Chopper Locomotive Demonstration Program Phase II

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Final Report

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**Abstract E44 Chopper Locomotive**

An E44 electric locomotive of 5000 hp, 6 axles and 6 motors was used as a test bed to evaluate full scale use of 6 separate high power DC to DC choppers for propulsion.

The normal phase control rectifier equipment was removed and replaced by a DC link at 2000 volts as the source of energy to the choppers. The choppers were then free to operate at any optimum frequency rather than being tied to the catenary frequency. Catenary power fed the link on a continuous basis thus providing a line power factor very close to unity (95%).

The project was a joint venture of the Federal Railroad Administration, Conrail and The General Electric Company. The old phase controlled electronics was removed at the Erie plant of General Electric and replaced by 6 choppers with the necessary ancillary equipment. The new propulsion system was matched to the normal E44 performance. The ability to operate in multiple with other diesel locomotives was also provided.

The objective of this project was to demonstrate that modern power electronics could be applied to an electric locomotive. Tests showed that all of the advantages available from this method of propulsion i.e. high efficiency, high power factor and smooth control can be achieved.

**Key Words**
Chopper Locomotive, Chopper Controls, Power Factor, Electric Propulsion
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A. INTRODUCTION

The Transportation Systems Business Operation of the General Electric Company has completed the Chopper Locomotive Demonstration Program. This report documents the E44 Chopper Locomotive tests that were performed on the GE-Erie locomotive test track, and the in-service runs pulling a Conrail trailer van train between Newark and Washington, D.C.

Please refer to the interim progress reports forwarded to the FRA during Phases I and II of this program for information on the design and fabrication of the Chopper Locomotive.

B. SUMMARY

1. Testing in Erie included motoring and dynamic braking performance, wheelslip evaluation, and measurement of the power factor,
2. **Motoring Performance** - Motoring performance was as expected per the published tractive effort vs speed curve, 41H14T280. See Figure 3.1 which shows the test data plotted on this curve.

3. **Dynamic Braking Performance** - Dynamic braking performance was also as expected per the published braking effort vs speed curve, 41H105988. See Figure 4.1 which shows the test data plotted on this curve.

4. **Wheelslip Evaluation** - The individual axle control of the wheelslip system performed very well as much of the locomotive testing was done during the winter on slippery track conditions. See Figures 5.1, 5.2, 5.3, and 5.4 which show the random slipping of the various axles and the resulting correction for only the affected axle.

5. **Power Factor** - The measured power factor was 0.91-0.925 over the speed range which was slightly better than expected per the published power factor vs speed curve, 41H119318. See Figure 6.1 for the power factor data plotted on this curve.
6. **Locomotive Efficiency** - The measured locomotive efficiency was 2-5% low in the lower speed range and 2% higher at 40 MPH compared to the calculated efficiency vs speed curve shown on 41H115682. See Figure 7.1 which shows the test data plotted on the above curve.

7. **Psophometric Current** - Telephone interference can be specified as either psophometric current or It product. The original curve, 41H119319, was plotted as an It product, but since that time (1979) the use of psophometric current has become standard and that is what our instruments measure. Therefore, a new curve had to be drawn, 41H106104, from some existing computer runs done in 1979 and the test data is shown plotted on this curve, Figure 8.1. The resulting psophometric current was from 1-2 amps lower than expected.

8. **In-Service Runs on Conrail** - Two round trips were made from the South Kearny Yard in Newark, N.J. to the Potomac Yard in Washington, D.C. The Chopper Locomotive ran very well and easily outpulled the two GP38-2 diesel electric locomotives which normally pull this trailer van train.

Some minor problems occurred, but not with the main power train, i.e., the main transformer, phase-controlled bridges, the choppers, and traction motors.
SECTION 2
ERIE TEST TRACK TESTS

A. POWER SUPPLY AND INSTRUMENTATION

All testing was done with the catenary energized at 25KV, 60 Hz. Figure 2.1 shows a simplified power circuit with some of the instrumentation used. Below is a listing of the various test instruments and their model numbers.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Power factor/wattmeter</td>
<td>Magtrol Power Analyzer Model #4612PF</td>
</tr>
<tr>
<td>2. Psophometer</td>
<td>Siemens Model # S44034-U2133-A702</td>
</tr>
<tr>
<td>3. Potential transformer (PT)</td>
<td>General Electric JVS150 Catalog #766X30G5</td>
</tr>
<tr>
<td>4. Non-inductive shunt</td>
<td>Co-axial shunt with a resistance of 0.0002485 ohms</td>
</tr>
</tbody>
</table>
5. Current transformer (CT)  Part of the main transformer which feeds the primary overcurrent relay.

6. Brush recorder  Gould 8 channel brush Model #481

B. TEST CONSIST

Two diesel-electric locomotives were used to simulate a train by operating them in dynamic braking for the Chopper motoring tests, and in motoring for the Chopper dynamic braking tests. Test runs were made with the Chopper Locomotive in either N8 motoring or dynamic braking at 10, 20, 30, and 40 MPH, which was the maximum speed allowed for a six axle electric locomotive on the Erie Test Track.
FIGURE 2.1 - SIMPLIFIED POWER CIRCUIT SHOWING THE INSTRUMENTATION USED

25,000V 60 Hz

CT 160:1

PT

104.2 Input Voltage

25,000

Power Factor and Wattmeter

Measures Power Factor and Input Power

RECT. 1

Auxiliary Circuits

RECT. 2

Dynamic Braking

CHOPPER #6

CHOPPER #1

TML

R R

M

Non-Inductive Shunt

Primary Current

Psophometer

Measures Psophometric Current
A. TEST SET-UP

Each traction motor current, the DC filter voltage, and locomotive speed were recorded on the Gould 8 channel brush recorder. These signals were taken from test points on the front of the electronic control cards.

B. TEST RESULTS

Figure 3.1 shows the published tractive effort/speed curve, 41H141280, with the four data points at 10, 20, 30, and 40 MPH plotted. The function generator card which puts out the traction motor current reference to the choppers was designed to have a steeper slope in the 0-20 MPH range which results in the currents at 10 and 20 MPH being slightly less than the motor capability.

C. FIGURE 3.2-MOTORING AND DYNAMIC BRAKING DATA

This chart shows the data taken from the brush recorder charts. Each run was at a specified speed and each of the six traction motor currents were shown with the average of those six currents and the resulting tractive effort or braking effort for the dynamic braking runs.
D. **FIGURE 3.3-NOTCH 8 ACCELERATION FROM STOP**

Typical N8 run from standstill. Note axle 4 wheelslips.

E. **FIGURE 3.4-TWO N8 ACCELERATION RUNS**

F. **FIGURE 3.5-RUNS 6 AND 7 - 10 MPH MOTORING**

Note some wheelslip activity and 300V volts peak to peak ripple on the filter voltage. This 10 Hz ripple is caused by the resonant frequency of the line filter reactors and filter capacitors and is most noticeable at the higher chopper current ranges.

G. **FIGURE 3.6-RUN 3 - 20 MPH MOTORING**

Note much wheelslip activity up to about 15 MPH

H. **FIGURE 3.7-RUN 1 - 30 MPH MOTORING**

I. **FIGURE 3.8-RUN 2 - 40 MPH MOTORING**

J. **FIGURE 3.9-RUN 4 - 40 MPH MOTORING**
K. FIGURE 3.10-RUNS 13 AND 14 - 10 MPH MOTORING WITH POWER FACTOR CORRECTION FILTERS CONNECTED

This set of runs was made with the power factor correction filters connected across the two traction windings of the main transformer.

L. FIGURE 3.11-RUNS 10 AND 11 - 20 MPH MOTORING WITH POWER FACTOR CORRECTION FILTERS CONNECTED

M. FIGURE 3.12-RUNS 8 AND 9 - 30 MPH MOTORING WITH POWER FACTOR CORRECTION FILTERS CONNECTED

N. FIGURE 3.13-RUNS 15 AND 12 - 40 MPH MOTORING WITH POWER FACTOR CORRECTION FILTERS CONNECTED
FIGURE 3.1 - TRACTIVE EFFORT VS SPEED CURVE

Preliminary Speed-Tractive Effort Curve
Straight Electric Chopper Locomotive
Equipment:
6 - 1400VDC Choppers
6 - EX63A1 Smoothing Reactors
6 - GE-752 AF Motors
83/20 Gear Ratio
40 in. wheel dia.

General Electric Co. (RY)
R. G. McGrath

REV 0 4/2/79

80,000 70,000 60,000 50,000 40,000 30,000 20,000 10,000
TRACTIVE EFFORT - POUNDS

130,000 120,000 110,000 100,000 90,000

SPEED MPH

41H41280
<table>
<thead>
<tr>
<th>RUN</th>
<th>SPEED (MPH)</th>
<th>TRACTION MOTOR CURRENT (AMP)</th>
<th>MAGTRON READINGS</th>
<th>PSOPHOMETER (MV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>1: 880 2: 830 3: 870 4: 910 5: 860 6: 940</td>
<td>3: 392</td>
<td>I(AMPS) 102.4 124.87 0.867 3.6</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>1: 790 2: 730 3: 770 4: 810 5: 760 6: 800</td>
<td>3: 397</td>
<td>I(AMPS) 101 118.2 0.868 3.6</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>1: 1200 2: 1120 3: 1240 4: 1220 5: 1270 6: 1218</td>
<td>3: 92.1K</td>
<td>I(AMPS) 101.4 131.5 0.857 3.6</td>
</tr>
<tr>
<td>5</td>
<td>RUN NO GOOD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>1: 910 2: 870 3: 390 4: 140 5: 140 6: 140 7: 140</td>
<td>3: 111.0K</td>
<td>I(AMPS) 103.2 88.2 0.860 2.9</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>1: 1390 2: 1330 3: 1330 4: 140 5: 140 6: 140 7: 140</td>
<td>3: 110.5K</td>
<td>I(AMPS) 103.4 89.25 0.851 2.9</td>
</tr>
<tr>
<td>8</td>
<td>30</td>
<td>1: 920 2: 900 3: 910 4: 940 5: 940 6: 940</td>
<td>3: 925</td>
<td>I(AMPS) 103.5 131.25 0.912 3.5</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
<td>1: 920 2: 900 3: 910 4: 940 5: 940 6: 940</td>
<td>3: 917</td>
<td>I(AMPS) 103.3 127.25 0.918 3.5</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>1: 1200 2: 1170 3: 1150 4: 1200 5: 1200 6: 1200</td>
<td>3: 91.8K</td>
<td>I(AMPS) 102.3 133.5 0.911 3.5</td>
</tr>
<tr>
<td>11</td>
<td>RUN NO GOOD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>1: 720 2: 720 3: 710 4: 730 5: 660 6: 740 7: 73</td>
<td>3: 46.0K</td>
<td>I(AMPS) 103.4 123.0 0.915 3.5</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>1: 1400 2: 1360 3: 1360 4: 1400 5: 1400 6: 1400</td>
<td>3: 104.8K</td>
<td>I(AMPS) 104.6 40.2 0.929 2.5</td>
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<tr>
<td>14</td>
<td>10</td>
<td>1: 1370 2: 1330 3: 1330 4: 1370 5: 1370 6: 1370</td>
<td>3: 110.5K</td>
<td>I(AMPS) 104.6 91.5 0.927 2.2</td>
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<td>15</td>
<td>40</td>
<td>1: 720 2: 720 3: 720 4: 720 5: 720 6: 720</td>
<td>3: 46.4K</td>
<td>I(AMPS) 103.6 126.6 0.915 3.5</td>
</tr>
</tbody>
</table>

**Note:** The table continues with more data rows but is not shown here. This table is used for analyzing motor and dynamic braking data.
TEN SECONDS

LOCOMOTIVE SPEED (MPH)  FILTER VOLTS  MOTOR #6 AMPS  MOTOR #5 AMPS

0 0 0 0 0 0 1200 1600 2000
600 800 400 0

TEN SECONDS
Figure 3.3 - Notch 8 Acceleration From Stop
TEN SECONDS

Locomotive Filter Volts Motor #6 Amps Motor #6 Amps
FIGURE 3.13 - RUNS 15 AND 12 - 40 MPH MOTORING WITH POWER FACTOR CORRECTION - FILTERS CONNECTED
SECTION 4
DYNAMIC BRAKING PERFORMANCE

A. TEST SET-UP

Test set-up was the same as for the motoring test.

B. TEST RESULTS

Figure 4.1 show the published braking effort vs speed curve, 41H105988, with the four data points at 10, 20, 30, and 40 MPH plotted.

C. FIGURE 4.2-RUNS 16, 17, 19, AND 19 - DYNAMIC BRAKING FROM 10-40 MPH

Note that the filter voltage is maintained at a minimum of 800 volts by the phase controlled bridges as this is the minimum at which the choppers will work. As motor current increases, the filter voltage increase above 800 and the bridges phase off. As motor current varies, the filter voltage varies and is controlled between 1100 and 1700 by two steps of braking grid resistance.

D. FIGURE 4.3-RUNS 20, 21, 22, AND 24 - DYNAMIC BRAKING FOR 10, 20, 30, AND 40 MPH
FIGURE 4.1 - BRAKING EFFORT VS SPEED CURVE

E44/E60 CHOPPER LOCOMOTIVE
DOT-FR-9027
BRAKING EFFORT VS SPEED
(6) 5GE 752AF MOTORS
83/20 CR 40" W.D.
3-26-79 H.H. HENNELL

BRAKING EFFORT
POUNDS
70000

MIN. BRAKING EFFORT

MPH
0 10 20 30 40 50 60
SECTION 5
WHEELSLIP EVALUATION

A. TEST SET-UP

Since much of the Chopper Locomotive testing was done during inclement weather, the wheelslip system got a thorough workout without having to manually wet the rails. As mentioned earlier, each of the six choppers is individually controlled such that when any axle slips or slides, only that particular motor current is reduced until the slip or slide is corrected.

B. FIGURES 5.1 AND 5.2 - WHEELSLIP - INDIVIDUAL AXLE CONTROL OF THE SIX TRACTION MOTOR CURRENTS

These two figures show the six traction motor currents randomly being reduced due to a wheelslip on that axle. The small ripple in the current signal is due to the 10 Hz ripple on the filter voltage.

C. FIGURES 5.3 AND 5.4 - WHEELSLIP - INDIVIDUAL AXLE CONTROL OF AXLES 1 AND 4

These two figures show axle speed, chopper reference voltage, and motor current for axles 1 and 4. As can be seen, a small increase in axle
speed causes a reference reduction for that chopper which in turn reduces the traction motor current until the slip is corrected.

D. FIGURE 5.5 - WHEELSLIP - SIX AXLE VELOCITIES

Figure 5.5 shows the six axle velocities, filter volts, and the auto sand signal. The small bumps in the velocity traces show where the wheel started to slip and how it was corrected. The bottom trace is the auto sand signal which provides 5 seconds of sanding any time any axle reaches the first level of detection.
FIGURE 5.1  - WHEELSLIP - INDIVIDUAL AXLE CONTROL OF THE SIX TRACTION MOTOR CURRENTS

ACCUCHART  Gould Inc., Instrument Systems Division  Cleveland, Ohio  Printed in U.S.A.

MOTOR 1 AMPs

MOTOR 2 AMPs

MOTOR 3 AMPs

MOTOR 4 AMPs

MOTOR 5 AMPs

MOTOR 6 AMPs

FILTER VOLTS

LOGO: TRlETED SECURITY

ONE SECOND
FIGURE 5.2  - WHEELSLIP - INDIVIDUAL AXLE CONTROL OF THE SIX TRACTION MOTOR CURRENTS
A. GENERAL

Locomotive power factor was read directly from the Magtrol Power Analyzer during the motoring runs covered in Section 3. This instrument gives total power factor, i.e., the displacement power factor (which measures how much the fundamental current waveshape is displaced from the fundamental voltage waveshape) multiplied by the distortion power factor (which measures how much harmonic current there is to "distort" the fundamental current).

B. FIGURE 6.1 - POWER FACTOR VS SPEED CURVE

Figure 6.1 shows the power factor data plotted on the published power factor curve, 41H119318, both with and without the power factor correcting filter connected. Power factor was slightly better than was predicted by the computer runs.
Locomotive efficiency is defined as the output power at the rail divided by the input power at the catenary. The output power was found by measuring the traction motor currents (to get tractive effort) and locomotive speed. The input power was found by reading the watts from the Power Factor/Wattmeter and using the correct multiplication factors to account for the location of the meter.

\[
\text{Locomotive Efficiency} = \frac{\text{Output Power}}{\text{Input Power}}
\]

where Output Power (KW) = \(\text{Ttractive Effort (Lbs) \times \text{Speed (mph)}} \times 0.746\),

\[
\frac{375}{375}
\]

Input Power (KW) = Wattmeter Reading \(*

\[
\frac{160}{1} \times 25,000 \times \frac{25,000}{104.2} \times \frac{1}{1000}
\]
B. **FIGURE 7.1 - EFFICIENCY VS SPEED CURVE**

Figure 7.1 shows the efficiency data plotted on the published efficiency vs speed curve, 41H115682, both with and without the power factor correction filter connected. Locomotive losses were more than calculated so the efficiency was not as good as expected.
FIGURE 7.1 - EFFICIENCY VS SPEED CURVE

- F60 CHOPPER, CONTRACT DOT-FR-9027
- 11KV, 25 Hz Power Supply of 0.5 Ohms
- 25KV, 60Hz Power Supply of 1.2 Ohms
- Includes 400KW Auxiliary Load

- With Power Factor Filter
- Without Power Factor Filter

GENERAL ELECTRIC COMPANY

Re-drawn 4/25/94 RJH

SPEED (MPH)
A. GENERAL

The psophometric current is an RMS number that is the result of taking the square root of the sum of the squares of each harmonic current multiplied by the weighing factor at that frequency. It was found using the Psophometer and the non-inductive resistor shunt shown in Fig. 2.1. The shunt was a 0.0002485 Ohm resistor connected in the primary winding of the main power transformer. The voltage across the shunt was fed to the Psophometer which internally applied the required frequency weighting curve to it and displayed the resulting voltage on the scale on the front of the meter. When this voltage is divided by the resistance of the shunt the result is the psophometric current number.

B. FIGURE 8.1 - PSOPHOMETRIC CURRENT VS SPEED CURVE

Figure 8.1 shows the psophometric current data plotted on curve 41H106104. Existing computer data for 10 MPH could not be found, but for 20-40 MPH the resulting psophometric current was 1-2 amps better than expected.
FIGURE 8.1 - PSOPHOMETRIC CURRENT VS SPEED CURVE

PSOPHOMETRIC CURRENT VS SPEED
CHOPPER-LOCOMOTIVE
DOT-ER-8027
ZERO OHMS IMPEDANCE

SPEED - MPH
A. **GENERAL**

The original schedule called for six round trips from the South Kearny Yard in Newark, N. J. to the Potomac Yard in Washington D.C., but for not more than a total elapsed time of two weeks. Because of problems with the track in the South Kearny Yard, downed catenary due to an ice storm, and scheduling of FRA observers, only two round trips were completed.

The Chopper Locomotive was to be tested as part of one of the trailer van (TV) trains that Conrail operates on a daily basis over Amtrak's Northeast Corridor tracks. This run is about 240 miles one way with about 200 miles under energized catenary at 11 KV, 25 Hz.

B. **TEST CONSIST**

The Chopper Locomotive was placed at the head end of the consist and MU’d with the two GP38-2 diesel electric locomotives which normally pull this train. The diesels were used to pull the train in and out of the yards and over the High Line in Philadelphia which is not energized. Once under the catenary on the main line, the Chopper was energized and the
two diesels isolated. This procedure worked well and could be done without stopping the train.

A two channel brush recorder was used to monitor the D.C. filter voltage and traction motor #5 current. Instrumentation was not available to record any other data.

C. **RUN 1 - NEWARK TO WASHINGTON**

This first run was made with TV23 on 3/7/84 leaving South Kearny at about 9:00 PM. TV23 included units 8071 and 8072 and 27 cars with a total weight of 2450 tons. As the consist was leaving the yard, two wheels of the Chopper Locomotive and one wheel of the first diesel unit derailed on a sharp curve. After the locomotives were re-railed, TV23 departed at 11:35 PM. Riders included:

- John Marchetti - FRA (only to Philadelphia)
- Henry Liban - Conrail
- Tad Mahoney - Conrail
- William Faulhaver - Conrail
- Ronald Griebel - GE
- Robert Hopkins - GE
Figure 9-1 shows a typical sweep of the throttle from IDLE to N8 at about 45 MPH and Figure 9.2 shows two motoring/dynamic braking cycles taken during the first run.

The Chopper Locomotive ran very well with only the following minor problems:

1. The crowbar overvoltage protection circuit activated twice - probably on noise spikes.

2. The axle 5 wheelslip indication light flickered a few times for no apparent reason.

3. The "no battery charge" light flickered for about a minute while the train was stopped to check out a hot axle box indication.

4. The electric cab heat was inadequate so the feed from the auxiliary transformer was changed to provide an additional 30 VAC to the heaters. This additional load may have been a contributing cause for the blowing of the auxiliary transformer fuse on the return trip.

Arrived at Potomac Yard at 6:30 AM.
D. RUN 2 - WASHINGTON TO NEWARK

Prior to departing on the return trip 3/8/84, the crowbar setting was changed from 2060 to 2200 volts to de-sensitize it. Also, because of a complaint from the engineer on the first run, the independent brake pressure switch was disconnected to permit the application of traction power with the independent brake on.

TV24 with the Chopper, units 8071 and 8072, and 27 cars with a total weight of 2016 tons left the Potomac Yard at 10:50 PM. Riders included:

* Henry Liban - Conrail
  Tad Mahoney - Conrail
* Ronald Griebel - GE
* Robert Hopkins - GE

* Left train in Philadelphia

A snowstorm caused so many delays that at 7:00 AM, TV24 was still in Philadelphia. The train crew had to leave and another crew did not arrive until about 1:00 PM to take TV24 to Newark.

The Chopper Locomotive ran well and only had two minor problems.

1. One crowbar activation.
2. The auxiliary transformer fuse (70A) blew near Baltimore. A spare fuse was not available so the feed to the transformer was tied temporarily to the blower fuse for the remainder of the trip.

Figure 9.3 shows a typical motoring sequence and Figure 9.4 shows a motoring/dynamic braking cycle during Run 2.

E. RUN 3 - NEWARK TO WASHINGTON

This trip was to commence on 3/21/84 but was cancelled when the Chopper Locomotive again derailed on the same curve leaving the South Kearny Yard.

On 3/13/84, a 100A fuse was installed for the auxiliary transformer (replaced the 70A fuse which blew during Run 2), and some additional filtering was added to the crowbar detection circuit. At 7:30 PM, this trip was cancelled due to an ice storm which damaged some catenary.

Run 3 finally commenced on 3/14/84 at 9:10 PM with units 8071 and 8072 and a train weight of 2325 tons. Riders included:

- John Stephenson - L.T. Klauder (FRA)
- Chip Savoye - Conrail
- Robert Hopkins - GE
When the Chopper Locomotive was energized on the main line, the air operated power contactors would not close. About one hour later when the train was stopped for a signal, it was discovered that someone closed the control air cut out cock in the compressor cab, thus no control air pressure was available for the air operated contactors. The cut out cock was opened and the Chopper Locomotive completed the trip to Washington. The Chopper worked well with the only problem occurring in the wheelslip panel with false wheelslip indications a couple of times.

Figure 9.5 shows a motoring trace with some wheelslips occurring between N6 and N7. Figure 9.6 shows another motoring/dynamic braking cycle.

TV23 arrived at Potomac Yard at 6:30 AM.

F. RUN 4 - WASHINGTON TO NEWARK

TV24 which included a GP38 (7854) and a U23B (2553) locomotive with a train weight of 1858 tons left Washington at 8:45 PM on 3/15/84. Riders included:

Cliff Gannett - FRA (only to Baltimore)
Gordon Stevens - FRA
Claude Dickson - Conrail (only to Baltimore)
Chip Savoye - Conrail
Henry Liban - Conrail
Robert Hopkins - GE
When the Chopper was energized on the main line, the power contactors would not pick up. The problem was traced to an open interlock in the vacuum breaker which was by-passed with a jumper to correct the problem.

The Chopper ran well to Philadelphia where a "power circuit ground" indication occurred which could not be cleared up with any of the traction motor cut-out switches. The Chopper was isolated for the remainder of the trip.

One other problem occurred in the wheelslip panel which prevented the Chopper from starting the train. It is theorized that with the brakes on, the locomotive was moving so slowly that individual pulses from the traction motor speed sensors looked like wheelslips to the detection circuits. One of the diesels was cut in to get the train moving which corrected the problem.

TV24 arrived in Newark at 6:00 AM.
FIGURE 9.1 - RUN 1 - MOTORING

FIGURE 9.2 - RUN 1 - MOTORING/DYNAMIC BRAKING CYCLES

FIGURE 9.3 - RUN 2 - MOTORING
Chopper Locomotive Demonstration Program, Phase II, 1984
US DOT, FRA, Robert Hopkins