
29
34
39
0.00 2.03 4.06 6.09 8.13 10.16 12.19 14.22 16.25 18.28 20.31 22.34 24.38 26.41 28.44 30.47 32.50 34.53 36.56 38.59
F. Deligiannis #6

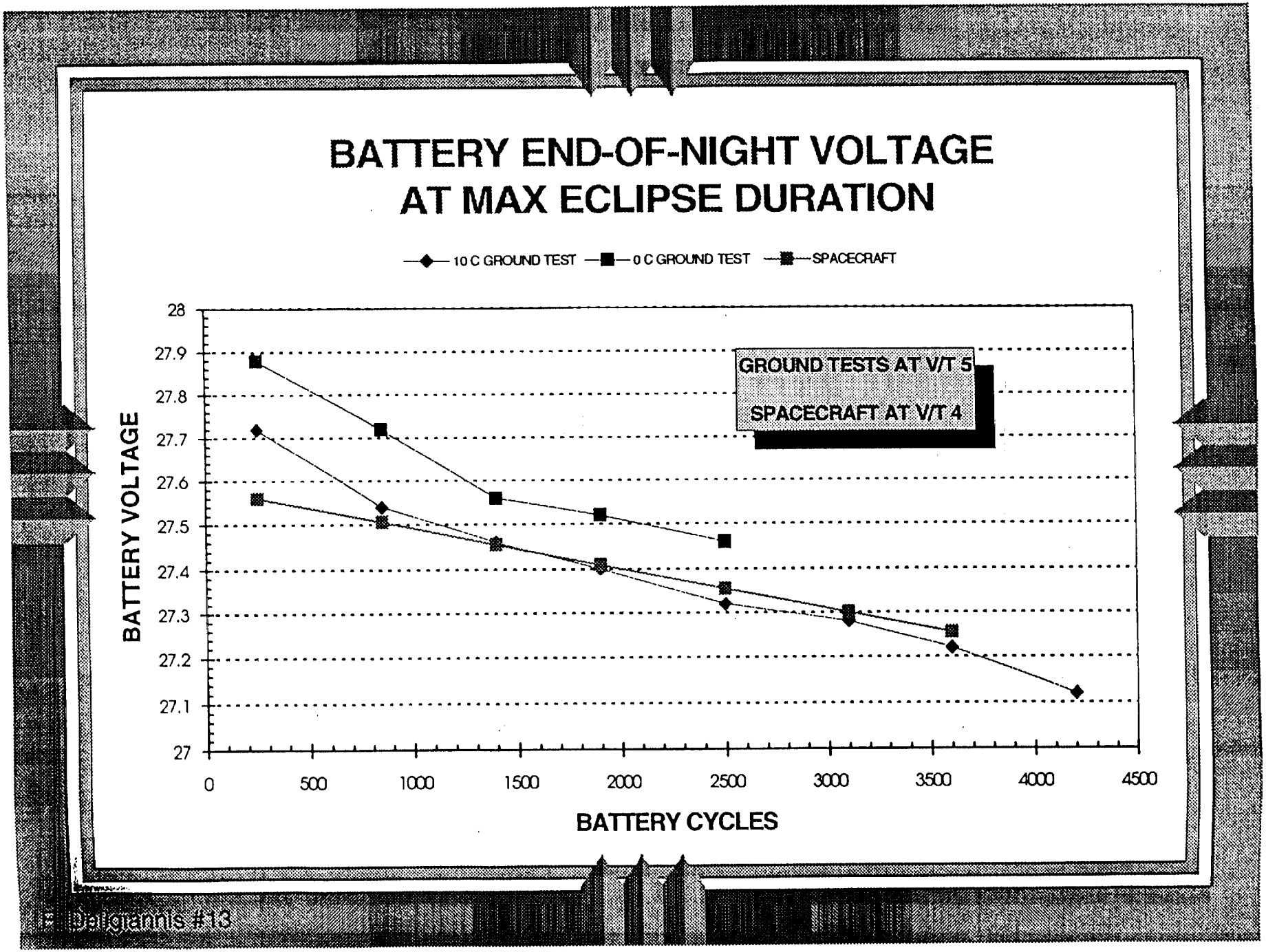

Battery Peak Charge Current
OCCULT#2 PPT
OCCULT #4 PPT
ECLIPSE TIME
INITIATED NO YAW STEERING AT +24
DELAYED YAW STEERING TO -26.7
CURRENT (A)
ECLIPSE TIME
DAY
0
5
10
15
20
25
4
9
14
19
24
29
34
39
0.00 4.69 9.38 14.06 18.75 23.44 28.13 32.81 37.50 42.19 46.88 51.56 56.25 60.94 65.63 70.31 75.00 79.69 84.38 89.06 93.75
F. Deligiannis #8


Battery Taper Current
OCCULT#1 TAPER CURRENT
OCCULT #3 TAPER CURRENT
ECLIPSE TIME
V/T 3 TO 4
V/T 4 TO 3
TAPER CURRENT
ECLIPSE TIME
DAY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
39
34
29
24
19
14
9
4
0.00 2.03 4.06 6.09 8.13 10.16 12.19 14.22 16.25 18.28 20.31 22.34 24.38 26.41 28.44 30.47 32.50 34.53 36.56 38.59

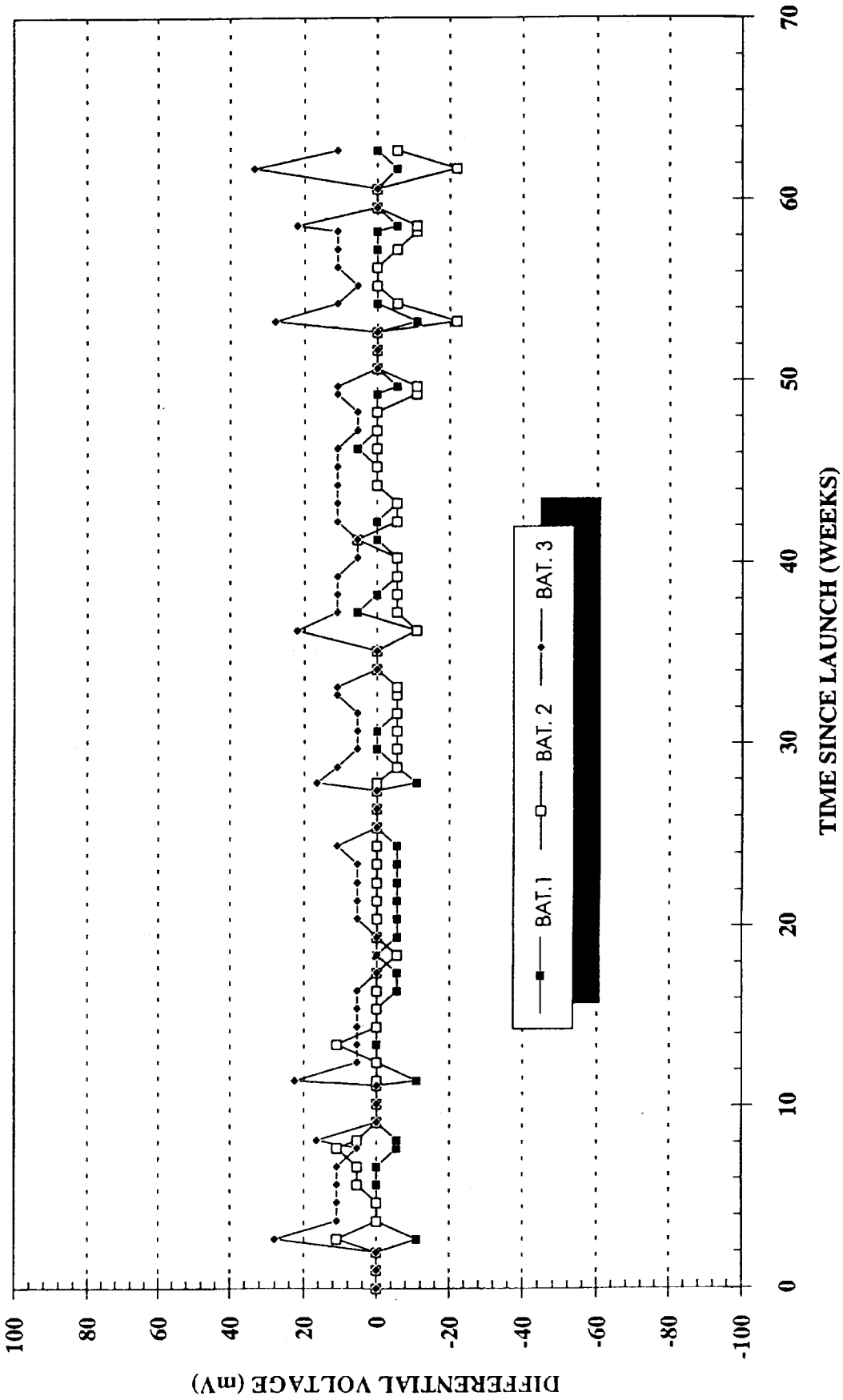

Battery Taper Current
OCCULT#2 TAPER CURRENT
OCCULT #4 TAPER CURRENT
ECLIPSE TIME
TAPER CURRENT
ECLIPSE TIME
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
39
34
29
24
19
14
9
4
V/T 3 TO 4
V/T 4 TO 3
V/T 3 TO 4
V/T 4 TO 3
0.00 4.69 9.38 14.06 18.75 23.44 28.13 32.81 37.50 42.19 46.88 51.56 56.25 60.94 65.63 70.31 75.00 79.69 84.38 89.06 93.75
DAY
F. Delgiannis #10


End of Night Battery Voltage
OCCULT#1 EON VOLT
OCCULT #3 EON VOLT
ECLIPSE TIME
END OF NIGHT VOLTAGE
ECLIPSE TIME
DAY
SAFEHOLD
V/T 3 TO 4
V/T 4 TO 3
30
29.5
29
28.5
28
27.5
27
26.5
26
39
34
29
24
19
14
9
4
0.00 2.03 4.06 6.09 8.13 10.16 12.19 14.22 16.25 18.28 20.31 22.34 24.38 26.41 28.44 30.47 32.50 34.53 36.56 38.59


End of Night Battery Voltage
OCCULT#2 EON VOLTAGE
OCCULT #4 EON VOLTAGE
ECLIPSE TIME
END OF NIGHT VOLTAGE
ECLIPSE TIME
DAY
V/T 4 TO 3
V/T 4 TO 3
V/T 3 TO 4
V/T 3 TO 4
30
29.5
29
28.5
28
27.5
27
26.5
26
39
34
29
24
19
14
9
4
0.00 4.69 9.38 14.06 18.75 23.44 28.13 32.81 37.50 42.19 46.88 51.56 56.25 60.94 65.63 70.31 75.00 79.69 84.38 89.06 93.75
F. Deligiannis, #12


BATTERY END-OF-NIGHT VOLTAGE
AT MAX ECLIPSE DURATION
10 C GROUND TEST
0 C GROUND TEST
SPACECRAFT
GROUND TESTS AT V/T 5
SPACECRAFT AT V/T 4
BATTERY VOLTAGE
28
27.9
27.8
27.7
27.6
27.5
27.4
27.3
27.2
27.1
27
0
500
1000
1500
2000
2500
3000
3500
4000
4500
BATTERY CYCLES
E. Deligiannis #13

TOPEX BATTERY DIFFERENTIAL VOLTAGE HISTORY DURING PEAK POWER TRACKING MODE



CONCLUSIONS

- COMPLETED 15 MONTHS OF SUCCESSFUL OPERATION
  - ANOTHER 21 MONTHS OF PRIMARY MISSION REMAINING
  - ADDITIONAL 24 MONTHS OF EXTENDED MISSION
- C/D HAS BEEN MAINTAINED AT APPROXIMATELY 1.07
- PEAK CHARGE CURRENTS WERE SUCCESSFULLY LIMITED TO BELOW 20 A
- END-OF-NIGHT VOLTAGE HAS DROPPED 2 DN COUNTS (0.32 V)
- VOLTAGE DIFFERENTIAL WAS WITHIN A FEW DN COUNTS (16 mV)
- WE ANTICIPATE WITH PROPER BATTERY MANAGEMENT THE BATTERY PERFORMANCE WILL REMAIN AT OPTIMUM LEVELS