Volume 3

INSTRUCTION MANUAL

FOR

APPLYING THE TOM

TO

TRANSIT SYSTEMS

DC ELECTRIC - METRIC UNITS

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Preface

This document is part of a series of instruction manuals, which can be used as guidelines for applying the Train Operations Model (TOM) to rail systems throughout the world. In this connotation, rail system definition includes main line railroads, heavy and light rail, trolleybuses, high-speed rail and MAGLEV and people movers.

There are several manuals in the series:

Volume 1 – An Introduction to the Instruction Manual for Applying the TOM  
Volume 2 – Instruction Manual for Applying the TOM to Transit Systems DC Electric – English Units  
Volume 3 – Instruction Manual for Applying the TOM to Transit Systems DC Electric – Metric Units  
Volume 4 – Instruction Manual for Applying the TOM to Transit Systems AC Electric – English Units  
Volume 5 – Instruction Manual for Applying the TOM to Transit Systems AC Electric – Metric Units  
Volume 6 – Instruction Manual for Applying the TOM to Railroads Fueled – English Units  
Volume 7 – Instruction Manual for Applying the TOM to Railroads Fueled – Metric Units  
Volume 8 – Instruction Manual for Applying the TOM to Rail Systems; Technology Aspects  
Volume 9 – Instruction Manual for Procedures and Shortcuts in the TOM

Volumes 2-7 cover nearly all transit systems and railroads in the world.

This instruction manual is Volume 3.

These volumes are unprotected. Thus the user is free to make notes or rewrite sections according to his preferences.

The primary purpose for using the TOM is evaluation. The evaluation generally takes the form of a study, with certain objectives, which may or may not be well defined. As the study is conducted, new objectives may result, because of unanticipated results. Within the framework of evaluation, designs may be modified and further evaluated, so that in this sense, the TOM may be considered a design tool.

The TOM is used together with other standard software, such as Microsoft Office (in particular, WORD, EXCEL and POWERPOINT). This combined package is most effective in assembling client data as well as presenting results. In some instances, the TOM interacts directly with these office programs, while in other cases; the user handles the office packages directly.
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The **DCEM** Rail Transit System is a fabricated rail transit system, which has been designed to contain most of the features of a real transit system. The purpose of this document is to guide the user to apply the Train Operations Model (**TOM**) to this transit system in order to familiarize the user with the techniques of this application. Having gone through this exercise, the user can then apply the **TOM** to similar real systems.

The Mnemonic **DCEM** represents **DC Electric – Metric units**, which means that the rail transit system uses DC electricity, which is converted from AC in substations and distributed via a third rail, overhead trolley or overhead catenary to the trains running on the system, the return path of the current being the running rails and the earth or a separate return, such as is the case with a trolley bus. Metric units are used to describe the system, rather than English units, which are in favor in United States. This situation is valid for most of the Rail Transit Authorities in the World, except for the United States, including heavy and light rail systems.

This document can be used as a guideline for applying the **TOM** to most of the Transit Authorities of the World, except for the United States.
The evaluation process begins with the client’s requirements statement. The second step is to describe the rail system in a format appropriate for input for the TOM. The third step is to cast the requirements statement into a format for application of the TOM to the rail transit system. The remaining steps consist of using the TOM to satisfy the requirements of the client.

This volume has four parts. Each of the parts corresponds to the steps in the evaluation process.

The first part (Chapter 2) presents the requirements of the client. These requirements are generally presented as his desired objectives. In the case of this instruction manual, these objectives were selected to use most of the features of the TOM, so that the user may have guidelines for further applications for his clients.

The second part (Chapter 3) contains a description of the rail transit system in technical terms, which are closely compatible with the kind of inputs required by the TOM. The inputs have already been through one condensation in the sense that a lot of work gathering and assembling raw data has already been done by the user. These data have already been assembled into tables, which can be used as references for input into the TOM. When working on a real rail transit system, the user should produce a document in the format of Chapter 3, which can then be similarly used as guidance for input to the TOM.

The third part (Chapter 4) contains the Exercises, which can be viewed as the expanded steps leading to the specification of what the client wants in terms of the application of the TOM. The process begins with the specification of what is to be accomplished. The chapter then continues listing the steps needed using the TOM to accomplish the goals of the client.

Finally the fourth part, consisting of the remaining chapters, shows how the TOM is applied using the data of the transit system to satisfying the clients request as specified in the exercises. In contrast to the Exercises chapter, which provides a listing of the work to be done, these chapters actually provide a step-by-step accomplishment of the work.

2. CLIENT REQUIREMENTS

The Client, the DCEM Transit Authority, operates an electrified rail transit system between the areas of Rock Garden on its eastern extremity to the areas of Noel in the southwest and Fenton Harbor in the northwest. The system is double tracked and as it proceeds east from the Rock Garden area, it splits into a Y at Lazy Junction, one set of double tracks proceeding to the Fenton Harbor area while the other set to the Noel area. Trains are now operated manually using a fixed block signaling system.

The Client has asked that a study be done to accomplish several objectives.

The present fleet of 63 CAM (resistor control) Cars is old and after thorough inspection, it was found only 14 of these cars could be fit for service in 3 years, the time it would take to procure new cars. In order to reduce the cost of the procurement, and a study done previously indicated that once the procured cars were on the property, there would be a new method of operation. The procurement would consist of 28 CHO (DC solid state chopper control) Cars and 21 Trailer (no propulsion power) Cars. Thus together with the 14 remaining CAM Cars, future operation would include a fleet of 63 cars. The basic unit for passenger service would be a triplet, which includes one trailer car coupled with two powered cars.

It has also been determined that the energy costs for operating the system will exceed the budget this year. This condition is expected to grow worse in the following years. It has been suggested that applying coasting to train operation could reduce the energy cost to bring it within budget. Coasting is a strategy where the trains operate in a no power, no brake condition during inter-station runs. The Client wants to estimate the energy savings using the coasting strategy in present operations. In the study, which led to the specification of the car purchase, it was stated that energy savings would be realized as a consequence of the operation of the future fleet of cars. The Client wishes to quantify this energy savings through simulation. He also wishes guidance on whether or not to include coasting once the new operation has begun.

At some point in the near future, the Client would like to install an automatic train control system, either fixed block or moving block (communications based). Installation of this system would anticipate expansion of ridership and the addition of
more trains to the operation. As a result, it would be necessary to evaluate the power system to determine if future changes would be required and what type of changes might be appropriate.

3. DESCRIPTION OF THE RAIL TRANSIT SYSTEM

Certain kinds of data are required to describe the rail transit system for TOM application. These data are divided into several general categories:

- Train File Data
- Right of Way files Data
- Electrical Distribution Data
- Operational Timetable Data
- Basic System Data

Each of these is described in the following sections.

3.1. TRAIN FILE DATA

The group Train File Data is further divided to include:

- Train Consists
- Train Resistance Information
- Car Physical Characteristics
- Car Propulsion Characteristics

This kind of information is used to create the train files, which are input files to the Train Performance Simulator (TPS).

3.1.1. TRAIN CONSISTS

The Train Consists are described by the types of cars in the fleet, which is used for service and how these cars are used in trains. A train is a “consist” of one or more cars.

3.1.1.1. Types of Cars in Fleet

There will be three types of cars in the transit fleet:

- Type 1 - Self-propelled using DC Series motors with Cam Control (CAM Cars)
- Type 2 - Self-propelled using DC Series motors with Chopper Control (CHO Cars)
- Type 3 - Trailer cars with no propulsion unit (Trailers)

Under present day operation, only Type 1 and Type 2 cars are available for service.

3.1.1.2. Train Types

Under present day operation, there are two types of trains: 1.) 3 cars of Type 1 and 2.) 6 cars of Type 2.

In future operation, the trains are made up into basic units of three cars:

- CAM Car – Trailer – CAM Car = CAM Car Unit
- CHO Car – Trailer – CHO Car = CHO Car Unit

The trains to be used for service are 1 or 2 units depending on the time of day. During the peak periods, 2 units or six car trains are used, while during off peak periods, 1 unit or 3 car trains are used.
3.1.2. TRAIN RESISTANCE INFORMATION

3.1.2.1. Train Resistance Formula

For present day operation the Davis Formula is to be used for train resistance information.

For future operation, the Davis Formula is to be used for the CAM Car Units and the Coefficient Method is to be used for the CHO Car Units.
3.1.2.2. Davis Formula Parameters

The input requirements appropriate for Train Resistance for the CAM Car Units on a per car basis including the trailers in future operation for the Davis Formula are:

<table>
<thead>
<tr>
<th>Davis Equation Parameters</th>
<th>1 Unit</th>
<th>2 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cars Per Train</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Number of Axles per Car</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Flange Coefficient (nt/tonne/kph)</td>
<td>0.2163</td>
<td>0.2163</td>
</tr>
<tr>
<td>Train Frontal Area (m²)</td>
<td>7.8996</td>
<td>7.8996</td>
</tr>
<tr>
<td>Front Car Aerodynamic Coefficient (nt/m²/kph²)</td>
<td>0.04435</td>
<td>0.04435</td>
</tr>
<tr>
<td>Trail Car Aerodynamic Coefficient (nt/m²/kph²)</td>
<td>0.00628</td>
<td>0.00628</td>
</tr>
</tbody>
</table>
3.1.2.3. Coefficient Method Parameters

The input requirements appropriate for Train Resistance for the CHO Car Units on a per car basis including the trailers in future operation:

<table>
<thead>
<tr>
<th>Coefficient Method Parameters</th>
<th>1 Unit</th>
<th>2 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cars per Train</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Constant Coefficient (C1)(nt)</td>
<td>516.0</td>
<td>516.0</td>
</tr>
<tr>
<td>Weight Dependent Coefficient (C2)(nt/tonne)</td>
<td>6.374</td>
<td>6.374</td>
</tr>
<tr>
<td>Speed Dependent Coefficient (C3)(nt/kph)</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Speed &amp; Weight Dependent Coefficient (C4)(nt/tonne/kph)</td>
<td>0.659</td>
<td>0.659</td>
</tr>
<tr>
<td>Aerodynamic Coefficient (C5) (nt/kph²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front Car</td>
<td>0.6018</td>
<td>0.6018</td>
</tr>
<tr>
<td>Trail Cars</td>
<td>0.0852</td>
<td>0.0852</td>
</tr>
</tbody>
</table>
3.1.3. CAR PHYSICAL CHARACTERISTICS

The car physical characteristics are outlined below for each type car:

<table>
<thead>
<tr>
<th>Parameter / Type Car</th>
<th>CAM Car</th>
<th>CHO Car</th>
<th>Trailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Weight (tonnes)</td>
<td>32.7</td>
<td>32.7</td>
<td>22.7</td>
</tr>
<tr>
<td>Number of Passengers at Crush Load (175 lbs/passenger)</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Full Weight (Crush Load) (tonnes)</td>
<td>50.2</td>
<td>50.2</td>
<td>40.2</td>
</tr>
<tr>
<td>Number of Seats</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Length (m)</td>
<td>12.7</td>
<td>12.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Auxiliary Power (kW)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>30</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Winter</td>
<td>40</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>Fall &amp; Spring</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Equivalent Rotational Weight (tonnes)</td>
<td>0.327</td>
<td>0.327</td>
<td>0.091</td>
</tr>
<tr>
<td>Wheel Diameter (m)</td>
<td>0.711</td>
<td>0.711</td>
<td>n/a</td>
</tr>
<tr>
<td>Gear Ratio</td>
<td>5.414</td>
<td>5.414</td>
<td>n/a</td>
</tr>
</tbody>
</table>
3.1.4. CAR PROPULSION SYSTEMS
The characteristics of the car propulsion systems for the two type cars were provided in different formats. In the case of the CAM Car, tractive effort vs. speed curves and efficiency curves were provided. In the case of the CHO Car, more detailed information on the motor and control system was provided.

3.1.4.1. Type Self-Propelled CAM Control (Input)

3.1.4.1.1. Tractive Effort vs. Speed Curve
The Tractive Effort Vs. Speed Curve is:

<table>
<thead>
<tr>
<th>Speed</th>
<th>TE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>72163</td>
</tr>
<tr>
<td>5</td>
<td>72163</td>
</tr>
<tr>
<td>10</td>
<td>72163</td>
</tr>
<tr>
<td>15</td>
<td>72163</td>
</tr>
<tr>
<td>20</td>
<td>72163</td>
</tr>
<tr>
<td>25</td>
<td>72163</td>
</tr>
<tr>
<td>30</td>
<td>72163</td>
</tr>
<tr>
<td>35</td>
<td>72163</td>
</tr>
<tr>
<td>40</td>
<td>72163</td>
</tr>
<tr>
<td>45</td>
<td>68398</td>
</tr>
<tr>
<td>50</td>
<td>59300</td>
</tr>
<tr>
<td>55</td>
<td>40383</td>
</tr>
<tr>
<td>60</td>
<td>31063</td>
</tr>
<tr>
<td>65</td>
<td>25455</td>
</tr>
<tr>
<td>70</td>
<td>21572</td>
</tr>
<tr>
<td>75</td>
<td>18323</td>
</tr>
<tr>
<td>80</td>
<td>15670</td>
</tr>
<tr>
<td>85</td>
<td>13650</td>
</tr>
<tr>
<td>90</td>
<td>11859</td>
</tr>
<tr>
<td>95</td>
<td>10452</td>
</tr>
<tr>
<td>100</td>
<td>9245</td>
</tr>
<tr>
<td>105</td>
<td>8147</td>
</tr>
<tr>
<td>110</td>
<td>7274</td>
</tr>
<tr>
<td>115</td>
<td>6448</td>
</tr>
<tr>
<td>120</td>
<td>5677</td>
</tr>
</tbody>
</table>

3.1.4.1.2. Efficiency Curves as functions of Tractive Effort & Speed
The manufacturer of the propulsion system provided the efficiency curve. It is provided as a function of speed and fraction of maximum tractive effort at the speed.
### 3.1.4.1.3. Braking Effort vs. Speed Curve

The braking curve is such as to give a deceleration rate of 1.34 mphps on level track for crush load.

### 3.1.4.2. Type Chopper Control (Model)

The supplier of the propulsion system has indicated the following specifications.

#### 3.1.4.2.1. Voltage Specifications

Nominal Line Voltage - 750-v dc  
Maximum Line Voltage – 825-v dc  
Minimum Line Voltage – 562.5-v dc

#### 3.1.4.2.2. Motor Type & Specification

The motor specified is as follows:
- 4 Motors per Car  
- DC Series Type Westinghouse 1462 (WE 1462) with field shunting  
- Power Mode Sequence: 2s/2p 100% field, 2s/2p 70% field  
- Electrical Braking Mode Sequence: 2s/2p 100% field

#### 3.1.4.2.3. Control Type & Specification

The control characteristics are shown below:

#### Chopper Control Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Controls/Car</td>
<td>1</td>
</tr>
<tr>
<td>Line Reactor Resistance</td>
<td>2.350</td>
</tr>
<tr>
<td>Motor Reactor Resistance</td>
<td>18.400</td>
</tr>
<tr>
<td>Filter Capacitor Resistance</td>
<td>7.800</td>
</tr>
<tr>
<td>Main Semiconductor Forward Drop (volts)</td>
<td>2.000</td>
</tr>
<tr>
<td>Diode Forward Drop (volts)</td>
<td>1.500</td>
</tr>
<tr>
<td>Constant Losses (watts)</td>
<td>300.000</td>
</tr>
<tr>
<td>Ratio Commutation Time to Period</td>
<td>0.010</td>
</tr>
</tbody>
</table>

The units would be capable of regenerating braking energy. The tractive effort vs. speed curve can be modified using the on board computer software to match that of a CAM car.
3.2. RIGHT OF WAY FILES DATA

3.2.1. RAIL SYSTEM LAYOUT

The rail system layout is shown below:

![Diagram of the rail system layout]

**NOTE:** Grade Values in %

*Speed Restrictions in kph*
3.2.2. PASSENGER STATION INFORMATION

3.2.2.1. Passenger Load Factors

The passenger counts are given below:

<table>
<thead>
<tr>
<th>From Station</th>
<th>To Station</th>
<th>AM Peak</th>
<th>Mid Day</th>
<th>PM Peak</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden</td>
<td>Marion Place</td>
<td>635</td>
<td>120</td>
<td>32</td>
<td>60</td>
</tr>
<tr>
<td>Marion Place</td>
<td>Vernor Avenue</td>
<td>1035</td>
<td>430</td>
<td>115</td>
<td>200</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Wright Landing</td>
<td>342</td>
<td>62</td>
<td>1301</td>
<td>31</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>Noel End</td>
<td>22</td>
<td>145</td>
<td>837</td>
<td>70</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Dillard Dock</td>
<td>140</td>
<td>345</td>
<td>993</td>
<td>165</td>
</tr>
<tr>
<td>Dillard Dock</td>
<td>Fenton Harbor</td>
<td>53</td>
<td>120</td>
<td>484</td>
<td>55</td>
</tr>
<tr>
<td>Marion Place</td>
<td>Rock Garden</td>
<td>35</td>
<td>112</td>
<td>623</td>
<td>52</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Marion Place</td>
<td>120</td>
<td>285</td>
<td>1022</td>
<td>145</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>Vernor Avenue</td>
<td>1224</td>
<td>390</td>
<td>329</td>
<td>200</td>
</tr>
<tr>
<td>Noel End</td>
<td>Wright Landing</td>
<td>846</td>
<td>110</td>
<td>34</td>
<td>56</td>
</tr>
<tr>
<td>Dillard Dock</td>
<td>Vernor Avenue</td>
<td>987</td>
<td>360</td>
<td>135</td>
<td>73</td>
</tr>
<tr>
<td>Fenton Harbor</td>
<td>Dillard Dock</td>
<td>478</td>
<td>132</td>
<td>49</td>
<td>21</td>
</tr>
</tbody>
</table>

3.2.2.2. Passenger Station Dwell Time

The dwell times are shown below:

<table>
<thead>
<tr>
<th>Station</th>
<th>Peak Dw Time (sec.)</th>
<th>Off Peak Dw Time (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marion Place</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Dillard Dock</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>
3.3. ELECTRICAL DISTRIBUTION SYSTEM DATA

3.3.1. NODAL DIAGRAM

[Diagram of the DCEM rail system nodal diagram with various symbols and track numbers labeled.]
3.3.2. SUBSTATIONS

All transformer-rectifier units are 12 pulse with a commutating to total reactance of 0.03. The open circuit AC voltage is 13.2 kV and the open circuit DC voltage is 750 v. The other data on the substations follow:

<table>
<thead>
<tr>
<th>Substation Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer-Rectifier</td>
</tr>
<tr>
<td>A1-D1</td>
</tr>
<tr>
<td>A2-D2</td>
</tr>
<tr>
<td>A3-D3</td>
</tr>
<tr>
<td>A4-D4</td>
</tr>
<tr>
<td>A5-D5</td>
</tr>
</tbody>
</table>

3.3.3. WAYSIDE ELECTRICAL COMPONENTS

The third rail in series with four parallel running rails is 0.31 ohms/km.

The resistances associated with the running rails are shown below.

<table>
<thead>
<tr>
<th>Running Rail Resistance Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Resistance (ohms/km)</td>
</tr>
<tr>
<td>Leakage Resistance (ohms)</td>
</tr>
<tr>
<td>Ground Resistance (ohms/km)</td>
</tr>
</tbody>
</table>

3.3.4. ELECTRIC UTILITIES

Westfield Illuminating Co. feeds the meters M1 and M2. Fenton Harbor Electric Co. feeds meters M3, M4 and M5. All service is at 13.2 kV. The demand interval is 30 minutes on the hour.

3.4. OPERATING TIMETABLE DATA

The information needed to construct the operating timetable is shown below:

<table>
<thead>
<tr>
<th>Operating Timetable Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
</tr>
<tr>
<td>AM Peak</td>
</tr>
<tr>
<td>AM Peak</td>
</tr>
<tr>
<td>Mid Day</td>
</tr>
<tr>
<td>Mid Day</td>
</tr>
<tr>
<td>PM Peak</td>
</tr>
<tr>
<td>PM Peak</td>
</tr>
<tr>
<td>Evening</td>
</tr>
<tr>
<td>Evening</td>
</tr>
</tbody>
</table>
Saturday, Sunday, or Holiday operation is from 8 AM – 12 PM and follows the Weekday Mid Day Operating Timetable.
3.5. BASIC SYSTEM DATA

Normal operation refers to today’s operation. There was an energy management study conducted by the transit authority. As a result of this study, it was suggested that coasting be implemented in an alternative method of operation.

3.5.1. NORMAL OPERATION

The basic system parameters are:

| Normal Operation | | |
|------------------|------------------|
| Parameter        | Value            |
| Normal Acceleration Rate (mpssq) | 1.12 |
| Maximum Acceleration Rate (mpssq) | None Set |
| Acceleration Jerk Limit (mpssqps) | 0.671 |
| Normal Brake Rate (mpssq) | 1.21 |
| Maximum Brake Rate (mpssq) | None Set |
| Brake Jerk Limit (mpssqps) | 0.581 |
| Head Wind Speed (kph) | None Set |

3.5.2. ALTERNATIVE OPERATION (COASTING)

Three types of coasting operation have been proposed. These are parameterized in the following:

<table>
<thead>
<tr>
<th>Coasting Operation</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Coasting</td>
<td>Sawtooth</td>
<td>Sawtooth</td>
<td>Anticipatory</td>
</tr>
<tr>
<td>Coast Speed (kph)</td>
<td>Speed Restriction</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Coast Speed Band (kph)</td>
<td>7</td>
<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>Coast Drag *</td>
<td>0.03</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* Fraction of Full Brake Effort
4. EXERCISES

4.1. DETERMINATION OF WORK

The Client, the DCEM Transit Authority, has a fleet of cars, which has been described in Section 3.1.1. The Client has asked that a study be done to accomplish several objectives. The present fleet of 63 CAM Cars is old and after thorough inspection, only 14 of these cars could be fit for service in 3 years, the time it would take to procure new cars. In order to reduce the cost of the procurement, and a study done previously indicated that once the procured cars were on the property, there would be a new method of operation. The procurement would consist of 28 CHO Cars and 21 Trailer Cars. Thus together with the 14 remaining CAM Cars, future operation would include a fleet of 63 cars.

Under present operation, nine 6-CAM Car trains are need for peak service. There is one spare 6-CAM Car train and three additional CAM Cars used as spares.

Under future operation, 20 Car Units will be available to operations:

CAM Car – Trailer – CAM Car = CAM Car Units (6)
CHO Car – Trailer – CHO Car = CHO Car Units (14)

For maximum energy savings benefit, all fourteen CHO Car Units would serve the peak periods together with four CAM Car Units. Three CAM Car Units would be spare. The off peak service would be served by five CHO Car Units.

The full details of this analysis are shown in the EXCEL spreadsheet file: DCEMWorkbookForInstructionManual.xls at labels [Schedule_Analysis__On_Peak], [Schedule_Analysis__Off_Peak] and [Car_Needs]. (To view the analyses, open the workbook and click the index tab. The labels are listed in alphabetical order. Click on the label to advance to the analysis.)

The Client has asked that the following work be done using the TOM.

Verify present operation
Determine energy savings with coasting in present operations.
Evaluate energy savings expected in future operation.
Enhance power distribution system capability
Design a train control system
Perform sensitivity analyses on scenarios to be defined later

Each of these work tasks is discussed further in the sections that follow.

4.1.1. VERIFICATION OF PRESENT OPERATION

The purpose of verifying present operation with the TOM is to determine the accuracy that the model can actually simulate the real operation of the system. Simulation mimics the average of how the system operates rather than any specific type of operation. This type of simulated operation is verified against real average operation, and is then used as the basis for evaluation of energy savings realized in coasting with present operation as well as future operation.

Verification of present operation consists of simulating weekly operation (weekday, Saturday and Sunday) under the present operating timetable. Three sets of simulations must be done because car auxiliaries operate differently in the summer, winter and spring & fall months. All three of these simulations can be carried out separately, so that only one set of file definitions need be handled at a time. These files can be archived and stored separately. With each of the archives, a readme.txt file will be included to describe the details of what is contained in the archive.
4.1.2. COASTING WITH PRESENT OPERATION

Coasting is a condition where trains operate part of the time in a station-to-station run in a condition of no power or no brake. Two coasting modes are available in the TOM. These modes are referred to as anticipatory coasting and sawtooth coasting.

Anticipatory coasting is when the train proceeds into a power off (no power/no brake) condition in anticipation of a lower speed restriction.

The second form of coasting is sawtooth coasting. In this case, the train will accelerate to the current speed command or restriction and then revert to a no power condition until its speed drops by a certain amount. Two options are available for sawtooth coasting.

In the first option, a coast speed is set and the train accelerates to this speed and then begins coasting until the speed drops a certain amount (termed the speed band), then it accelerates again to the coast speed, coasts again and so on, thus the term sawtooth coasting.

The second option of sawtooth coasting uses the speed restrictions or speed commands as the coast speed. The speed band has the same meaning as in the first option.

Evaluation of the coasting option can also be done using archives, rather than changing filenames. Again, three sets of simulations must be done because car auxiliaries operate differently in the summer, winter and spring & fall months. Since there are three types of coasting options to be evaluated, a total of nine archives will be required. Again, a readme.txt file will be made for each of the archives.

4.1.3. SIMULATION OF FUTURE OPERATIONS

Future operation is different from present operation because the transit authority has retired some of their CAM cars and purchased new CHO cars and trailer cars.

Simulation of future operation consists of simulating weekly operation (weekday, Saturday and Sunday) under a future operating timetable, which during the peak period contains a mixture of train types. Three sets of simulations must be done because car auxiliaries operate differently in the summer, winter and spring & fall months. All three of these simulations can be carried out separately, so that only one set of file definitions need be handled at a time. These files can be archived and stored separately. With each of the archives, a readme.txt file will be included to describe the details of what the archive represents.

4.1.4. COASTING WITH FUTURE OPERATION

Evaluation of the coasting option under future operation can also be done using archives, rather than changing filenames. Again, three sets of simulations must be done because car auxiliaries operate differently in the summer, winter and spring & fall months. Since there are three types of coasting options to be evaluated, a total of nine archives will be required. Again, a readme.txt file will be made for each of the archives.

4.1.5. POWER SYSTEM STUDY

Under present, normal operation, find the low voltage points in the power distribution system. Determine if the low voltage points are below traction minimum (open circuit voltage minus 25% of open circuit voltage). If there are voltages below minimum evaluate solutions for improving these including wayside energy storage.

Check to determine how future operation might improve these weak points. Since future operation involves trains which regenerate power, determine if energy storage can improve energy savings.

Monitor the current flowing from substation D3.
4.1.6. TRAIN CONTROL SYSTEM
Design and evaluate a train control system for the authority. The train control may be fixed block or moving block.

Using this train control system, assure that there are no conflicts for present normal operation.

4.1.7. SENSITIVITY ANALYSIS
Conduct a sensitivity analysis of the rail system.
### 4.2. TPS RUNS

#### 4.2.1. PRESENT OPERATION - NORMAL

The following train performance runs will be required.

<table>
<thead>
<tr>
<th>Present Operations TPS Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Run</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

**Definitions:**

- (+dir) = Positive Kilometerpost Direction
- (-dir) = Negative Kilometerpost
- a = AM Peak
- m = Mid Day
- r = Rock Garden
- p = PM Peak
- f = Fenton Harbor
- e = Evening
- n = Noel End
- For example: rfa = Rock Garden to Fenton Harbor AM Peak

#### 4.2.2. PRESENT OPERATION – COASTING

##### 4.2.2.1. Type 1 Coasting

The same train performance runs would be completed as in Section 4.2.1, except that the control file would be changed to reflect the Type 1 coasting.

##### 4.2.2.2. Type 2 Coasting

The same train performance runs would be completed as in Section 4.2.1, except that the control file would be changed to reflect the Type 2 coasting.
### 4.2.2.3. Type 3 Coasting

The same train performance runs would be completed as in Section 4.2.1, except that the control file would be changed to reflect the Type 3 coasting.

### 4.2.3. FUTURE OPERATION – NORMAL

For future operation, without coasting, the best energy savings would be to use the maximum number of **CHO Car Units** (3 cars) as possible during the off peak periods. This means that an all **CHO Car Unit** fleet would be used. During the on peak periods, **CAM Car Units** would be added. The TPS runs to be made are:

<table>
<thead>
<tr>
<th>Run</th>
<th>Time</th>
<th>Direction</th>
<th>Train</th>
<th>Station</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AM Peak (+dir)</td>
<td>6-car</td>
<td>rfa</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AM Peak (-dir)</td>
<td>6-car</td>
<td>fra</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AM Peak (+dir)</td>
<td>6-car</td>
<td>rna</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AM Peak (-dir)</td>
<td>6-car</td>
<td>nra</td>
<td>nr</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Mid Day (+dir)</td>
<td>3-car</td>
<td>rfm</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Mid Day (-dir)</td>
<td>3-car</td>
<td>frm</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mid Day (+dir)</td>
<td>3-car</td>
<td>rnm</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Mid Day (-dir)</td>
<td>3-car</td>
<td>nrm</td>
<td>nr</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>PM Peak (+dir)</td>
<td>6-car</td>
<td>rfp</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PM Peak (-dir)</td>
<td>6-car</td>
<td>frp</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>PM Peak (+dir)</td>
<td>6-car</td>
<td>rnp</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>PM Peak (-dir)</td>
<td>6-car</td>
<td>nrp</td>
<td>nr</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Evening (+dir)</td>
<td>3-car</td>
<td>rfe</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Evening (-dir)</td>
<td>3-car</td>
<td>fre</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Evening (+dir)</td>
<td>3-car</td>
<td>rne</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Evening (-dir)</td>
<td>3-car</td>
<td>nre</td>
<td>nr</td>
<td></td>
</tr>
</tbody>
</table>

**For CHO Car Units**

<table>
<thead>
<tr>
<th>Run</th>
<th>Time</th>
<th>Direction</th>
<th>Train</th>
<th>Station</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>AM Peak (+dir)</td>
<td>6-car</td>
<td>rfa</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>AM Peak (-dir)</td>
<td>6-car</td>
<td>fra</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>AM Peak (+dir)</td>
<td>6-car</td>
<td>rna</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>AM Peak (-dir)</td>
<td>6-car</td>
<td>nra</td>
<td>nr</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>PM Peak (+dir)</td>
<td>6-car</td>
<td>rfp</td>
<td>rf</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>PM Peak (-dir)</td>
<td>6-car</td>
<td>frp</td>
<td>fr</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>PM Peak (+dir)</td>
<td>6-car</td>
<td>rnp</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>PM Peak (-dir)</td>
<td>6-car</td>
<td>nrp</td>
<td>nr</td>
<td></td>
</tr>
</tbody>
</table>

**Definitions:**

(+dir) = Positive Kilometerpost Direction  
(-dir) = Negative Kilometerpost  
\(a = AM\) Peak  
\(m = Mid\) Day  
r = Rock Garden  
p = PM Peak  
f = Fenton Harbor  
e = Evening  
n = Noel End  
For example: rfa = Rock Garden to Fenton Harbor AM Peak
4.2.4. FUTURE OPERATION – COASTING

The same TPS runs would be completed as in Section 4.2.3, except that the control file would be changed to reflect the Types 1, 2 & 3 coasting. No other changes are necessary.

4.3. ENS RUNS

4.3.1. PRESENT OPERATION – NORMAL

Very few ENS runs will be required. Since in the peak period, the rail system cycle time is 6 minutes, the ENS run duration should be set at six minutes. Likewise, the duration of the off peak runs should be 12 minutes

<table>
<thead>
<tr>
<th>Present Operation ENS Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1AM Peak</td>
</tr>
<tr>
<td>2Mid Day</td>
</tr>
<tr>
<td>3PM Peak</td>
</tr>
<tr>
<td>4Evening</td>
</tr>
</tbody>
</table>

4.3.2. PRESENT OPERATION – COASTING

Coasting, Types 1, 2 & 3 would be simulated by just changing the control files for Normal Operation to reflect coasting. No other changes are necessary. The ENS runs would be the same as the previous Section 4.3.1.

4.3.3. FUTURE OPERATION – NORMAL

Again very few ENS runs would be required. Since all CHO Car Units will be running in the off peak period, the cycle time of the system is 12 minutes. Thus the duration of ENS runs in the off peak period would be 12 minutes. However, during the peak period, there will be a mixture of CHO Car and CAM Car Units. Thus it will be necessary for the duration of the ENS runs to be longer.

<table>
<thead>
<tr>
<th>Future Operation ENS Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1AM Peak</td>
</tr>
<tr>
<td>2Mid Day</td>
</tr>
<tr>
<td>3PM Peak</td>
</tr>
<tr>
<td>4Evening</td>
</tr>
</tbody>
</table>

4.3.4. FUTURE OPERATION – COASTING

Coasting, Types 1,2 & 3 would be simulated by just changing the control files for Normal Operation to reflect coasting. No other changes are necessary. The ENS runs would be the same as the previous Section 4.3.3.
4.4. TRAIN MOVEMENT SIMULATION – DESIGN OF TRAIN CONTROL SYSTEM

4.5. OTHER TOM MODULE AND UTILITY RUNS

5. INPUT FILE CONSTRUCTION AND SIMULATION – PRESENT OPERATION

The first set of TOM files to be created will be for Present Normal Operation in contrast to Present Coasting Operation. This set of runs will also be for a summer operating month.

5.1. DATA BASE AND DIRECTORY

The first step is to run the TOM by clicking on its icon. This produces the screen:
In any of the following procedures throughout the rest of this manual, help is always available. Click the Help command button to produce the following screen, which has the instructions for obtaining help.

This screen is also the **File Viewer**. All files of the **TOM** can be viewed via this screen. The files can also be printed in a Microsoft **WORD** format if Microsoft **WORD** is present on the User’s computer. Otherwise, the print command will automatically export the file to **Notepad**, from which it can then be printed.

The next step is to click on the **Database Utility** command button **DB** on the main **TOM** screen. This action will produce the following screen.
Click on the **ADD** command button to produce the following screen.
Fill in the **Add Mnemonic here**: text box with the **DCEM Rail Transit system ID** and the **Add File Extension**: text box with the file extension as shown in the next screen.
Clicking the **Add Selection** command button produces the following screen.
The previous procedure created the **DCEM Rail System Data Base** and the **DCEM Rail System Directory**. For more information on the **Rail System Data Base**, click on the (?) at the upper right of the screen and then click on the **Add Mnemonic here:** text box. For more information on the **Rail System Directory**, click on the (?) at the upper right of the screen and then click on the **Add File Extension:** text box.

Having created the **Rail System Database** and **Directory** for the **DCEM** Rail Transit System, the user is ready to proceed with developing the input files to the model.

Since the user will be working with metric units, select **Metric** as the **Default Unit** and since the user will be working with the **DCEM** rail system, select **DCEM** as the **Rail System Selection**.
The **File Construction Module** (FCM) is required to construct the input files for the **TOM**. To access this module, click the FCM command button on the **TOM** main screen.
All of the input files can now be constructed from links to this screen.

### 5.2. TPS INPUT FILES

Selecting the TPS Input check box on the previous screen produces the following.
The user can now select from one of the TPS Input files, which are displayed on the screen.

5.2.1. CONTROL FILES

Review of Section 3.2.1 indicates that there will be two directions of running; namely, the increasing kilometerpost direction for trains from Rock Garden to Noel End and from Rock Garden to Fenton Harbor and the decreasing kilometerpost direction from Noel End to Rock Garden and from Fenton Harbor to Rock Garden. In addition, there are four conditions, which will affect the Control file for both present and future operation; namely, normal, coasting type 1, coasting type 2 and coasting type 3. Since the plans are to handle only one of these conditions at a time and then archiving all of the results, only the positive and negative kilometerpost directions need be present within a given analysis, and as such only two different control filenames will be used. Double clicking on Control of the TPS Input in the previous screen produces the following screen.
5.2.1.1. NORMAL OPERATION
The text boxes on the screen above are filled out with information pertinent to the DCEM Rail Transit System for Normal Operation. Most of these parameters can be found in Section 3.5.1 Basic System Data – Normal Operation.

5.2.1.1.1. INCREASING KILOMETERPOST DIRECTION
A completed screen with the correct parameters for trains running in the increasing kilometerpost direction is shown next.
The definition of any one of the parameters on this screen or any other screen to follow in this manual is obtained by clicking on the (?) at the top right of the screen followed by a click on the parameter of interest. The Control file is then constructed by clicking on the Create File command button. The result follows.
The file CL-n+.dce has been created and now exists in the DCSEM Rail System Data Base and Directory. Clicking the Yes command button under Review File? label on the screen results in a display of the file that was created.
5.2.1.2. DECREASING KILOMETERPOST DIRECTION

Modifying the file that was just created can create the Control file for trains running in the decreasing kilometerpost direction. Following this procedure:

- Double click on CL-n+.dce in the Control Input file box. This action imports the file into the screen.
- Change the Increasing Position Run in the combo box at the top center of the screen to Decreasing Position Run.
- Change the File Caption: at the bottom center of the screen from “Normal (+ Dir)” to “Normal (- Dir)”. 
- Change the File Name from “CL-n+.dce” to “CL-n-.dce”
- Click the Create File command button, which results in the final screen.
There is a requirement to create control files with coasting. Note that the files for coasting will not be created at this point, but rather the screens prior to their creation will be displayed.

5.2.1.2. TYPE 1 COASTING

5.2.1.2.1. INCREASING KILOMETERPOST DIRECTION

The screen for Type 1 coasting for trains running in the increasing kilometerpost direction is shown below.
Completion of this screen follows the specifications of Section 3.5.2.

5.2.1.1.1. DECREASING KILOMETERPOST DIRECTION

The screen for Type 1 coasting for trains running in the decreasing kilometerpost direction is shown below.
Completion of this screen follows the specifications of Section 3.5.2.

5.2.1.2. **TYPE 2 COASTING**

5.2.1.2.1. **INCREASING KILOMETERPOST DIRECTION**

The screen for Type 2 coasting for trains running in the increasing kilometerpost direction is shown below.
Completion of this screen follows the specifications of Section 3.5.2.

5.2.1.2.2. DECREASING KILOMETERPOST DIRECTION

The screen for Type 2 coasting for trains running in the decreasing kilometerpost direction is shown below.
5.2.1.3. TYPE 3 COASTING

5.2.1.3.1. INCREASING KILOMETERPOST DIRECTION

The screen for Type 3 coasting for trains running in the increasing kilometerpost direction is shown below.
Completion of this screen follows the specifications of Section 3.5.2.

5.2.1.3.2. DECREASING KILOMETERPOST DIRECTION

The screen for Type 3 coasting for trains running in the decreasing kilometerpost direction is shown below.
Completion of this screen follows the specifications of Section 3.5.2.

5.2.2. TRAIN FILES

Select the **Train** item in the **TPS Input** list box in the following screen.
Click the Select command button under the TPS Input list box.
The input to the Train file will differ depending on present or future operation, peak or off-peak periods, and summer, winter, spring or fall seasons.

5.2.2.1. PRESENT OPERATION

5.2.2.1.1. PEAK PERIODS

Completing the entries for the above screen for present operation during the peak period (AM or PM) results in the following screen.
The next step is to makeup the train of 6 cars. Click the **Train Makeup Input** check box to access the Train Makeup Input screen.
The auxiliary power per car (Aux Power/Car) varies depending on the season. For summer, the value is shown; for winter the value is 40 kW and for spring or fall, the value is 10 kW.

Click the Select command button to return to the previous screen.
Click the Create File command button to save the file to this point.
Click the **Propulsion Input** check box produces the next screen.
Section 3.1.4.1.2 shows the Efficiency as a function of Speed and Fraction of Tractive Effort at that Speed. There are 3 Speed Points and 5 Tractive Effort Points. Set the **Number of Spd Points** to 3 and the **Number of TE Points** to 5. Set the **Max Spd** to 120. Clicking on **Set Entry To Grid** produces the following screen.
The efficiencies can now be entered. After entry the screen is shown below.
A second method for entering efficiencies involves the **Text Transfer** method. Click on the **Text Transfer** command button to produce the following screen.

Click on the **Real Power Efficiency** check box to produce the following screen.
The Speed Points, Traction Effort Points and the Real Power Efficiency Matrix can be copied directly from an EXCEL sheet or any other text program and pasted in the entry space above. Using the values from Section 3.1.4.1.2, the values are copied and pasted into the screen shown below.
Click the **Transfer** command button to transfer the values to the previous **Propulsion Input Screen**. A click on the **Reset** command button followed by a click on the **TE vs. Spd Curve** check box produces the following screen.
The Tractive Effort vs. Speed Curve can be copied directly from Section 3.1.4.1.1 and pasted into this screen to produce the following screen.
A click on the **Transfer** command button followed by a click on the **Close** button produces the following screen.
Now click on the TE vs. Spd Curve check box to verify that the Tractive Effort vs. Speed curve was transferred into the Propulsion Input Screen.
Click the Select command button returns to the Train File Input - Main Screen.
A click on the **Create File** command button creates the **Train** file as seen in the next screen.

---

### File Construction Module - Train File Input - Main Screen

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS DCEM Rail System</td>
<td></td>
</tr>
<tr>
<td>Train input file</td>
<td></td>
</tr>
<tr>
<td>Units</td>
<td>Metric</td>
</tr>
<tr>
<td>Convert to English</td>
<td></td>
</tr>
<tr>
<td>T-pr6.dce</td>
<td></td>
</tr>
<tr>
<td>View One</td>
<td></td>
</tr>
<tr>
<td>Select One</td>
<td>7.9</td>
</tr>
<tr>
<td>Delete One</td>
<td></td>
</tr>
<tr>
<td>Name of File path</td>
<td>C:\tom\tomdat\dce</td>
</tr>
<tr>
<td>Name</td>
<td>T-pr6.dce</td>
</tr>
<tr>
<td>File Caption</td>
<td>Present 6 CAM cars</td>
</tr>
<tr>
<td>Davis Equation</td>
<td></td>
</tr>
<tr>
<td>Method to specify train resistance</td>
<td></td>
</tr>
<tr>
<td>Electric - Input</td>
<td></td>
</tr>
<tr>
<td>Type Propulsion System</td>
<td></td>
</tr>
<tr>
<td>&lt;= 290</td>
<td></td>
</tr>
<tr>
<td>Maximum Speed</td>
<td></td>
</tr>
<tr>
<td>Train Part of Name (2 alphanum)</td>
<td>R6</td>
</tr>
<tr>
<td>Number of Types of Cars in Train</td>
<td>2</td>
</tr>
<tr>
<td>Train Frontal Area</td>
<td>111578.66</td>
</tr>
<tr>
<td>Fuel Heat Content per Unit Volume</td>
<td>.2163</td>
</tr>
<tr>
<td>Flange Coefficient</td>
<td></td>
</tr>
<tr>
<td>Wheel Diameter</td>
<td></td>
</tr>
<tr>
<td>Gear Ratio</td>
<td>.000</td>
</tr>
<tr>
<td>Train Makeup Input</td>
<td>Close</td>
</tr>
<tr>
<td>Friction Brake Input</td>
<td>Exit</td>
</tr>
<tr>
<td>Propulsion Input</td>
<td></td>
</tr>
<tr>
<td>OnBoard Storage Input</td>
<td></td>
</tr>
<tr>
<td>Create File</td>
<td></td>
</tr>
</tbody>
</table>
Click the **Yes** command button to review the created file.
5.2.2.1.2. OFF PEAK PERIODS

The only difference in the CAM car train in the off peak period is the number of cars per train. A click on Train Makeup Input check box produces the following screen.

Close the File Viewer.

5.2.2.1.2. OFF PEAK PERIODS

The only difference in the CAM car train in the off peak period is the number of cars per train. A click on Train Makeup Input check box produces the following screen.

Close the File Viewer.
The # Cars entry in the second column is changed from 5 to 2.
Click on the `Select` button to return to the `Train File Input – Main Screen`.

### Train Makeup Input

<table>
<thead>
<tr>
<th>Type Car</th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td># Cars</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td># Prop</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td># Axles/Car</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td># Seats/Car</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Aux Power/Car</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Length/Car</td>
<td>12.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Empty Wt/Car</td>
<td>32.7</td>
<td>32.7</td>
</tr>
<tr>
<td>Full Wt/Car</td>
<td>50.2</td>
<td>50.2</td>
</tr>
<tr>
<td>Aero Drag</td>
<td>0.04435</td>
<td>0.00628</td>
</tr>
<tr>
<td>Eq Rot Wt/Car</td>
<td>.33</td>
<td>.33</td>
</tr>
<tr>
<td>TR Coef 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Click on cell to enter.
Doubleclick on cell to delete.
<esc> to delete. del to delete.
Arrow buttons and return active.
There are four remaining tasks to create the off peak train file for present operation of the DCEE rail transit system:

- Change the **Train Part of Name** from R6 to R3.
- Change the **File Caption** to Present 3 CAM Cars.
- Change the **Name of File – name** to T-pr3.dce
- Click the **Create File** command button.

The result is the next screen.
5.2.2.2. **FUTURE OPERATION**

5.2.2.2.1. **CAM CAR UNIT**

The present CAM car Train file can be used to create the CAM Car unit train for future operation. This unit train has been defined in Section 3.1.1.2.

**CAM Car – Trailer – CAM Car = CAM Car Unit**

On the main screen, make the following changes

- Change the **Train Part of Name** from R3 to R1.
- Change the **Number of Types of Cars in Train** from 2 to 3.
- Change the **File Caption** to Future 1 CAM Car Unit.
- Change the **Name of File – name** to T-fr1.dce

These changes result in the following screen
Next, click on the **Train Makeup Input** checkbox to get to the **Train Makeup Input** screen.
The **Type 2 # Cars** will be changed from 2 to 1. The data will be entered for Type 3 cars, which are trailers. These data are shown in Sections 3.1.2.2 and 3.1.3.

<table>
<thead>
<tr>
<th>Type Car</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td># Cars</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td># Prop</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td># Axels/Car</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td># Seats/Car</td>
<td>80</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Aux Power/Car</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Length/Car</td>
<td>12.7</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>Empty Wt/Car</td>
<td>32.7</td>
<td>32.7</td>
<td></td>
</tr>
<tr>
<td>Full Wt/Car</td>
<td>50.2</td>
<td>50.2</td>
<td></td>
</tr>
<tr>
<td>Aero Drag</td>
<td>0.04435</td>
<td>0.0628</td>
<td></td>
</tr>
<tr>
<td>Eq Rot Wt/Car</td>
<td>0.33</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>TR Coef 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Click the Select command button to return to the Train File Input - Main Screen.

<table>
<thead>
<tr>
<th>Type Car</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td># Cars</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td># Prop</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td># Axels/Car</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td># Seats/Car</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Aux Power/Car</td>
<td>30</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Length/Car</td>
<td>12.7</td>
<td>12.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Empty Wt/Car</td>
<td>32.7</td>
<td>32.7</td>
<td>22.7</td>
</tr>
<tr>
<td>Full Wt/Car</td>
<td>50.2</td>
<td>50.2</td>
<td>40.2</td>
</tr>
<tr>
<td>Aero Drag</td>
<td>.04435</td>
<td>.00628</td>
<td>.00628</td>
</tr>
<tr>
<td>Eq Rot Wt/Car</td>
<td>.33</td>
<td>.33</td>
<td>.091</td>
</tr>
<tr>
<td>TR Coef 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR Coef 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Click on cell to enter. Doubleclick on cell to delete. <esc> to delete. del to delete. Arrow buttons and return active.
Click the **Create File** command button to create the file. This results in the screen.
Review the file by clicking the **YES** command button.
Close the File Viewer.

5.2.2.2. CHO CAR UNIT

The present CAM Car Unit, which was just created, can be used as the basis for constructing the CHO Car Unit. The following changes are made on the previous screen.

- Change Method to specify train resistance to Single Car Coefficients
- For Type of Propulsion System, change to Electric – Model
- Change the Train Part of Name from R1 to C1.
- Change the File Caption to Future 1 CHO Car Unit.
- Change the Name of File – name to T-fc1.dce

These changes result in the following screen.
Click the Train Makeup Input check box to proceed to the Train Makeup Input Screen.
Add the TR Coef 1 – 5, which are specified in Section 3.1.2.3.
The **Aero Drag** can be left in or left blank. Likewise the **Train Frontal Area** and the **Flange Coefficient** may also be left blank or as is. Click the **Select** command button to return to the Main Screen.
The next step is to model the propulsion system using the Electric – Model Type. Click the Propulsion Input check box to produce the following screen.
Because the propulsion system characteristics will be calculated using the internal model, the mesh size for the efficiency matrices can be finer. Set **Number of Spd Points** text box to 20 and the **Number of TE Points** text box to 20. Since this train will regenerate braking energy set the **No Regeneration** combo box to **Regeneration**. These actions result in the following screen.
Click on the **Compute from Model** check box to produce the following screen.
A review of the propulsion system specifications for the CHO car in Section 3.1.4.2.3 shows that the Control must be build from basic circuit parameters. Thus the first step is to set the Control Selection combo box to (NEW).
This will allow the Chopper Model Input screen to become visible.
Using the parameters specified in Section 3.1.4.2.3, entering “Future” in the Designation or ID text box, and setting the Name of File text box to future.con, the resulting screen.
Click of the Create File command button to create the file. The result is shown in the next screen.
Review the file by clicking the Yes command button.
Close the File Viewer.

Click the Close command button to close the Chopper Model Input screen, which allows the Electric Propulsion Model Input screen to become visible again.
Click the **Reset** command button and the following screen appears.
The following items will be entered on the screen:

The **Nominal, Maximum and Minimum Voltages** are correct as stated in Section 3.1.4.2.1.

Set the **Model Output File** name to `C:\tom\tomdat\TC-fc1.dce`.

Set the **Power Control Modes** text box to 2 as stated in Section 3.1.4.2.2.

The **Number of Motors /Car** text box has the correct entry as stated in Section 3.1.4.2.2.

The **Motor Type** combo box has the correct entry as stated in Section 3.1.4.2.2.

The **Motor Selection** combo box should be set to **we 1462** as stated in Section 3.1.4.2.2.

The **Number of Controls/Car** text box has the correct entry as stated in Section 3.1.4.2.3.

The **Type Control** combo box has the correct entry as stated in Section 3.1.4.2.3.

Set the **Control Selection** combo box to **Future**.

The remaining items on the screen are left alone for the time being. The screen as it now appears is shown below.
Next the Power Control Modes grid is completed using the data in Section 3.1.4.2.2. The first entry is for **Mode 1** and **Mtrs Sers** (Number of Motors in Series). This entry is 2. The following screen results.
The **Mtrs Prll** (Number of Motors in Parallel) and the **Fld Str** (Field Strength of the Motor) are automatically added. The next entry for **Mode 2** and **Mtrs Sers** is 2. The following screen results.
The field strength is selected in the **Power Field Strength** combo box.
Select 70%.
Since there is only one electrical brake control mode, enter the number 2 in the **Brake Control Modes** grid under **Mode 1 Mtrs Sers**. The following screen results.
If satisfied with all entries, click the Select command button and the following screen appears.
The following screen then appears.
There are no entries for the **Wheel Diameter** and the **Gear Ratio**, which in the **Electric – Model Type Propulsion System** are required. The values are found in Section 3.1.3.
For the following screen:
Click the Select command button again.
Click the **Select** command button on this screen to get back to the **Train File Input - Main Screen.**
Click the Create File command button.
Click on the **Yes** command button to review, which results in the final screen.
The Tractive Effort vs. Speed curve calculated will be the maximum capability for the CHO Car. Since it can be programmed to be exactly the same as the CAM Car, it is necessary to make that modification. To view the TE vs. Speed curve for the CHO Car, double click on the T-fc1.dce entry in the Train input file list box. Next click on the Propulsion Input check box, which results in the following screen.
Click the TE vs. Spd Curve check box to obtain the following screen.
If the same procedure is used using the **CAM Car Unit Train** file T-fr1.dce, the resulting screen is shown next.
This is the **Tractive Effort vs. Speed** curve for the **CAM Car**, which is less than or equal to that of the **CHO Car**, shown in the previous screen. Using the Text Transfer method effects modification. Click the **Text Transfer** command button to obtain the **Text to TOM Transfer** screen.
Click the **Import** command button to import the **Tractive Effort vs. Speed** curve into the screen.
Copy the Tractive Effort vs. Speed Curve to the Clipboard. Clicking the right mouse button on the Tractive Effort vs. Speed Curve text box followed by selection of Select All on the menu followed by another right click followed by Copy on the menu. The second method is to set the mouse at the upper left corner of the text box, hold the left mouse button down and drag the mouse along the left edge of the text box until all data are highlighted, then do a <ctrl> C on the keyboard. Any combination in these two methods will also work. These actions will produce the following screen.
The next step is to close the Text to TOM Transfer screen and the Propulsion Input screen and then import the train file T-fc1.dce into the Train Input File - Main Screen. This action is then followed by the click on Train Input File - Main Screen’s Propulsion Input checkbox. Finally, a click on the Propulsion Input screen’s Text Transfer command leads to the following screen.
Paste the Clip Board contents to the Tractive Effort vs. Speed Curve text box. This can be done by a left mouse click on the text box followed by <ctrl>V on the keyboard or by a right mouse click on the text box followed by selecting Paste from the menu. This results in the following screen.
Clicking the **Transfer** command button then close the **Text to TOM Transfer** screen. The **Propulsion Input** screen is now visible. Verify the transfer by clicking the **TE vs Spd Curve** command button.
Click the Select command button to return to the Train File Input – Main Screen.
Click the Create File command button on the Train Input File – Main Screen to save the file. The following screen results.
Click the Yes command button to review the file.
The final result is a train file T-fc1.dce that has the same Tractive Effort vs. Speed Curve as the train file T-fr1.dce.

### 5.2.2.3. OFF PEAK AND PEAK PERIODS

The train files created in Sections 5.2.2.2.1 and 5.2.2.2.2 are for single CAM Car Unit and CHO Car Unit, respectively. These trains are used for off peak operation. Creation of the files for Peak operation is accomplished by using these two train files. For the previous screen, make the following changes:

- Change the Train Part of Name text box contents from C1 to C2.
- Change the File Caption text box contents to Future 2 CHO Car Units
- Change the Name of File – Name text box contents to T-fc2.dce.

This results in the following screen.
Click the **Train Makeup Input** check box to arrive at the following screen.
Make the following changes:

Change # Cars Type 2 from 1 to 3.
Change # Cars Type 3 from 1 to 2.
Click the **Select** command button to return to the **Train File Input – Main Screen**. Click the **Create File** command button to finalize the file. This action results in the following screen.
Click the Yes command button to review the file.
Close the **File Viewer**.

To build the Train file for the two **CAM Car Units**, double click on the one **CAM Car Unit Train** file in the **Train input file** list box (T-fr1.dce). This action imports the file into the screen as follows.

```plaintext
Close the File Viewer.
To build the Train file for the two CAM Car Units, double click on the one CAM Car Unit Train file in the Train input file list box (T-fr1.dce). This action imports the file into the screen as follows.
```
Make the following changes:

- Change the **Train Part of Name** text box contents from **R1** to **R2**.
- Change the **File Caption** text box contents to **Future 2 CAM Car Units**
- Change the **Name of File – Name** text box contents to **T-fr2.dce**.

This results in the following screen.
Click on the **Train Makeup Input** check box, which exposes the following screen.
Make the following changes:

Change # Cars Type 2 from 1 to 3.
Change # Cars Type 3 from 1 to 2.
Click the **Select** command button to return to the **Train File Input – Main Screen**.
Click the Create File command button to finalize the file. This action results in the following screen.
Click the **Yes** command button to review the file.
Close the File Viewer.

The Train files T-fr2.dce and T-fc2.dce are used for the peak periods.

5.2.3. STATION FILES

Before the Station files can be created, it is necessary to compute the passenger load factors in percent given the passenger counts as shown in Section 3.2.2.1. This computation can be accomplished using an EXCEL spreadsheet and recognizing that a crush loaded car (100% load factor) has 220 passengers (Section 3.1.3). The result is the following spreadsheet.
### Average Passenger Load Factor Per Train (%)

<table>
<thead>
<tr>
<th>From Station</th>
<th>To Station</th>
<th>AM Peak</th>
<th>Mid Day</th>
<th>PM Peak</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden</td>
<td>Marion Place</td>
<td>48.11</td>
<td>18.18</td>
<td>2.42</td>
<td>9.09</td>
</tr>
<tr>
<td>Marion Place</td>
<td>Vernor Avenue</td>
<td>78.41</td>
<td>65.15</td>
<td>8.71</td>
<td>30.30</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Wright Landing</td>
<td>25.91</td>
<td>9.39</td>
<td>98.56</td>
<td>4.70</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>Noel End</td>
<td>1.67</td>
<td>21.97</td>
<td>63.41</td>
<td>10.61</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Dillard Dock</td>
<td>10.61</td>
<td>52.27</td>
<td>75.23</td>
<td>25.00</td>
</tr>
<tr>
<td>Dillard Dock</td>
<td>Fenton Harbor</td>
<td>4.02</td>
<td>18.18</td>
<td>36.67</td>
<td>8.33</td>
</tr>
<tr>
<td>Marion Place</td>
<td>Rock Garden</td>
<td>2.65</td>
<td>16.97</td>
<td>47.20</td>
<td>7.88</td>
</tr>
<tr>
<td>Vernor Avenue</td>
<td>Marion Place</td>
<td>9.09</td>
<td>43.18</td>
<td>77.42</td>
<td>21.97</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>Vernor Avenue</td>
<td>92.73</td>
<td>59.09</td>
<td>24.92</td>
<td>30.30</td>
</tr>
<tr>
<td>Noel End</td>
<td>Wright Landing</td>
<td>64.09</td>
<td>16.67</td>
<td>2.58</td>
<td>8.48</td>
</tr>
<tr>
<td>Dillard Dock</td>
<td>Vernor Avenue</td>
<td>74.77</td>
<td>54.55</td>
<td>10.23</td>
<td>11.06</td>
</tr>
<tr>
<td>Fenton Harbor</td>
<td>Dillard Dock</td>
<td>36.21</td>
<td>20.00</td>
<td>3.71</td>
<td>3.18</td>
</tr>
</tbody>
</table>

Creation of the Station files can now proceed.

#### 5.2.3.1. AM PEAK

##### 5.2.3.1.1. ROCK GARDEN TO FENTON HARBOR

Expose the **File Construction Module – Main Screen.**
Click **Station** in the **TPS Input** list box. Click the **Select** command button to expose the following screen.
The following entries are made.

Set the contents of the Name of File - name text box to ST-rfa.dce.
Set the contents of the File Caption text box to Rock Garden to Fenton Harbor AM Peak.
Set the contents of the Station File ID text box to RF.
Set the contents of the Station Name, Position, Dwell Time (sec), Passenger Load Factor (%) text box. All entries are always in the order of increasing values for position.

When completed, the screen appears as follows.
Click the **Create File** command button to complete the file.
Click the Yes command button to review the file. This is always a good idea, since errors are reported via this route.
Close the **File Viewer**.

All of the remaining **Station** files are created in the same manner. Their screens are shown in the next several sections.

5.2.3.1.2. **FENTON HARBOR TO ROCK GARDEN**

The **File Viewer** is shown below:
Fenton Harbor to Rock Garden AM Peak

PR 5

<table>
<thead>
<tr>
<th>Time</th>
<th>Station</th>
<th>TRM</th>
<th>TRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3000</td>
<td>Rock Garden</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>1.4000</td>
<td>Horton Place</td>
<td>28.0000</td>
<td>2.6300</td>
</tr>
<tr>
<td>3.8000</td>
<td>Vernon Ave</td>
<td>30.0000</td>
<td>9.0900</td>
</tr>
<tr>
<td>5.1000</td>
<td>Dillard Dock</td>
<td>20.0000</td>
<td>74.7700</td>
</tr>
<tr>
<td>6.4000</td>
<td>Fenton Harbor</td>
<td>6.0000</td>
<td>36.2100</td>
</tr>
</tbody>
</table>

FILENAME: C:\ton\tondata\dce\ST-trm.dce
5.2.3.1.3. ROCK GARDEN TO NOEL END

<table>
<thead>
<tr>
<th>#</th>
<th>Stop Name</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rock Garden</td>
<td>48.11000</td>
<td>78.41000</td>
</tr>
<tr>
<td>2</td>
<td>Norton Place</td>
<td>35.00000</td>
<td>25.91000</td>
</tr>
<tr>
<td>3</td>
<td>Yumaor Ave</td>
<td>26.00000</td>
<td>1.67000</td>
</tr>
<tr>
<td>4</td>
<td>Wright Landing</td>
<td>26.00000</td>
<td>8.40000</td>
</tr>
<tr>
<td>5</td>
<td>Noel End</td>
<td>8.00000</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

FILENAME: C:\Tom\TomData\DC\Tovm.dcc
5.2.3.1.4. NOEL END TO ROCK GARDEN

<table>
<thead>
<tr>
<th>No.</th>
<th>0.3000 Rock Garden</th>
<th>0.00000</th>
<th>0.00000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4000 Norton Place</td>
<td>20.00000</td>
<td>2.63000</td>
<td></td>
</tr>
<tr>
<td>5.0000 Varior Ave</td>
<td>30.00000</td>
<td>9.09000</td>
<td></td>
</tr>
<tr>
<td>5.2000 Wright Landing</td>
<td>20.00000</td>
<td>92.73000</td>
<td></td>
</tr>
<tr>
<td>7.0000 Noel End</td>
<td>8.00000</td>
<td>64.09000</td>
<td></td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomdata\dee\ST-mrc.dce
5.2.3.2. MID DAY

5.2.3.2.1. ROCK GARDEN TO FENTON HARBOR

```
Rock Garden to Fenton Harbor Mid Day
5
  0.3000 Rock Garden   0.00000  10.10000
  1.4000 Marion Place  20.00000  65.35000
  3.4000 Yarnor Ave   35.00000  52.27000
  5.1000 Birdardock   20.00000  10.10000
  6.4000 Fenton Harbor 0.00000   0.00000
```

FILENAME: C:\tom\tms\l\de\ST-rm.dce
5.2.3.2.2. FENTON HARBOR TO ROCK GARDEN

Fentom Harbor to Rock Garden Mid Day

FR
5
0.3000 Rock Garden 0.00000 0.00000
1.4000 Marion Place 20.00000 16.97000
3.0000 Vernon Ave 30.00000 43.10000
5.1000 Dillard Dock 26.00000 56.93000
6.4000 FentonHarbor 0.00000 20.00000

FILENAME: C:\tom\model\dce\ST-fcn.dce
5.2.3.2.3. ROCK GARDEN TO NOEL END

<table>
<thead>
<tr>
<th></th>
<th>Rock Garden to Noel End Mid Day RN</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3000 Rock Garden</td>
<td>0.00000</td>
<td>18.10000</td>
</tr>
<tr>
<td>1.4000 Norton Place</td>
<td>20.00000</td>
<td>65.15000</td>
</tr>
<tr>
<td>3.8000 Yorbaar Ave</td>
<td>30.00000</td>
<td>9.39000</td>
</tr>
<tr>
<td>5.2000 Wright Landing</td>
<td>20.00000</td>
<td>21.97000</td>
</tr>
<tr>
<td>7.0000 Noel End</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\toms\tdeec\GRnm.dce
### 5.2.3.2.4. NOEL END TO ROCK GARDEN

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>X-Position</th>
<th>Y-Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Rock Garden</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>1</td>
<td>Norton Place</td>
<td>20.00000</td>
<td>16.97000</td>
</tr>
<tr>
<td>3</td>
<td>Verna Ave</td>
<td>30.00000</td>
<td>43.10000</td>
</tr>
<tr>
<td>5</td>
<td>Wright Landing</td>
<td>20.00000</td>
<td>59.09000</td>
</tr>
<tr>
<td>7</td>
<td>Noel End</td>
<td>0.000000</td>
<td>16.62000</td>
</tr>
</tbody>
</table>

FILE NAME: C:\Tom\Tomdata\dce\GTLumed.doc
5.2.3.3. **PM PEAK**

5.2.3.3.1. **ROCK GARDEN TO FENTON HARBOR**

The completed screen is shown below:

```
Rock Garden to Fenton Harbor PM Peak

RF 5
  0.3000 Rock Garden  0.00000  2.42000
  1.4000 Norton Place  20.00000  8.71000
  3.4000 Ynezor Ave  30.00000  75.23000
  5.1000 Dillard Dock  20.00000  36.67000
  6.4000 FentonHarbor  0.00000  0.00000

FILENAME: C:\tom\tomsat\dce\ST-rp.dce
```
5.2.3.3.2. FENTON HARBOR TO ROCK GARDEN

5.2.3.3.3. ROCK GARDEN TO NOEL END
Rock Garden to Noel End PK Peak

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3000</td>
<td>Rock Garden</td>
<td>0.00000</td>
</tr>
<tr>
<td>1.4000</td>
<td>Morton Place</td>
<td>26.00000</td>
</tr>
<tr>
<td>3.8000</td>
<td>Vernon Ave</td>
<td>30.00000</td>
</tr>
<tr>
<td>5.2000</td>
<td>Wright Lining</td>
<td>20.00000</td>
</tr>
<tr>
<td>7.0000</td>
<td>Noel End</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomdata\dec\ST-rmp.dce
5.2.3.4. NOEL END TO ROCK GARDEN

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>X-Coordinate</th>
<th>Y-Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Rock Garden</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>1.4K</td>
<td>Morton Place</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>3.000</td>
<td>Yeesor Ave</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>5.200</td>
<td>Wright Living</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>7.000</td>
<td>Noel End</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

FILENAV: C:\ssc\tomsd\doc\ST.mnp.dce
5.2.3.4. **EVENING**

### 5.2.3.4.1. ROCK GARDEN TO FENTON HARBOR

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3000</td>
<td>Rock Garden</td>
<td>0.00000</td>
<td>9.09000</td>
</tr>
<tr>
<td>1.4000</td>
<td>Marton Place</td>
<td>26.00000</td>
<td>30.30000</td>
</tr>
<tr>
<td>3.4000</td>
<td>Yorson Ave</td>
<td>36.00000</td>
<td>25.00000</td>
</tr>
<tr>
<td>5.1000</td>
<td>Billard Dock</td>
<td>20.00000</td>
<td>0.33000</td>
</tr>
<tr>
<td>6.4000</td>
<td>Fentoon Harbor</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\ton\ton\adde\ST-rfe.dce
5.2.3.4.2. FENTON HARBOR TO ROCK GARDEN

File Name: C:\ton\tds\ST-M-S.inw

Fenton Harbor to Rock Garden Evening

<table>
<thead>
<tr>
<th>PR</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Rock Garden</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>1.4000</td>
<td>Norton Place</td>
<td>28.0000</td>
<td>7.0000</td>
</tr>
<tr>
<td>3.8000</td>
<td>Vernon Ave</td>
<td>36.0000</td>
<td>21.9700</td>
</tr>
<tr>
<td>5.1000</td>
<td>Dillard Dock</td>
<td>28.0000</td>
<td>11.0602</td>
</tr>
<tr>
<td>6.4000</td>
<td>Fenton Harbor</td>
<td>0.0000</td>
<td>3.1800</td>
</tr>
</tbody>
</table>

FILENAME: C:\ton\tds\ST-M-S.inw
5.2.3.4.3. ROCK GARDEN TO NOEL END

<table>
<thead>
<tr>
<th>ROCK GARDEN TO NOEL END EVENING</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO.</td>
</tr>
<tr>
<td>0.3000</td>
</tr>
<tr>
<td>3.0000</td>
</tr>
<tr>
<td>5.2000</td>
</tr>
<tr>
<td>7.0000</td>
</tr>
</tbody>
</table>

FILENAME: C:\Tom\Tom\Tom\Tom\Tom\S\ST_rme.dce
5.2.3.4.4. NOEL END TO ROCK GARDEN

Noel End to Rock Garden Evening
NR 5
0.3000 Rock Garden 0.00000 0.00000
1.4000 Marion Place 20.00000 7.00000
3.0000 Vernon Ave 30.00000 31.90000
5.2000 Wright Line 20.00000 30.30000
7.0000 Noel End 0.00000 4.48000

FILENAME: C:\\tom\\data\\documents\\NoelEndToRockGarden.doc
5.2.4. GRADE FILES

Two Grade files will be required: a Grade file for trains running between Rock Garden and Fenton Harbor and another for trains running between Rock Garden and Noel End.

5.2.4.1. ROCK GARDEN TO FENTON HARBOR

Expose the File Construction Module – Main Screen.

Click on Grade in the TPS Input list box of the File Construction Module – Main Screen. Click the Select command button. This action will produce the following screen.
Set the following:

- Set the contents of the Name of File – name text box to GR-rf.dce.
- Set the contents of the File Caption text box to Rock Garden to Fenton Harbor.
- Set the contents of the Position, Grade text box. All entries are always in the order of increasing values for position.

The data are shown in the Rail System Layout of Section 3.2.1.

The completed screen follows.
Note that the entry for Grade always represents the grade from the present position to the previous position. Thus, .78 is the grade from Kilometerpost .9 to Kilometerpost 2.1.

Click the Create File command button to complete the file.
Click the **Yes** command button to review the file.
5.2.4.2. ROCK GARDEN TO NOEL END

The Grade file from Rock Garden to Noel End is completed in similar fashion. The File Viewer after file creation is shown.

Close the File Viewer.

5.2.4.2. ROCK GARDEN TO NOEL END

The Grade file from Rock Garden to Noel End is completed in similar fashion. The File Viewer after file creation is shown.
5.2.5. CURVE FILES

The Rail System Layout in Section 3.2.1 states No Curves. As a result, one Curve file will be required for all of the TPS runs.
Click on **Curve** in the **TPS Input** list box of the **File Construction Module – Main Screen**. Click the **Select** command button. Follow by clicking the **Reset** command button on the Grade File Input screen, which will come up. This action will produce the following screen.
Set the following:

Set the contents of the Name of File – name text box to CU-t.dce.
Set the contents of the File Caption text box to Tangent Track.
Set the contents of the Position, Curve text box. All entries are always in the order of increasing values for position. For tangent track the curve value is 0.

The following screen is produced upon completion.
Click the Create File command button to complete the file.
Click the Yes command button to review the file.
Close the File Viewer.

5.2.6. SPEED RESTRICTION FILES

Two Speed Restriction files will be required: a Speed Restriction file for trains running between Rock Garden and Fenton Harbor and another for trains running between Rock Garden and Noel End.

5.2.6.1. ROCK GARDEN TO FENTON HARBOR

Expose the File Construction Module – Main Screen.
Click on Spd Res in the TPS Input list box of the File Construction Module – Main Screen. Click the Select command button. This action will produce the following screen.
Set the following:

Set the contents of the **Name of File** – name text box to **SP-rf.dce**.
Set the contents of the **File Caption** text box to **Rock Garden to Fenton Harbor**.
Set the contents of the **Position, Speed Restriction** text box. All entries are always in the order of increasing values for position. The data are shown in the Rail System Layout of Section 3.2.1

The completed screen follows.
Note that the entry for Speed Restriction always represents the speed restriction from the present position to the previous position. Thus, 50 kph is the speed restriction from Kilometerpost 3.8 to Kilometerpost 4.2.

Click the Create File command button to complete the file.
Click the **Yes** command button to review the file.
5.2.6.2. ROCK GARDEN TO NOEL END

The screen for the speed restrictions from Rock Garden to Noel End can be completed directly from the previous screen by the following modifications.

In the Name of File – name text box, change rf to rn.
In the File Caption text box change Rock Garden to Noel End.
In the Position, Speed Restriction text box, replace the last entry with two additional entries.

The completed screen follows.

Close the File Viewer.

5.2.6.2. ROCK GARDEN TO NOEL END

The screen for the speed restrictions from Rock Garden to Noel End can be completed directly from the previous screen by the following modifications.

In the Name of File – name text box, change rf to rn.
In the File Caption text box change Rock Garden to Noel End.
In the Position, Speed Restriction text box, replace the last entry with two additional entries.

The completed screen follows.
Click the Create File command button to complete the file.
Click the Yes command button to review the file.
5.2.7. ROUTE FILES

There are four route files required based on the Rail System Layout of Section 3.2.1 and the Operating Timetable Data of Section 3.4. One is required for all trains running from Rock Garden to Fenton Harbor, for all trains running from Fenton Harbor to Rock Garden, for all trains running from Rock Garden to Noel End and for all trains running from Noel End to Rock Garden.

5.2.7.1. ROCK GARDEN TO FENTON HARBOR

Exposé the File Construction Module – Main Screen.
Click on **Route** in the **TPS Input** list box of the **File Construction Module – Main Screen**. Click the **Select** command button. This action will produce the following screen.
Set the following:

Set the contents of the Name of File – name text box to RU-rf.dce.
Set the contents of the File Caption text box to Rock Garden to Fenton Harbor Track 1 to 3 (+Dir).
Set the contents of the Position, Track Number text box. All entries are always in the order of increasing values for position. The data are shown in the Rail System Layout of Section 3.2.1

The completed screen follows.
Note that the beginning and end positions are far outside of the terminal stations at Rock Garden (MP 0.3) and Fenton Harbor (MP 6.4). There is no problem here since trains will never run beyond these terminal stations.

Click on the Create File command button to complete the file.
Click the Yes command button to review the file.
Close the **File Viewer**.

All of the remaining route files are created in the same manner. Their completed files are shown in the next several sections.
5.2.7.2. **FENTON HARBOR TO ROCK GARDEN**

```plaintext
3
-1.00000  2
4.00000   2
-20.00000 4

FILENAME: C:\Tom\TomDat\deo\RU-4.dat
Fenton Harbor to Rock Garden Track 4 to 2 (-Dir)
```
5.2.7.3. ROCK GARDEN TO NOEL END
5.2.7.4. NOEL END TO ROCK GARDEN

The final set of files to develop is the File of Filenames. Each of these files will define a TPS run. Four will be required for each peak and off peak period giving a total of 16 files for present operation. The first file for the AM Peak Rock Garden to Fenton Harbor will be developed in some detail, while the remaining 15 will be presented as completed files.

5.2.8. TPS FILE OF FILENAMES

The final set of files to develop is the File of Filenames. Each of these files will define a TPS run. Four will be required for each peak and off peak period giving a total of 16 files for present operation. The first file for the AM Peak Rock Garden to Fenton Harbor will be developed in some detail, while the remaining 15 will be presented as completed files.

5.2.8.1. AM PEAK

5.2.8.1.1. RG – FH

Expose the File Construction Module – Main Screen.
Click **Fnames** in the **TPS Input** list box. Click the **Select** command button to expose the following screen.
In the **Input File Type** list box, click on **Control Input File**. This action produces the following screen.
Since the AM Peak Rock Garden to Fenton Harbor train is moving in the positive kilometerpost direction (+dir), choose the Control file CL-n+.dce by clicking on the file in the List of Files text box, followed by a click on the Select One command button. Alternatively, double clicking on the Control file CL-n+.dce will effect the same result. If the user is uncertain of which file to choose, he may view them by clicking on the file in the List of Files text box, followed by a click on the View One command button. After selecting a file, the following screen appears.
The Control file CL-n+.dce is added to the Input File Name list box.

Note that the TPS command button appears. The user will be able to run the TPS from this screen once the File of Filenames is created.

The user then proceeds to add all of the files appropriate to the AM Peak Rock Garden to Fenton Harbor TPS run. The results are shown in the next screen.
The next step is to place an entry in the * area of the Name of File – name text box. By the convention selected here, that value would be rfa. This results in the following screen.
It is now time to select and name the output files and file caption. In the **Output Files Desired**: check boxes, select the output files. Selecting **Power** and **Summary** checkboxes, by clicking on them, results in the following screen.
The output files are now named using the convention chosen and the **File Caption** is entered. This results in the following screen.
The `Create File` command button is now clicked to complete the file, which results in the next screen.
To view the file just created, click on the Yes command button.
Imported screens for the other 15 **Files of Filenames** are shown in the next sections.
5.2.8.1.2. FH – RG

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Dev file input
Route file input
Power profile output
Detailed output
Summary output

FILENAME: C:\tom\tomdata\dce\TPSfr.a.dce
Present Normal FH-RG AN Peak
5.2.8.1.3. RG – NE

Train Operations Model - file viewer

File Name: C:\tom\tcon\dce\TPSma.dce

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Dcs file input
Route file input
Power profile output
Detailed output
Summary output

Present Normal RG-NE AV Peak
5.2.8.1.4. NE – RG

C:\tom\tomdat\dce\CT-n-dce
C:\tom\tomdat\dce\ST-gnt-dce
C:\tom\tomdat\dce\ST-a2a-dce
C:\tom\tomdat\dce\DE-rn-dce
C:\tom\tomdat\dce\VR-t-dce
C:\tom\tomdat\dce\SP-xn-dce
y C:\tom\tomdat\dce\AV-x2-dce
y C:\tom\tomdat\dce\PM-xa-dce
y C:\tom\tomdat\dce\TS-xza-dce
FILENAME: C:\tom\tomdat\dce\TPSara.dce
Present Normal NS-RG \n Peak

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Rsc filo input
Route file input
Power profile output
Detailed output
Summary output
5.2.8.2. **MID DAY**

5.2.8.2.1. RG – FH
5.2.8.2.2. FH – RG

[Image of Train Operations Model - File Viewer]

- Control file input
- Train file input
- Station file input
- Grade file input
- Curve file input
- Spd Reg file input
- Route file input
- Power profile output
- Detailed output
- Summary output
5.2.8.2.3. RG – NE

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Rsc file input
Route file input
Power profile output
Detailed output
Summary output

Present Normal RG-NE Mid Day
5.2.8.2.4. NE – RG

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control file input</td>
<td>C:\tom\tcmdat\dce\clm.dce</td>
</tr>
<tr>
<td>Train file input</td>
<td>C:\tom\tcmdat\dce\tgrid.dce</td>
</tr>
<tr>
<td>Station file input</td>
<td>C:\tom\tcmdat\dce\st-acm.dce</td>
</tr>
<tr>
<td>Grade file input</td>
<td>C:\tom\tcmdat\dce\grn-r.m.dce</td>
</tr>
<tr>
<td>Curve file input</td>
<td>C:\tom\tcmdat\dce\crn-t.dce</td>
</tr>
<tr>
<td>Spd Dsc file input</td>
<td>C:\tom\tcmdat\dce\spd-dsc.m.dce</td>
</tr>
<tr>
<td>Route file input</td>
<td>C:\tom\tcmdat\dce\rout-dsc.m.dce</td>
</tr>
<tr>
<td>Power profile output</td>
<td>C:\tom\tcmdat\dce\p-ser.m.dce</td>
</tr>
<tr>
<td>Detailed output</td>
<td>C:\tom\tcmdat\dce\dser.m.dce</td>
</tr>
<tr>
<td>Summary output</td>
<td>C:\tom\tcmdat\dce\summ.m.dce</td>
</tr>
</tbody>
</table>

FILE: Normal NE-RG Mid Day

C:\tom\tomdat\dce\TPSnm.dce
5.2.8.3. PM PEAK

5.2.8.3.1. RG – FH
5.2.8.3.2FH – RG

Train Operations Model - File Viewer

File Name: C:\tom\tomdat\decr\TP5lrp.dce

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Doc file input
Route file input
Power profile output
Detailed output
Summary output

Present Normal FH-RG FH Peak
5.2.8.3.3. RG – NE

Train Operations Model - File Viewer

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C:\ton\tondata\dce\TSPmp.dce</td>
<td>Control file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\Tmpr.dce</td>
<td>Train file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\ST-zmp.dce</td>
<td>Station file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\SP-zm.dce</td>
<td>Grade file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\CH-t.dce</td>
<td>Curve file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\SP-zn.dce</td>
<td>Spd Rsc file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\VWU-zn.dce</td>
<td>Route file input</td>
</tr>
<tr>
<td>C:\ton\tondata\dce\F-zmp.dce</td>
<td>Power profile output</td>
</tr>
<tr>
<td>m</td>
<td>Detailed output</td>
</tr>
<tr>
<td>m</td>
<td>Summary output</td>
</tr>
</tbody>
</table>

Current file: C:\ton\tondata\dce\TSPmp.dce

Present Normal RG-NE Mid Day
5.2.8.3.4. NE – RG
5.2.8.4. EVENING

5.2.8.4.1. RG – FH
5.2.8.4.2. FH – RG

- Control file input
- Train file input
- Station file input
- Grade file input
- Curve file input
- Spd Reg file input
- Route file input
- Power profile output
- Detailed output
- Summary output

File Name: C:\tom\tomsagt\doc\TPSfire.doc

Present Normal FH-RG Evening
5.2.8.4.3. RG – NE

The image contains a file viewer interface with a list of file names and their corresponding file types. The list includes:
- Control file input
- Train file input
- Station file input
- Grade file input
- Curve file input
- Spd Dev file input
- Route file input
- Power profile output
- Detailed output
- Summary output

The file names and paths are as follows:
- C:\tom\tmodat\dce\CL-nr.dce
- C:\tom\tmodat\dce\GR-gr3.dce
- C:\tom\tmodat\dce\ST-snr.dce
- C:\tom\tmodat\dce\GR-rn.dce
- C:\tom\tmodat\dce\CR-t.dce
- C:\tom\tmodat\dce\SF-xn.dce
- C:\tom\tmodat\dce\WW-rn.dce
- C:\tom\tmodat\dce\FW-xx.dce
- C:\tom\tmodat\dce\TSSxne.dce

The file paths also include:
- FOLDER: C:\tom\tmodat\dce\TSSxne.dce
- Present Normal RG-ME Evening
5.2.8.4.4. NE-RG

Train Operations Model - File Viewer

File Name: C:\tom\tomdat\dce\TSare.dce

C:\\tom\\tomdat\\dce\\CL-are.dce
C:\tom\tomdat\dce\ST-grd.dce
C:\tom\tomdat\dce\ST-snc.dce
C:\tom\tomdat\dce\DR-tn.dce
C:\tom\tomdat\dce\CI-t.dce
C:\tom\tomdat\dce\SP-tn.dce
C:\tom\tomdat\dce\VAR-nc.dce
C:\tom\tomdat\dce\P-are.dce
C:\tom\tomdat\dce\TSare.dce

FILE_NAME: C:\tom\tomdat\dce\TSare.dce

Present Normal NI-RG Evening

Control file input
Train file input
Station file input
Grade file input
Curve file input
Spd Rsn file input
Route file input
Power profile output
Detailed output
Summary output
5.3. TPS RUNS

Four will be required for each peak and off peak period giving a total of 16 TPS runs for present operation. The first run for the AM Peak Rock Garden to Fenton Harbor will be developed in more detail, while the remaining 15 will be presented as just the summaries.

5.3.1. AM PEAK

5.3.1.1. RG – FH

On the TOM main screen, click the TPS command button. This action results in the following screen.
The text box in the center of the screen is the list of TPS files of filenames. To perform a TPS run, click on a file of filenames in the text box and then click on the Select command button below the list. Double-clicking of the file is just as effective. The following screen results selecting the AM Peak Rock Garden to Fenton Harbor file of filenames: TPSrfa.dce.

Click the Select command button to run the TPS.
Clicking the Yes command button causes the Train Operations Model - File Viewer to display the summary of the run.
The remainder of the 15 TPS runs can be accomplished by clicking the **Batch Run** command button on the previous screen. This action causes all of the files in the files of filenames text box to be executed via the TPS. The following screen results.
To view each of the Summary Output files of the TPS runs, perform the following procedure. Click the DB command button on the Train Operations Model screen, which causes the following screen to appear.
Click on the View Database command button to obtain the following screen.
Having scrolled using the right hand scroll button, to the bottom of the data base, select the **AM Peak** Rock Garden – Fenton Harbor **TPS** runs summary file: **TSSrfa.dce**, which results in the following screen.
Click the **View File** command button to obtain the following screen.
This is the **File Viewer** display of the output file **TSSrfa.dce**.

Since all of the runs were completed using the **Batch Run** command of the Train Performance Simulator screen, they will each be viewed in the following sections for peak and off peak service for present, normal operation.
5.3.1.2. **FH – RG**

The summary output file is:

```
Train Performance Simulation - Station Summary

Present 6 CRM cars
Fenton Harbor to Rock Garden AM Peak
Normal (-dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td>min</td>
<td>mph</td>
<td>kwh</td>
</tr>
<tr>
<td>Fenton Harbor TO Dillard Dock</td>
<td>1.30</td>
<td>1.59</td>
<td>48.90</td>
<td>51.14</td>
</tr>
<tr>
<td>Dillard Dock TO Vernon Ave</td>
<td>1.30</td>
<td>1.95</td>
<td>39.94</td>
<td>58.17</td>
</tr>
<tr>
<td>Vernon Ave TO Marion Place</td>
<td>2.40</td>
<td>2.24</td>
<td>64.33</td>
<td>56.85</td>
</tr>
<tr>
<td>Marion Place TO Rock Garden</td>
<td>1.10</td>
<td>1.89</td>
<td>60.50</td>
<td>38.46</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td>min</td>
<td>kwh</td>
<td>kwh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.10</td>
<td>6.83</td>
<td>53.24</td>
<td>156.07</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomdata\VSS\FH-G\FH-G.df DATE: 11/24/2005 TIME: 8:58:33
CAPTION: Present Normal FH-RG AM Peak
```
5.3.1.3. **RG – NE**

The summary output file is:

![Train Operations Model - File Viewer](image)

---

**Train Operations Model**

**Train Performance Simulation - Station Summary**

**Present 6 CGM cars**

**Rock Garden to Noel End AM Peak**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden TO Marion Place</td>
<td>1.10</td>
<td>1.46</td>
<td>45.32</td>
<td>47.47</td>
</tr>
<tr>
<td>Marion Place TO Vernon Ave</td>
<td>2.40</td>
<td>2.46</td>
<td>58.43</td>
<td>74.65</td>
</tr>
<tr>
<td>Vernon Ave TO Wright Line</td>
<td>1.40</td>
<td>1.67</td>
<td>50.43</td>
<td>48.91</td>
</tr>
<tr>
<td>Wright Line TO Noel End</td>
<td>1.80</td>
<td>2.83</td>
<td>38.15</td>
<td>35.09</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>6.70</td>
<td>0.41</td>
<td>47.77</td>
<td>206.08</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\tom\data\TSS\data.doc

**DATE:** 11/26/2005 **TIME:** 08:58:51

**CAPTION:** Present Normal RG-HI AM Peak
5.3.1.4. **NE – RG**

The summary output file is:

```
Train Operations Model
Train Performance Simulation - Station Summary

Present 6 CRM cars
Roel End to Rock Garden Bi Peak
Normal (-dir)

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td>minutes</td>
<td>mph</td>
<td>Kwh</td>
<td>Kwh</td>
</tr>
<tr>
<td>Roel End TO Wright Living</td>
<td>1.80</td>
<td>3.19</td>
<td>33.82</td>
<td>40.17</td>
<td>3.72</td>
</tr>
<tr>
<td>Wright Living TO Vernon Ave</td>
<td>1.40</td>
<td>1.88</td>
<td>44.72</td>
<td>57.61</td>
<td>6.86</td>
</tr>
<tr>
<td>Vernon Ave TO Marion Place</td>
<td>2.40</td>
<td>2.28</td>
<td>64.33</td>
<td>56.05</td>
<td>3.89</td>
</tr>
<tr>
<td>Marion Place TO Rock Garden</td>
<td>1.10</td>
<td>1.09</td>
<td>60.50</td>
<td>38.66</td>
<td>5.86</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.70</td>
<td>8.40</td>
<td>47.85</td>
<td>192.49</td>
<td>4.79</td>
</tr>
</tbody>
</table>

FILENAME: C:\Tom\Tomdata\TPSim\TPSim.exe
DATE: 11/26/2005  TIME: 8:58:39
CAPTION: Present Normal NE-RG AM Peak
```
5.3.2. MID DAY

5.3.2.1. RG – FH

The summary output file is:

![Summary Output File]

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Garden TO Marion Place</td>
<td>1.10</td>
<td>1.45</td>
<td>45.66</td>
<td>22.42</td>
<td>6.79</td>
</tr>
<tr>
<td>Marion Place TO Vernon Ave</td>
<td>2.40</td>
<td>2.26</td>
<td>58.56</td>
<td>36.88</td>
<td>5.12</td>
</tr>
<tr>
<td>Vernon Ave TO Dillard Dock</td>
<td>1.30</td>
<td>1.30</td>
<td>43.33</td>
<td>23.98</td>
<td>6.15</td>
</tr>
<tr>
<td>Dillard Dock TO Fenton Harbor</td>
<td>1.30</td>
<td>1.24</td>
<td>62.09</td>
<td>22.56</td>
<td>5.79</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

- Distance: 6.10 km
- Time: 6.94 minutes
- Speed: 52.70 kph
- Energy: 185.83 kWh
- Energy Input: 5.78 kWh

**FILENAME:** C:\tom\tomsd\doc\TSSfm.doc

**DATE:** 11/24/2005

**TIME:** 6:58:47

**CAPTION:** Present Normal RG-FH Mid Day
5.3.2.2. FH – RG

The summary output file is:

```
Train Operations Model
Train Performance Simulation - Station Summary

Present 3 CRN cars
Fenton Harbor to Rock Garden Mid Day
Normal (-dir)

<table>
<thead>
<tr>
<th>Route</th>
<th>Distance (km)</th>
<th>Time (minutes)</th>
<th>Speed (mph)</th>
<th>Energy (kWh)</th>
<th>Energy (kWh/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenton Harbor to Billard Dock</td>
<td>1.30</td>
<td>1.59</td>
<td>49.10</td>
<td>24.50</td>
<td>6.39</td>
</tr>
<tr>
<td>Billard Dock to Vermor Ave</td>
<td>1.30</td>
<td>1.95</td>
<td>40.04</td>
<td>24.26</td>
<td>6.22</td>
</tr>
<tr>
<td>Vermor Ave to Marion Place</td>
<td>2.40</td>
<td>2.26</td>
<td>63.01</td>
<td>38.73</td>
<td>4.27</td>
</tr>
<tr>
<td>Marion Place to Rock Garden</td>
<td>1.40</td>
<td>1.10</td>
<td>50.11</td>
<td>28.43</td>
<td>6.19</td>
</tr>
<tr>
<td>RUN SUMMARY</td>
<td>6.10</td>
<td>6.89</td>
<td>53.14</td>
<td>108.32</td>
<td>5.48</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomdata\TPSim.dcm
DATE: 11/24/2005  TIME: 0:50:36
CAPTION: Present Normal FH-RG Mid Day
```
5.3.2.3. **RG – NE**

The summary output file is:

![Train Operations Model - File Viewer](Image)

**Train Operations Model**

**Train Performance Simulation - Station Summary**

**Present 3 CRN cars**

**Rock Garden to Wool End Mid Day**

<table>
<thead>
<tr>
<th>Line</th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>minutes</td>
<td>kph</td>
<td></td>
<td>kwh</td>
<td>kwh</td>
</tr>
<tr>
<td>Rock Garden TO Marion Place</td>
<td>1.10</td>
<td>1.45</td>
<td>45.66</td>
<td>22.42</td>
<td>6.79</td>
</tr>
<tr>
<td>Marion Place TO Vermor Ave</td>
<td>2.40</td>
<td>2.46</td>
<td>50.56</td>
<td>36.88</td>
<td>5.12</td>
</tr>
<tr>
<td>Vermor Ave TO Wright Landing</td>
<td>1.40</td>
<td>1.66</td>
<td>36.72</td>
<td>23.66</td>
<td>5.63</td>
</tr>
<tr>
<td>Wright Landing TO Wool End</td>
<td>1.00</td>
<td>2.83</td>
<td>38.18</td>
<td>18.57</td>
<td>3.11</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.39</td>
<td>47.92</td>
<td>181.53</td>
<td>5.85</td>
</tr>
</tbody>
</table>

**FILE: C:\tor\mobile\co\TPSim.doc**

**DATE: 11/24/2005**

**TIME: 8:50:54**

**CAPTION: Present Normal RG-NE Mid Day**
5.3.2.4. NE – RG

The summary output file is:

---

Train Operations Model
Train Performance Simulation - Station Summary

Present 3 CRM cars

Noel End to Rock Garden Mid Day
Normal (-dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td></td>
<td>km/h</td>
<td>kwh/km</td>
</tr>
<tr>
<td>Noel End</td>
<td>1.80</td>
<td>3.18</td>
<td>33.95</td>
<td>19.39</td>
</tr>
<tr>
<td>Wright Line</td>
<td>1.40</td>
<td>1.87</td>
<td>45.02</td>
<td>27.17</td>
</tr>
<tr>
<td>Vermer Ave</td>
<td>2.40</td>
<td>2.26</td>
<td>63.83</td>
<td>38.73</td>
</tr>
<tr>
<td>Marion Place</td>
<td>1.40</td>
<td>1.10</td>
<td>50.11</td>
<td>28.43</td>
</tr>
<tr>
<td>Rock Garden</td>
<td>1.40</td>
<td>1.00</td>
<td>50.11</td>
<td>28.43</td>
</tr>
</tbody>
</table>

RUN SUMMARY

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td></td>
<td>kwh/km</td>
</tr>
<tr>
<td>Noel End</td>
<td>6.70</td>
<td>8.40</td>
<td>47.85</td>
</tr>
<tr>
<td>Marion Place</td>
<td>6.70</td>
<td>6.80</td>
<td>37.71</td>
</tr>
</tbody>
</table>

FILE: C:\tom\trainst\file\TPSnrn.dcr DATE: 11/24/2005 TIME: 8:58:42
CAPTION: Present Normal NE-RG Mid Day
5.3.3. PM PEAK

5.3.3.1. RG – FH

The summary output file is:

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td>minutes</td>
<td>kph</td>
<td>lwhk</td>
</tr>
<tr>
<td>Back Garden TO Marion Place</td>
<td>1.10</td>
<td>1.44</td>
<td>45.95</td>
<td>42.91</td>
</tr>
<tr>
<td>Marion Place TO Vernon Ave</td>
<td>2.40</td>
<td>2.42</td>
<td>59.46</td>
<td>63.97</td>
</tr>
<tr>
<td>Vernon Ave TO Dillard Dock</td>
<td>1.30</td>
<td>1.82</td>
<td>42.83</td>
<td>49.78</td>
</tr>
<tr>
<td>Dillard Dock TO Fenton Harbor</td>
<td>1.30</td>
<td>1.25</td>
<td>62.56</td>
<td>46.81</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>km</td>
<td>minutes</td>
<td>kph</td>
<td>lwhk</td>
</tr>
<tr>
<td>6.10</td>
<td>6.93</td>
<td>52.04</td>
<td>283.40</td>
<td>5.56</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\tom\tools\dco\TSS\FM\doc.doc
**DATE:** 11/24/2005
**TIME:** 8:58:49
**CAPTION:** Present Normal RG-FH PM Peak
5.3.3.2. **FH – RG**

The summary output file is:

![Train Operations Model - File Viewer](image)

```
Train Operations Model
Train Performance Simulation - Station Summary

Present 6 CRR cars
Fenton Harbor to Rock Garden PM Peak
Normal (-dir)

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>minutes</td>
<td>mph</td>
<td>kcal</td>
<td>J/kg</td>
<td>J/kg</td>
</tr>
<tr>
<td>Fenton Harbor to Billard Dock</td>
<td>1.30</td>
<td>1.57</td>
<td>49.52</td>
<td>46.94</td>
<td>6.02</td>
</tr>
<tr>
<td>Billard Dock to Vermore Ave</td>
<td>1.30</td>
<td>1.93</td>
<td>49.38</td>
<td>43.93</td>
<td>5.63</td>
</tr>
<tr>
<td>Vermore Ave to Marion Place</td>
<td>2.40</td>
<td>2.27</td>
<td>63.40</td>
<td>63.80</td>
<td>4.32</td>
</tr>
<tr>
<td>Marion Place to Rock Garden</td>
<td>1.40</td>
<td>1.11</td>
<td>59.61</td>
<td>49.18</td>
<td>6.74</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>minutes</td>
<td>kcal</td>
<td>J/kg</td>
<td>J/kg</td>
<td></td>
</tr>
<tr>
<td>RUN SUMMARY</td>
<td>6.10</td>
<td>6.88</td>
<td>53.16</td>
<td>199.18</td>
<td>54.4</td>
</tr>
</tbody>
</table>
```

**FILENAME:** C:\Tom\tomsat\doc\TSSfnp.doe  **DATE:** 11/24/2005  **TIME:** 0:50:37

**CAPTION:** Present Normal FH-RG PM Peak
5.3.3.3. RG – NE

The summary output file is:

```
Train Operations Model
Train Performance Simulation - Station Summary

Present 6 CMN cars
Rock Garden to Hoel End PM Peak
Normal (+dir)

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Time (min)</th>
<th>Speed (mph)</th>
<th>Energy (kwh)</th>
<th>Energy (kwh/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden</td>
<td>1.10</td>
<td>1.44</td>
<td>45.95</td>
<td>42.91</td>
</tr>
<tr>
<td>Marion Place</td>
<td>2.40</td>
<td>2.42</td>
<td>59.46</td>
<td>63.97</td>
</tr>
<tr>
<td>Vermea Ave</td>
<td>1.40</td>
<td>1.69</td>
<td>49.83</td>
<td>57.20</td>
</tr>
<tr>
<td>Wright Landing</td>
<td>1.00</td>
<td>2.03</td>
<td>38.18</td>
<td>39.53</td>
</tr>
</tbody>
</table>

RUN SUMMARY
6.70 3.37 40.01 203.42 5.06
```

FILENAME: C:\tom\tomsdata\v12\TSSmp.exe
DATE: 11/24/2005 TIME: 8:58:55
CAPTION: Present Normal RG-NE Mid Day
### 5.3.3.4. NE – RG

The summary output file is:

![Train Operations Model](image)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>min</td>
<td>mph</td>
<td>Joules</td>
<td>Joules</td>
</tr>
<tr>
<td>Moel End</td>
<td>1.00</td>
<td>3.19</td>
<td>33.82</td>
<td>35.96</td>
</tr>
<tr>
<td>Wright Liby</td>
<td>1.40</td>
<td>1.85</td>
<td>45.44</td>
<td>50.49</td>
</tr>
<tr>
<td>Vermer Ave</td>
<td>2.40</td>
<td>2.27</td>
<td>63.40</td>
<td>65.83</td>
</tr>
<tr>
<td>Marion Place</td>
<td>1.40</td>
<td>1.11</td>
<td>59.61</td>
<td>53.18</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

- **Distance:** 6.70 km
- **Time:** 8.42 min
- **Speed:** 47.74 mph
- **Energy:** 194.67 Joules
- **Energy:** 4.84 Joules

**FILE:** C:\tom\tomsat\kell\TSSrp.dse  **DATE:** 11/26/2005  **TIME:** 8:30:43

**CAPTION:** Present Normal NE–RG PM Peak
5.3.4. EVENING

5.3.4.1. RG – FH

The summary output file is:

![Train Operations Model - File Viewer](image)

Train Operations Model
Train Performance Simulation - Station Summary
 Present 3 CRH cars
 Rock Garden to Fenton Harbor Evening
 Normal (+dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>minutes</td>
<td>kph</td>
<td>kwh</td>
<td>kwh</td>
</tr>
<tr>
<td>Back Garden TO Marion Place</td>
<td>1.10</td>
<td>1.44</td>
<td>45.00</td>
<td>21.86</td>
</tr>
<tr>
<td>Marion Place TO Vermar Ave</td>
<td>2.40</td>
<td>2.44</td>
<td>99.09</td>
<td>34.76</td>
</tr>
<tr>
<td>Vermar Ave TO Dillard Dock</td>
<td>1.30</td>
<td>1.79</td>
<td>43.50</td>
<td>22.85</td>
</tr>
<tr>
<td>Dillard Dock TO Fenton Harbor</td>
<td>1.30</td>
<td>1.24</td>
<td>63.11</td>
<td>21.92</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>minutes</td>
<td>kph</td>
<td>kwh</td>
<td>kwh</td>
</tr>
<tr>
<td>6.10</td>
<td>6.91</td>
<td>53.00</td>
<td>100.89</td>
<td>5.51</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\tom\09data\dce\OPSfe_0ce.doc
**DATE:** 11/24/2005 **TIME:** 4:59:46
**CAPTION:** Present Normal RG-FH Evening
5.3.4.2. FH – RG

The summary output file is:

![Train Operations Model](image)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>min</td>
<td>mph</td>
<td>kWh</td>
<td>kWh</td>
</tr>
<tr>
<td>Fenton Harbor TO Billard Dock</td>
<td>1.30</td>
<td>1.50</td>
<td>49.47</td>
<td>23.70</td>
</tr>
<tr>
<td>Billard Dock TO Vernon Ave</td>
<td>1.30</td>
<td>1.93</td>
<td>48.35</td>
<td>22.15</td>
</tr>
<tr>
<td>Vernon Ave TO Marion Place</td>
<td>2.40</td>
<td>2.25</td>
<td>64.10</td>
<td>29.33</td>
</tr>
<tr>
<td>Marion Place TO Rock Garden</td>
<td>1.10</td>
<td>1.09</td>
<td>50.33</td>
<td>19.47</td>
</tr>
</tbody>
</table>

RUN SUMMARY

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FILENAME: C:\\<file name>  DATE: 11/26/2005  TIME: 8:58:34
CAPTION: Present Normal FH-RG Evening
5.3.4.3. **RG – NE**

The summary output file is:

```
Train Operations Model
Train Performance Simulation - Station Summary

Present 3 CRM cars
Rock Garden to Hoel End Evening
Normal (+dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock Garden TO Marion Place</td>
<td>1.10</td>
<td>1.44</td>
<td>45.80</td>
<td>21.46</td>
</tr>
<tr>
<td>Marion Place TO Vernon Ave</td>
<td>2.40</td>
<td>2.44</td>
<td>59.09</td>
<td>34.26</td>
</tr>
<tr>
<td>Vernon Ave TO Wright Landing</td>
<td>1.00</td>
<td>1.65</td>
<td>50.19</td>
<td>23.30</td>
</tr>
<tr>
<td>Wright Landing TO Hoel End</td>
<td>1.00</td>
<td>2.03</td>
<td>38.18</td>
<td>18.17</td>
</tr>
</tbody>
</table>

RUN SUMMARY

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.70</td>
<td>8.36</td>
<td>40.00</td>
<td>97.67</td>
<td>4.86</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomdata\doc\TSSImo.doc   DATE: 11/26/2005   TIME: 0:58:22
CAPTION: Present Normal RG-NH Evening
```
5.3.4.4. **NE – RG**

The summary output file is:

```plaintext
Train Operations Model
Train Performance Simulation - Station Summary

Present 3 CRN cars
Noel End to Rock Garden Evening
Normal (-dir)

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (km)</th>
<th>Time (min)</th>
<th>Speed (mph)</th>
<th>Energy (kWh)</th>
<th>Energy (kWh/mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noel End</td>
<td>1.00</td>
<td>3.18</td>
<td>33.95</td>
<td>19.09</td>
<td>3.53</td>
</tr>
<tr>
<td>Wright Line</td>
<td>1.40</td>
<td>1.85</td>
<td>45.34</td>
<td>25.70</td>
<td>6.12</td>
</tr>
<tr>
<td>Vermer Ave</td>
<td>2.40</td>
<td>2.25</td>
<td>64.10</td>
<td>29.33</td>
<td>4.10</td>
</tr>
<tr>
<td>Marion Place</td>
<td>1.40</td>
<td>1.09</td>
<td>60.13</td>
<td>19.87</td>
<td>6.02</td>
</tr>
<tr>
<td>Rock Garden</td>
<td>6.70</td>
<td>8.37</td>
<td>40.01</td>
<td>94.19</td>
<td>4.69</td>
</tr>
</tbody>
</table>

RUN SUMMARY

FILENAME: C:\tom\tomsat\tces\TSSrun.doc
DATE: 11/24/2005
TIME: 9:58:40
CAPTION: Present Normal NE-RG Evening
```
5.4. ENS INPUT FILES

Click the FCM command button on the TOM screen to obtain the File Construction Module – Main Screen.

Click the ENS Input checkbox to obtain the next screen.
5.4.1. NETWORK FILE

Double-click the Network entry in the ENS Input list box to obtain the next screen.
This is the Network File Input – Main Screen. It will be the first screen to complete for the electrical network input.

This screen is completed using the following input.

- Enter **N-b.dce** for the Name of File – name text box.
- Enter **Base** for File Captions text box.
- The remainder of the screen remains the same.

The screen is shown with this information entered.
Click the **AC Part of the Nodal Diagram** check box to obtain the next screen.
The default network will be used to generate the input for the nodal diagram, since the default network is close to the network shown in Section 3.3.1. The nodal diagram for the default network is shown next.
The default network can continue indefinitely with new substations, say M5, M6, M7, … Click the Use default sequence check box and the next screen is shown.
The next step in creating the default network is to create the AC lines for the five substations of the DC electric rail system network. In the Line Input Grid, click the mouse in the Line Name entry space. This action results in the next screen.
Press the **enter** key which results in the next screen.
Repeat this procedure, namely, Click on the new Line Name entry followed by a carriage return (enter key) until five lines have been generated. The screen is shown next.
Execute a carriage return and click the **Node Name** space in the **Node Input** grid. This action produces the following grid.
Click the **View DC Input** check box to show the following screen.
Click the **Line Input** grid on the space under **Line Name**. Click the **Node Input** grid on the space under **Node Name**. This action results in the following screen.
Next, click the **View Converter Input** check box.
Click the **Converter Input** grid at the A1 (first) entry. The result is the next screen.
This completes the input for the default network. Uncheck the **Use Default Network** check box. This action results in the following screen.
The screens are now ready for editing, so that the default network can be changed into the DC EM network. The first step is to make all converter parameters agree with the specification in Section 3.3.2. The results are shown in the next screen.
Click the View DC Input check box, which results in the following screen.
Modify the Line Input grid to agree with the DCEM Nodal diagram of Section 3.3.1. The first part of the Line Input grid is modified as follows.

Lines D2: Change T2 to T12
Lines D3: Change T2 to T12
Lines D4: Change T3 to D3
Lines D5: Delete using the Delete Row command button.
Lines D6: Change T4 to T34
Lines D7: Change T4 to T34
Scroll to the bottom of Line Input grid.

The status of the screen is shown next.
Continuing to modify the Line Input grid as follows.

Lines D8: Change T5 to T4
Lines D9: Change T5 to T35 and Trk # 1,2 to 3,4
Lines D10: Change T6 to T5 and Trk # 1,2 to 3,4

The present screen is shown next.
Continuing to modify the **Line Input** grid. Add two new lines, **D5**, with nodes **D3** to **T35**, Trk # 3 and 4. To accomplish this action click on last row, last column of Line Input grid and execute a carriage return. Enter the two lines as shown in the next screen.
Close the **Line Input** grid by clicking on the last row, last column and executing a double **carriage return**. Opening the **Node Input** grid by clicking on the first entry **Node Name** then follows this. The result is the following screen.
Add the information for the new nodes, T12, T34 and T35. To accomplish this action, for each of these nodes, click on the Node Type entry in the Node Input grid and select Load from the Select Node Type combo box. The result is the following screen.
Enter the right of way positions of all of the nodes as specified in Section 3.3.1. All of these nodes are track nodes, since they are on the tracks on which trains are running. To affirm them as track nodes, click on the entry spaces under Track Node. The result is the following screen.
The next step is to calculate the unit resistances for the DC Lines, using an Excel spreadsheet. Before this can be done, it is necessary to create the file and then import it back into the screen. Click the Select command button to advance to the Network File Input – Main Screen. This screen is shown next.
Click the **Create File** command button to create the file.
Click the Yes command button to review the file.
Close the **File Viewer**.

Double click on the file to import it back to the screen. Click the **DC Part of Nodal Diagram** check box. These actions lead to the following screen.

```
<table>
<thead>
<tr>
<th>Name</th>
<th></th>
<th>1</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>9500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>10</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>5</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>a1</td>
<td>m1</td>
<td>a1</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>a2</td>
<td>m2</td>
<td>a2</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>a3</td>
<td>m3</td>
<td>a3</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>a4</td>
<td>m4</td>
<td>a4</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>a5</td>
<td>m5</td>
<td>a5</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>n1</td>
<td>3</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>n2</td>
<td>3</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>n3</td>
<td>3</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>n4</td>
<td>3</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>n5</td>
<td>3</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>a1</td>
<td>4</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>a2</td>
<td>4</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>a3</td>
<td>4</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>a4</td>
<td>4</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>a5</td>
<td>4</td>
<td>1.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td>t1</td>
<td>b1</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>b2</td>
<td>t1</td>
<td>b2</td>
<td>2</td>
<td>.00000</td>
</tr>
<tr>
<td>b2</td>
<td>t1</td>
<td>b2</td>
<td>2</td>
<td>.00000</td>
</tr>
<tr>
<td>b3</td>
<td>t1</td>
<td>b3</td>
<td>1</td>
<td>.00000</td>
</tr>
<tr>
<td>b4</td>
<td>t1</td>
<td>b4</td>
<td>1</td>
<td>.00000</td>
</tr>
</tbody>
</table>
```
Click on the **Text Transfer** command button. This action produces the next screen.
Click on the **DC Lines** check box followed by a click on the **Import** command button. The screen becomes.
Copy this text to the **EXCEL** sheet.
### Network Input

#### DC Lines

<table>
<thead>
<tr>
<th>Line Name</th>
<th>Begin Node</th>
<th>End Node</th>
<th>Track #</th>
<th>Resistance (Unit Ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>T1</td>
<td>D1</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D1</td>
<td>T1</td>
<td>D1</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D2</td>
<td>D1</td>
<td>T12</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D2</td>
<td>D1</td>
<td>T12</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D3</td>
<td>T12</td>
<td>D2</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D3</td>
<td>T12</td>
<td>D2</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D4</td>
<td>D2</td>
<td>TS1</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D4</td>
<td>D2</td>
<td>TS1</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D5</td>
<td>TS1</td>
<td>D3</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D5</td>
<td>TS1</td>
<td>D3</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D6</td>
<td>D3</td>
<td>T34</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D6</td>
<td>D3</td>
<td>T34</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D7</td>
<td>T34</td>
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<td>0.0000</td>
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<tr>
<td>D7</td>
<td>T34</td>
<td>D4</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D8</td>
<td>D4</td>
<td>T4</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>D8</td>
<td>D4</td>
<td>T4</td>
<td>2</td>
<td>0.0000</td>
</tr>
<tr>
<td>D9</td>
<td>T35</td>
<td>D5</td>
<td>3</td>
<td>0.0000</td>
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<tr>
<td>D9</td>
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<td>4</td>
<td>0.0000</td>
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<td>D10</td>
<td>D5</td>
<td>T5</td>
<td>3</td>
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<td>D5</td>
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<td>4</td>
<td>0.0000</td>
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<td>D5</td>
<td>D3</td>
<td>T35</td>
<td>3</td>
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<td>D5</td>
<td>D3</td>
<td>T35</td>
<td>4</td>
<td>0.0000</td>
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</tbody>
</table>

Repeat the same procedure for the DC nodes.
### DC Nodes

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Type</th>
<th>Voltage</th>
<th>Power</th>
<th>Kilometerpos tTrack (y or n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>0.1y</td>
</tr>
<tr>
<td>D1</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>1y</td>
</tr>
<tr>
<td>T12</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>2.1y</td>
</tr>
<tr>
<td>D2</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>3y</td>
</tr>
<tr>
<td>D3</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>4y</td>
</tr>
<tr>
<td>T34</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>5.1y</td>
</tr>
<tr>
<td>D4</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>6.3y</td>
</tr>
<tr>
<td>T4</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>7.4y</td>
</tr>
<tr>
<td>T35</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>5y</td>
</tr>
<tr>
<td>D5</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>5.7y</td>
</tr>
<tr>
<td>T5</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>6.6y</td>
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</tbody>
</table>

Expand this to the following spreadsheet.

<table>
<thead>
<tr>
<th>Network Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Lines</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>D1</td>
</tr>
<tr>
<td>D1</td>
</tr>
<tr>
<td>D3</td>
</tr>
<tr>
<td>D3</td>
</tr>
<tr>
<td>D5</td>
</tr>
<tr>
<td>D5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DC Nodes</th>
<th>Node Name</th>
<th>Type</th>
<th>Voltage</th>
<th>Power</th>
<th>Milepost Track (y or n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>0.1y</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>1y</td>
<td></td>
</tr>
<tr>
<td>T12</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>2.1y</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>3y</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>4y</td>
<td></td>
</tr>
<tr>
<td>T34</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>5.1y</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>6.3y</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>7.4y</td>
<td></td>
</tr>
<tr>
<td>T35</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>5y</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Convr</td>
<td>1</td>
<td>0</td>
<td>5.7y</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>Load</td>
<td>1</td>
<td>0</td>
<td>6.6y</td>
<td></td>
</tr>
</tbody>
</table>
This spreadsheet will allow an automatic computation of the resistances. These can be copied directly from the spreadsheet and pasted into the **Text Transfer** screen.

Click the **Transfer** command button and the **DC Line** input will be transferred to the **Line Input** grid. Click the **Close** command button and the following screen appears.
Click the Select command button to produce the Network File Input – Main Screen, again, and recreate the file by clicking the Create File command button. The result is shown below.
Click the Yes command button to review the file.
Close the File Viewer. The Network file has been created.

5.4.2. OPERATING TIME FILES

Four Operating Time files must be created to cover the four periods of operation; namely, AM Peak, Mid Day, PM Peak and Evening. The File Construction Module – Main Screen is shown below with Op Tim highlighted.
A click on the Select command button under the ENS Input list box produces the Operating Time File Input screen.
Because the DCEM rail system is periodic in time, with a period of 6 minutes in the peak periods and 12 minutes in the off-peak periods, it is only necessary to perform ENS for 6 and 12 minutes, respectively, in each of these periods.

5.4.2.1. **AM PEAK**

The completed file for the **AM Peak** is shown next.
Click the **Create File** command button to create the file.
Click the Yes command button to review the file.
Close the **File Viewer**.

The completed files are shown for the remainder of the time periods.
5.4.2.2. **MID DAY**
5.4.2.3. **PM PEAK**

![Train Operations Model - File Viewer](image)

**PM Peak 16:00 - 16:06**

16: 0: 0 16: 6: 0 1, 0

FILE_NAME: C:\tom\tomsat\dce\OP-p.doc
5.4.2.4. **EVENING**

![Image of Train Operations Model - File Viewer]

File Name: C:\tom\toms1\dc\OP-e.dce

EVENING 20:00 - 20:12
20:0:0 20:12:0 1.0
FILENAME: C:\tom\toms1\dc\OP-e.dce
5.4.3. TRAIN LOCATION FILES

Four Train Location files must be created to cover the four periods of operation; namely, AM Peak, Mid Day, PM Peak and Evening. The File Construction Module – Main Screen is shown below with Trn Loc highlighted.

A click on the Select command button produces the Train Location File Input screen.
5.4.3.1. **AM PEAK**

Entries for the *Name of File – name* and *File Captions* are provided. The next step in the completion of a train location file is to select the p-files from the *P-File* list box, appropriate for the **AM Peak** operation. These files are *P-*a.dce and are chosen by clicking on them. The next screen shows the results.
These timetable entries for the basis for constructing the timetable. For an ENS run during any period, all trains should already be on the line for that period, rather than a transition from a previous period. Since the Operating Time file for the AM Peak will run the simulation from 8:00 – 8:06, the timetable should start early enough, so that by 8:00, the first trains of each Train ID should already have reached their arrival terminals.

Now the trains between Rock Garden and Fenton Harbor take 9 minutes for their runs (Section 5.3.1.1 and 5.3.1.2). Trains running between Rock Garden and Noel End take 11 minutes for their runs (Section 5.3.1.3 and 5.3.1.4). Thus the entries for each Train ID Departure Time should at least be 11 minutes before 8:00. The completed Timetable text box is shown next. This timetable was constructed using the conditions of Section 3.4.
Click on the Create File command button to produce the following screen.
Click the Yes command button to review the file.
5.4.3.2. MID DAY

The Train Location file for Mid Day can be created using the file, which was just created for the AM Peak. Modify the previous screen as follows.

- Change R6 to R3 in the Train ID.
- Change a to m in the Name of File – name text box.
- Change AM Peak to Mid Day in the File Caption text box.

These changes lead to the following screen.

Close the File Viewer.

5.4.3.2. MID DAY

The Train Location file for Mid Day can be created using the file, which was just created for the AM Peak. Modify the previous screen as follows.

- Change R6 to R3 in the Train ID.
- Change a to m in the Name of File – name text box.
- Change AM Peak to Mid Day in the File Caption text box.

These changes lead to the following screen.
The next step is to use the **Shift** command button to modify the **Departure Times**. This is accomplished with the help of the **Time Calculator**. First, note that the operating time for the AM Peak begins at 8:00 and the operating time for **Mid Day** begins at 10:00 and then click the **Time Calculator** command button. This action leads to the following screen.
Click the Subtract check box, which leads to the next screen.

Next enter 10:0 and 08:0 in the **Time in Hrs and Mins (hh:mm.mmm)**, **Minuend** and **Subtrahend** text boxes, respectively. This leads to the following screen.
Click the **Subtract** command button, which results in the following screen.

Copy the **Time in Seconds (ss) Result** text box and paste it in the **Shift Highlighted Values by Number of Seconds** text box of the **Train Location File Input** screen.
Highlight all of the entries in the Timetable text box by pacing the mouse cursor before the first entry and dragging the mouse along the left-hand side of the text box past the last entry. The results are shown in the following screen.
Click the **Shift** command button resulting in the following screen.
All of the Departure Times have been shifted by 7200 seconds or 2 hours. The next step is to bring the timetable into agreement with the conditions for Mid Day of Section 3.4, by eliminating records.

The following screen is obtained just by eliminating records.
The headway for each Train ID is now 12 minutes and the only entries that are not in agreement with the timetable specifications of Section 3.4, are the Train ID R3RN. These entries must be shifted by 3 minutes or 180 seconds by again using the Shift command button. The following screen shows the setup before the shift.
Clicking the **Shift** command button results in the following screen.
The timetable is now in agreement with the specification of Section 3.4. Click the Create File command button to create the file. The result is the next screen.
Completed screens for the remaining time periods are shown in the following sections.

5.4.3.3. **PM PEAK**

The completed screen is shown next.
5.4.3.4. EVENING

The completed screen is shown next.
5.4.4. CURRENT MEASUREMENT FILES

One Current Measurement Input file must be created to measure the current flowing out of Substation D3. The File Construction Module – Main Screen is shown below with Cur Meas highlighted.
Click the Select command button under the ENS Input list box to obtain the following screen.
In order to monitor the current flowing from substation D3, as specified in Section 4.1.5, ammeters are placed on all lines emanating from the substation.

The **Current Measurement Input** screen is filled in as follows.
Click on the Create File command button to complete the file creation process.
Click the Yes command button to review the file.
Close the File Viewer.
5.4.5. ENS FILE OF FILENAMES

The final set of files to develop is the File of Filenames. Each of these files will define an ENS run. One will be required for each peak and off peak period giving a total of 4 files for present operation. The first file for the AM Peak will be developed in some detail, while the remaining 3 will be presented in the File Viewer.

The File Construction Module – Main Screen is shown below with Fnames highlighted.

Click the Select command button under the ENS Input list box to produce the next screen.
Click on the **Network Input File** in the **Input File Type** list box to produce the following screen.
Double-click on the **N-b.dce** file in the **List of files** list box to produce the following screen.
Note that the ENS command button appears, allowing the running of the ENS from this screen. The ENS cannot be run, however, until a File of Filenames has been created.

5.4.5.1. AM PEAK

In a similar manner, load the next three filenames into the Input File Name list box, for AM Peak operation. The result is shown in the following screen.
The next task is to select all of the **Power Profile Inputs** appropriate for **AM Peak** running. Clicking the **Power Profile Inputs** in the **Input Type File** list box produces the following screen.
The **P-files** are then selected as shown in the following screen.
The next tasks are then accomplished to continue completion of the screen.

Change * to a in the Name of File – name text box.
Click the Load check box to obtain a Load Curve output file.
Click the Cur Meas check box to obtain a Current Measurement Output file.
Include a caption in the File Caption text box.

The result is the following screen.
Replace the * with an a in the **Load Curve** text box and **Cur Meas** text box and then click the **Create File** command button to finish the file. The result is the screen.
Click the Yes command button to review the file.
Close the File Viewer.
5.4.5.2. MID DAY
5.4.5.3. PM PEAK
5.4.5.4. EVENING

![Train Operations Model - File Viewer](image)

- File Name: `C:\tom\Tomsat\dc\VNSe.dce`
- **Network file input**
- `C:\tom\Tomsat\dc\OP-e.dce`
- **Operations file input**
- `C:\tom\Tomsat\dc\TL-e.dce`
- **Train locator file input**
- `C:\tom\Tomsat\dc\PP-e.dce`
- **Our nets file input**
- `C:\tom\Tomsat\dc\AR-e.dce`
- **Detailed output**
- `C:\tom\Tomsat\dc\Vn-e.dce`
- **Load Curve output**
- `C:\tom\Tomsat\dc\Vap-e.dce`
- **Car meas output**
- `C:\tom\Tomsat\dc\Vap\vpp.e.dce`
- **Power profile 1 input**
- `C:\tom\Tomsat\dc\Vap\vpe.e.dce`
- **Power profile 2 input**
- `C:\tom\Tomsat\dc\Vap\vte.e.dce`
- **Power profile 3 input**
- `C:\tom\Tomsat\dc\Vap\vme.e.dce`
- **Power profile 4 input**

**FILENAME:** `C:\tom\Tomsat\dc\VNSe.dce`
5.5. ENS RUNS

For Present, Normal, Summer Month Operation, four ENS runs will be required. The first run for the AM Peak will be developed in more detail, while the remaining three will be presented as just the summaries. Click the ENS command button on the Train Operation Model screen to obtain the following screen.
5.5.1. AM PEAK

Click on the ENSa.dce in the Files of Filenames list box to obtain the following screen.

Click the Select command button under the Files of Filenames list box to complete the ENS run.
Click the Yes command button to review the summary output in the File Viewer.
Scroll the right bars to the bottom of the screen.
This is the summary of the run. This summary is not saved. If there is a desire by the user to save it, it can be copied to Notepad and saved. It can also be printed.

This summary is shown for each of the remaining three ENS runs for present, normal, summer month operations.
5.5.2. MID DAY

The summary file is shown in the File Viewer.
5.5.3. PM PEAK

The summary file is shown in the File Viewer.

![File Viewer](image)

- File Name: C:\tom\onstemp.out
- Summary at 16: 6: .00
- KWh: 7015.419, 16: 5:51.00
- KVARh: 7595.407, 16: 5:52.00
- KVARh/PCD: 3.357, 16: 5:51.00
- KVARh: 7184.802, 16: 5:53.00
- KVARh/PCD: 2.747, 16: 5:55.00
- KVARh: 6701.256, 16: 5:54.00
- KVARh/PCD: 2.441, 16: 5:55.00
- KVARh: 6794.234, 16: 5:56.00
- KVARh/PCD: 2.441, 16: 5:57.00
- KVARh: 5676.385, 16: 5:58.00
- KVARh/PCD: 1.221, 16: 5:59.00
- KVARh: 5033.826, 16: 6: 0.00
- KVARh/PCD: .916, 16: 6: 0.00
- KVARh: 4788.821, 16: 6: 0.00
- KVARh/PCD: .610, 16: 6: 0.00
- KVARh: 4280.100, 16: 6: 0.00
- KVARh/PCD: .305, 16: 6: 0.00
- KVARh: 4990.793, 16: 6: 0.00
- KVARh/PCD: 2.747, 16: 6: 0.00

- Metering Point Energy: 054.9, .5, 5.57, .00
- Energy Delivered to Vehicles: 800.0, .0, 5.21, .00
- Energy Regenerated by Vehicles: .0, .0, .00, .00
- AC Network Losses: .0, .0, .00, .00
- Converter Losses: 24.3, .0, .16, .00
- DC Network Losses: 30.7, .0, .20, .00
- Total Network Losses: 55.0, .0, .36, .00
- Energy Balance for Network: -.1

- Accumulated Car-Distance: 153.60
- Number of Non-Convergent Snapshots: 0

- File Name: C:\tom\onstemp\onstemp.out
- Date: 11/28/2000
- Time: 7:55:18
- Caption: PM Peak
5.5.4. EVENING

The summary file is shown in the File Viewer.

![File Viewer screenshot]

- File Name: C:\tom\onstemp.out
- Time: 20:11:51.00 to 20:12:12.00
- Summarized at 20:12:12.00

**Summary:****

- **Energy Delivered to Vehicles:** 144.125
- **Energy Regenerated by Vehicles:** -0.916
- **AC Network Losses:** -1.221
- **DC Network Losses:** -1.221
- **Total Network Losses:** -1.221
- **Energy Balance for Network:** 0.0
- **Accumulated Car-Distance:** 110.00
- **Number of Non-Convergent Snapshots:** 0

**File Path:** C:\tom\onstemp\onstemp.out
**Date:** 11/28/2003 **Time:** 7:36:18
**Caption:** Evening
5.6. FILE MANIPULATION MODULE – LOAD CURVE EXTENSION

The Load Curve files, which were calculated during the ENS and provided as output, were only developed for the cycle time of the rail system. They now must be extended to one hour. Click the FMM command button on the Train Operations Model screen to produce the following screen.

![File Manipulation Module - Main Screen](image)

Click the Extend Load Curve command button to produce the next screen.
5.6.1. AM PEAK

Complete the screen using the following procedure.

Change the * to ax in the Name of Converted File – name text box.
Double-click on L-a.dce in the Load Curves Available list box.

These actions will produce the following screen.
In the To: hh:mm:ss / Extended: text box enter 9:00. Click the Create File command button leading to the following screen.
This completes the extended **Load Curve** for the **AM Peak**. The completed screens will be shown for each of the other extended load curves.
5.6.2. MID DAY

The completed screen for the extended load curve follows.
5.6.3. PM PEAK

The completed screen for the extended load curve follows.

5.6.4. EVENING

The completed screen for the extended load curve follows.
5.7. ENERGY COST MODULE – COMPUTE ENERGY-DEMAND

Having built the extended load curves for the peak and off peak operating periods, the Energy-Demand Computer can now be used to obtain meter readings. Click the ECM command button on the Train Operations Model screen, leading to the following screen.

Click the Compute Energy-Demand command button to obtain the following screen.

![Diagram of Energy Cost Module - Main Screen]

Select a Rail System

DCEM

Select a procedure:

Compute Energy-Demand

Consolidate Load Curves

Exit

Help

Reset

Close

Page 324 of 764
5.7.1. AM PEAK

For the AM Peak operating period, complete the screen as follows.

- Change * to ax for the Name of Output File – name text box.
- Enter 30 in the Demand Interval text box as specified in Section 3.3.4
- In the Load Curves Available list box, double-click L-ax.dce.
- Change * to ax for the Name of File for meter readings (OUTPUT) text box.
- Enter AM Peak in the upper Captions text box.

These actions result in the following screens.

Clicking the Create File command button completes the file creation process for EDCax.dce and M-ax.dce. The result is shown in the next screen.
Click the **Yes** command button to review the file.
DEMAND AND ENERGY METER READINGS

AM Peak

load curve from 8:0:0 TO 9:0:0 meters-5 cor-dist-1336.00

meter ** demand interval ** ** metered demand quantities **

<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th>kwh</th>
<th>kva</th>
<th>ave pf</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>8:0:0 TO 8:30:0</td>
<td>2261.5</td>
<td>2261.5</td>
<td>1.000</td>
</tr>
<tr>
<td>E1</td>
<td>8:30:0 TO 9:0:0</td>
<td>2261.5</td>
<td>2261.5</td>
<td>1.000</td>
</tr>
</tbody>
</table>

M1 8:0:0 TO 9:0:0 ENERGY USED - 2261.5 kwh

1.47 kwh peak

meter ** demand interval ** ** metered demand quantities **

<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th>kwh</th>
<th>kva</th>
<th>ave pf</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2</td>
<td>8:0:0 TO 8:30:0</td>
<td>1477.5</td>
<td>1477.5</td>
<td>1.000</td>
</tr>
<tr>
<td>E2</td>
<td>8:30:0 TO 9:0:0</td>
<td>1477.5</td>
<td>1477.5</td>
<td>1.000</td>
</tr>
</tbody>
</table>

E2 8:0:0 TO 9:0:0 ENERGY USED - 1477.5 kwh

.95 kwh peak

meter ** demand interval ** ** metered demand quantities **

<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th>kwh</th>
<th>kva</th>
<th>ave pf</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>8:0:0 TO 8:30:0</td>
<td>2629.3</td>
<td>2629.4</td>
<td>1.000</td>
</tr>
<tr>
<td>E3</td>
<td>8:30:0 TO 9:0:0</td>
<td>2629.3</td>
<td>2629.4</td>
<td>1.000</td>
</tr>
</tbody>
</table>

E3 8:0:0 TO 9:0:0 ENERGY USED - 2629.3 kwh

.10 kwh peak

Scroll to the bottom to produce the following screen.
<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th>Metered Demand Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>8:00:00 TO 9:00:00</td>
<td>1260.0 1260.0 1.000</td>
</tr>
<tr>
<td>M5</td>
<td>9:00:00 TO 9:30:00</td>
<td>1260.0 1260.0 1.000</td>
</tr>
<tr>
<td></td>
<td>ENERGY USED:</td>
<td>1260.0 kWh</td>
</tr>
</tbody>
</table>

:: CONSOLIDATED DEMAND AND ENERGY ::

**AM Peak**

Load curve from 8:00:00 TO 9:00:00

<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th>Metered Demand Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>8:00:00 TO 9:00:00</td>
<td>8609.0 8609.0 1.000</td>
</tr>
<tr>
<td>ALL</td>
<td>9:00:00 TO 9:30:00</td>
<td>8609.0 8609.0 1.000</td>
</tr>
<tr>
<td></td>
<td>ENERGY USED:</td>
<td>8609.0 kWh</td>
</tr>
</tbody>
</table>

Kwhpgd is 5.61 based on 1336.00 estimated car-dist
5.7.2. MID DAY
The completed screen for the operating period follows.

Clicking the Yes command button and scrolling to the bottom of the file produces the next screen.
### Consolidated Demand and Energy

**Mid Day**

<table>
<thead>
<tr>
<th>Meter</th>
<th>Demand Interval</th>
<th><strong>Demand Quantities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>kW</td>
</tr>
<tr>
<td>ALL</td>
<td>10:00:00 to 10:30:00</td>
<td>2140.8</td>
</tr>
<tr>
<td>ALL</td>
<td>10:30:00 to 11:00:00</td>
<td>2032.3</td>
</tr>
</tbody>
</table>

Energy used: 2066.6 kWh

**Adjusted to 2.72 based on 76.00 estimated car-dist**
5.7.3. PM PEAK

The completed screen for the operating period follows.

Clicking the Yes command button and scrolling to the bottom of the file produces the next screen.
.66 kwhpeak

Meter ** Demand Interval ** ** Metered Demand Quantities **
__kw  kva  ave pf
RS  16: 0: 0 TO 16:30: 0  1250.2  1250.2  1.000
RS  16:30: 0 TO 17: 0: 0  1250.2  1250.2  1.000

RS  16: 0: 0 TO 17: 0: 0  ENERGY USED--  1250.2 kwh

.81 kwhpeak

:: CONSOLIDATED DEMAND AND ENERGY ::

PM Peak

Load curve from 16: 0: 0 TO 17: 0: 0 @meters-  5  car-dist-  1936.00

Meter ** Demand Interval ** ** Metered Demand Quantities **
__kw  kva  ave pf
ALL  16: 0: 0 TO 16:30: 0  8548.7  8548.7  1.000
ALL  16:30: 0 TO 17: 0: 0  8548.7  8548.7  1.000

ALL  16: 0: 0 TO 17: 0: 0  ENERGY USED--  8548.7 kwh

Kwh peak is  5.57 based on  1936.00 estimated car-dist
5.7.4. EVENING

The completed screen for the operating period follows.

Clicking the **Yes** command button and scrolling to the bottom of the file produces the next screen.
Sat 20:0:0 TO 21:0:0

ENERGY USED -- 290.0 kWh

르 20:0:0 TO 21:0:0

ENERGY USED -- 1992.2 kWh

allocated is 5.19 based on 384.00 estimated car-dist
5.8. FILE MANIPULATION MODULE – METER READER

Clicking the Meter Reader command button on the File Manipulation Module – Main Screen, which is shown below, exposes the Meter Reader screen.

The result is the next screen.
5.8.1. AM PEAK

Double-clicking `M-ax.dce` in the Type File list box yields the meter readings for one hour in the AM Peak operating period.
The values here can be copied directly from the text box and pasted into a daily load curve in a spreadsheet as follows.
The paste repeated three times yields the **AM Peak Load Curve**, since it repeats every hour.

5.8.2. MID DAY

There is a similar screen shown next.
5.8.3. PM PEAK

There is a similar screen shown next.
5.8.4. EVENING
There is a similar screen shown next.

All of these screens provide the information necessary to develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurvePresentNormalSummer (see index tab).

5.9. OTHER PRESENT OPERATION

5.9.1. NORMAL OPERATION
Present, Normal Operation is the Base Case, to which everything else is to be compared. It consists of Summer, Winter, Spring & Fall Cases. An annual summary is constructed in an EXCEL spread sheet.
5.9.1.1. **SUMMER**

All of the summer runs have been completed and the load curves have been generated in the spreadsheet. At this point, all of the DCEE Rail System TOM files are archived in the zip file: DCEMPresentNormalSummer.zip. This process will allow the user to use the same files for all of the estimates, without going through the complicated effort of tracking file names.

5.9.1.2. **WINTER**

The present files in the Rail System Database and Directory are used. No new filenames will be created. The Train files are the only ones to be modified to account for the different value of auxiliary power.

5.9.1.2.1. **TRAIN FILE MODIFICATION**

Begin with the Train Operation Model screen shown below.

Click the FCM command button to expose the following screen.
Click the **TPS Input** check box to produce the following screen.
Double-click the Train entry in the TPS Input list box. These action leads to the following screen.
Double-click on the **T-pr3.dce** file in the **Train File** list box to expose the next screen.
Click the **Train Makeup Input** check box to the next screen.
Change the Aux Power/Car Type 1 and Type 2 cells to the winter value of 40 as specified in Section 3.1.3. This action produces the following screen.
Click the **Select** command button to go back to the previous screen.
Click the **Create File** command button to recreate the **T-pr3.dce** file with the winter auxiliary power instead of summer.
Click the Yes command button to review the file.
Close the File Viewer.

Double-click the T-pr6.dce entry in the Train File list box screen to import the file into the screen.
The same procedure is now followed to recreate the **T-pr6.dce** train file with winter rather than summer auxiliary power.

The resulting **Train** file is shown in the **File Viewer**.
There is no need to modify the other Train files, since they are not used in Present, Normal Operation.

5.9.1.2. BATCH TPS AND ENS PROCESSES

Since all files remain the same as in previous operation, both the TPS and ENS runs can be batched to produce the Load Curves.

On the Train Operation Model screen, click the TPS command button. The following screen appears.
Click the **Batch Run** command button to complete all of the runs.

The next step is the **ENS** runs. Click the **ENS** command button on the **Train Operation Model** screen to obtain the following screen.
Click the **Batch Run** command button to complete all of the **ENS** runs.

### 5.9.1.2.3. LOAD CURVE EXTENSION
Load curve extension is much faster at this stage. Click the **FMM** command button on the **Train Operations Model** screen to obtain the following screen.
Click the **Extend Load Curve** command button to obtain the next screen.
The following procedure will be repeated for the following load curves L-ax.dce, L-ex.dce, L-mx.dce and L-px.dce. The details are stepped through for L-ax.dce.

Double-click on L-ax.dce in the Type File list box.
Double-click on L-a.dce in the Load Curves Available list box.

These actions lead to the following screen.
Extend the Load Curve one hour to 9:00 and click the Create File command button to produce the following screen.
Repeat the procedure for L-ex.dce, L-mx.dce and L-px.dce.

5.9.1.2.4. ENERGY DEMAND COMPUTATION
On the Train Operation Model screen, click the ECM command button. The result is the next screen.
Click the **Compute Energy – Demand** command button, which gives the next screen.
For the AM Peak, double click the EDCax.dce file, the L-ax.dce file and the M-ax.dce file in their respective list boxes and enter a Demand Interval of 30. The resulting screen is next.
5.9.1.2.5. METER READING

The Meter files were created in the previous section. Clicking on the **Meter Reader** command button of the **File Manipulation Module – Main Screen**, which is shown next.

Click the **Create File** command button for the resulting files.

This procedure is repeated for Mid Day (* = mx), PM Peak (* = px) and Evening (* = ex).
will lead to the next screen.
For the AM Peak, double-click on the M-ax.dce file to produce the following screen.
These meter readings can be cut and pasted into the appropriate Excel sheet to create a Daily Load Curve.

5.9.1.2.6. DAILY LOAD CURVE CONSTRUCTION

All of these screens provide the information necessary to develop Weekday and Weekend Load Curves in an Excel sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurvePresentNormalWinter (see index tab).

5.9.1.2.7. ARCHIVING TOM FILES

In a similar manner, these files are archived in the file: DCEMPresentNormalWinter.zip

5.9.1.3. SPRING AND FALL

5.9.1.3.1. TRAIN FILE MODIFICATION

The process for modifying the winter month Train files into the spring or fall month Train files is the same as that in Section 5.9.1.2.1 except that the Aux Power/Car for Type 1 and Type 2 cars is changed to 10, where previously it was changed to 40.
5.9.1.3.2. BATCH TPS AND ENS PROCESSES
The same procedure is used as outlined in Section 5.9.1.2.2

5.9.1.3.3. LOAD CURVE EXTENSION
The same procedure is used as outlined in Section 5.9.1.2.3

5.9.1.3.4. ENERGY DEMAND COMPUTATION
The same procedure is used as outlined in Section 5.9.1.2.4

5.9.1.3.5. METER READING
The same procedure is used as outlined in Section 5.9.1.2.5

5.9.1.3.6. DAILY LOAD CURVE CONSTRUCTION
All of these screens provide the information necessary to develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label: LoadCurvePresentNormalSpringAndFall (see index tab).

5.9.1.3.7. ARCHIVING TOM FILES
In a similar manner, these files are archived in the file: DCEMPresentNormalSpringAndFall.zip.

5.9.1.4. ANNUAL
To obtain an estimate of annual demand and energy for present, normal operation, it is necessary to integrate over the daily load curves and develop a weighted sum using assumed Calendar Data.

<table>
<thead>
<tr>
<th>Calendar Data</th>
<th>Weekdays</th>
<th>Sat &amp; Sun</th>
<th>Holidays</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>63.57</td>
<td>25.43</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Winter</td>
<td>63.57</td>
<td>25.43</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Spring &amp; Fall</td>
<td>127.14</td>
<td>50.86</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Holidays per Year</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Days per Year</td>
<td>365</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekdays Sat &amp; Sun/year</td>
<td>356</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekdays Sat &amp; Sun/month</td>
<td>29.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekdays/Month</td>
<td>21.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sat &amp; Sun /month</td>
<td>8.48</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The summary is developed in the EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label: SummaryPresentNormal (see index tab).

5.9.2. COASTING TYPE 1 OPERATION
There are only two files that are changed for all Coasting Operations. These are the Control Files. Control Files have been created for Coasting Type 1. These are shown in Section 5.2.1.2.

5.9.2.1. SUMMER
The following procedure is used develop the Load Curves.
Extract the archived files from `DCEMPresentNormalSummer.zip`. Modify the Control Files as outlined in Section 5.2.1.2. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop **Weekday and Weekend Load Curves** in an EXCEL sheet as shown in the file: `DCEMWorkbookForInstructionManual.xls` at the label `LoadCurvePresentCoastingType1Summer` (see index tab). Archive the files in the Archive file: `DCEMPresentCoastingType1Summer.zip`.

### 5.9.2.2. WINTER

The following procedure is used to develop the **Load Curves**.

Extract the archived files from `DCEMPresentNormalWinter.zip`. Modify the Control Files as outlined in Section 5.2.1.2. Equivalently, extract the Control files from `DCEMPresentCoastingType1Summer.zip`. If done in the latter manner, they must be imported and recreated to bring the Rail System Database in line. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: `DCEMWorkbookForInstructionManual.xls` at the label `LoadCurvePresentCoastingType1Winter`. Archive the files in the Archive file: `DCEMPresentCoastingType1Winter.zip`.

### 5.9.2.3. SPRING AND FALL

The following procedure is used to develop the **Load Curves**.

Extract the archived files from `DCEMPresentNormalSpringAndFall.zip`. Modify the Control Files as outlined in Section 5.2.1.2. Equivalently, extract the Control files from `DCEMPresentCoastingType1Summer.zip`. If done in the latter manner, they must be imported and recreated to bring the Rail System Database in line. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: `DCEMWorkbookForInstructionManual.xls` at the label `LoadCurvePresentCoastingType1SpringAndFall`. Archive the files in the Archive file: `DCEMPresentCoastingType1SpringAndFall.zip`. 
5.9.2.4. **ANNUAL**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](#) at the label **Summary Present Coasting Type 1 Operation**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy</th>
<th>Demand</th>
<th>Winter Energy</th>
<th>Demand</th>
<th>Spring &amp; Fall Energy</th>
<th>Demand</th>
<th>Annual Energy</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1,477,807</td>
<td>2,242</td>
<td>1,525,890</td>
<td>2,315</td>
<td>1,442,547</td>
<td>2,096</td>
<td>4,445,244</td>
<td>26,247</td>
</tr>
<tr>
<td>M2</td>
<td>911,439</td>
<td>1,354</td>
<td>946,485</td>
<td>1,419</td>
<td>886,601</td>
<td>1,259</td>
<td>2,744,526</td>
<td>15,894</td>
</tr>
<tr>
<td>M3</td>
<td>1,741,751</td>
<td>2,623</td>
<td>1,813,348</td>
<td>2,731</td>
<td>1,691,100</td>
<td>2,415</td>
<td>5,246,160</td>
<td>30,522</td>
</tr>
<tr>
<td>M4</td>
<td>724,903</td>
<td>1,117</td>
<td>767,722</td>
<td>1,182</td>
<td>694,488</td>
<td>989</td>
<td>2,187,113</td>
<td>12,831</td>
</tr>
<tr>
<td>M5</td>
<td>825,753</td>
<td>1,244</td>
<td>853,700</td>
<td>1,288</td>
<td>800,730</td>
<td>1,163</td>
<td>2,485,272</td>
<td>14,560</td>
</tr>
<tr>
<td>ALL</td>
<td>5,681,603</td>
<td>8,548</td>
<td>5,907,235</td>
<td>8,887</td>
<td>5,520,468</td>
<td>7,872</td>
<td>17,109,304</td>
<td>99,537</td>
</tr>
</tbody>
</table>

5.9.2.5. **ANNUAL SAVINGS**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](#) at the label **Summary Present Coasting Type 1 Savings**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy</th>
<th>Demand</th>
<th>Winter Energy</th>
<th>Demand</th>
<th>Spring &amp; Fall Energy</th>
<th>Demand</th>
<th>Annual Energy</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>-0.23%</td>
<td>0.84%</td>
<td>-0.21%</td>
<td>0.86%</td>
<td>-0.24%</td>
<td>0.95%</td>
<td>-0.22%</td>
<td>0.89%</td>
</tr>
<tr>
<td>M2</td>
<td>-4.60%</td>
<td>4.48%</td>
<td>-4.42%</td>
<td>4.32%</td>
<td>-4.74%</td>
<td>4.91%</td>
<td>-4.58%</td>
<td>4.64%</td>
</tr>
<tr>
<td>M3</td>
<td>-2.83%</td>
<td>3.32%</td>
<td>-2.48%</td>
<td>3.05%</td>
<td>-2.77%</td>
<td>3.72%</td>
<td>-2.62%</td>
<td>3.45%</td>
</tr>
<tr>
<td>M4</td>
<td>-6.85%</td>
<td>-3.34%</td>
<td>-6.75%</td>
<td>-3.24%</td>
<td>-6.79%</td>
<td>-3.56%</td>
<td>-6.80%</td>
<td>-3.42%</td>
</tr>
<tr>
<td>M5</td>
<td>1.68%</td>
<td>1.27%</td>
<td>1.61%</td>
<td>1.23%</td>
<td>1.73%</td>
<td>1.36%</td>
<td>1.67%</td>
<td>1.30%</td>
</tr>
<tr>
<td>ALL</td>
<td>1.08%</td>
<td>-0.71%</td>
<td>0.98%</td>
<td>-0.64%</td>
<td>1.18%</td>
<td>0.94%</td>
<td>1.08%</td>
<td>0.88%</td>
</tr>
</tbody>
</table>
5.9.3. COASTING TYPE 2 OPERATION
There are only two files that are changed for all Coasting Operations. These are the Control Files. Control Files have been created for Coasting Type 2. These are shown in Section 5.2.1.2.

5.9.3.1. SUMMER
The following procedure is used develop the Load Curves.

Excerpt the archived files from \texttt{DCEMPresentNormalSummer.zip}.
Modify the Control Files as outlined in Section 5.2.1.2.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: \texttt{DCEMWorkbookForInstructionManual.xls} at the label \texttt{LoadCurvePresentCoastingType2Summer}.
Archive the files in the Archive file: \texttt{DCEMPresentCoastingType2Summer.zip}.

5.9.3.2. WINTER
The following procedure is used develop the Load Curves.

Excerpt the archived files from \texttt{DCEMPresentNormalWinter.zip}.
Modify the Control Files as outlined in Section 5.2.1.2.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: \texttt{DCEMWorkbookForInstructionManual.xls} at the label \texttt{LoadCurvePresentCoastingType2Winter}.
Archive the files in the Archive file: \texttt{DCEMPresentCoastingType2Winter.zip}.

5.9.3.3. SPRING AND FALL
The following procedure is used develop the Load Curves.

Excerpt the archived files from \texttt{DCEMPresentNormalSpringAndFall.zip}.
Modify the Control Files as outlined in Section 5.2.1.2.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: \texttt{DCEMWorkbookForInstructionManual.xls} at the label \texttt{LoadCurvePresentCoastingType2SpringAndFall}.
Archive the files in the Archive file: \texttt{DCEMPresentCoastingType2SpringAndFall.zip}.
5.9.3.4. **ANNUAL**
The summary is developed in the EXCEL sheet as shown in the file: `DCEMWorkbookForInstructionManual.xls` at the label **Summary_Present_Coasting_Type_2_Operation**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Energy Demand</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1,471,837</td>
<td>2,235</td>
<td>1,519,930</td>
<td>2,301</td>
<td>4,428,526</td>
</tr>
<tr>
<td>M2</td>
<td>909,341</td>
<td>1,356</td>
<td>944,036</td>
<td>1,408</td>
<td>2,737,551</td>
</tr>
<tr>
<td>M3</td>
<td>1,741,082</td>
<td>2,620</td>
<td>1,811,175</td>
<td>2,726</td>
<td>5,243,090</td>
</tr>
<tr>
<td>M4</td>
<td>672,215</td>
<td>1,020</td>
<td>713,126</td>
<td>1,089</td>
<td>2,029,428</td>
</tr>
<tr>
<td>M5</td>
<td>824,227</td>
<td>1,240</td>
<td>852,264</td>
<td>1,302</td>
<td>2,481,076</td>
</tr>
<tr>
<td>ALL</td>
<td>5,618,702</td>
<td>8,419</td>
<td>5,840,491</td>
<td>8,752</td>
<td>16,919,971</td>
</tr>
</tbody>
</table>

5.9.3.5. **SAVINGS**
The summary is developed in the EXCEL sheet as shown in the file: `DCEMWorkbookForInstructionManual.xls` at the label **Summary_Present_Coasting_Type_2_Savings**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Energy Demand</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>0.63%</td>
<td>1.46%</td>
<td>0.56%</td>
<td>1.49%</td>
<td>0.66%</td>
</tr>
<tr>
<td>M2</td>
<td>4.82%</td>
<td>5.04%</td>
<td>4.67%</td>
<td>4.86%</td>
<td>4.85%</td>
</tr>
<tr>
<td>M3</td>
<td>2.66%</td>
<td>3.43%</td>
<td>2.59%</td>
<td>3.29%</td>
<td>2.57%</td>
</tr>
<tr>
<td>M4</td>
<td>0.92%</td>
<td>0.58%</td>
<td>0.84%</td>
<td>0.55%</td>
<td>0.90%</td>
</tr>
<tr>
<td>M5</td>
<td>1.87%</td>
<td>1.50%</td>
<td>1.78%</td>
<td>1.54%</td>
<td>1.84%</td>
</tr>
<tr>
<td>ALL</td>
<td>2.17%</td>
<td>2.21%</td>
<td>2.10%</td>
<td>2.15%</td>
<td>2.17%</td>
</tr>
</tbody>
</table>
5.9.4. COASTING TYPE 3 OPERATION

There are only two files that are changed for all Coasting Operations. These are the Control files. Control files have been created for Coasting Type 3. These are shown in Section 5.2.1.3.

5.9.4.1. SUMMER

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMPresentNormalSummer.zip. Modify the Control Files as outlined in Section 5.2.1.3. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurvePresentCoastingType3Summer. Archive the files in the Archive file: DCEMPresentCoastingType3Summer.zip.

5.9.4.2. WINTER

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMPresentNormalWinter.zip. Modify the Control Files as outlined in Section 5.2.1.3. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurvePresentCoastingType3Winter. Archive the files in the Archive file: DCEMPresentCoastingType3Winter.zip.

5.9.4.3. SPRING AND FALL

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMPresentNormalSpringAndFall.zip. Modify the Control Files as outlined in Section 5.2.1.3. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5. Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurvePresentCoastingType3SpringAndFall. Archive the files in the Archive file: DCEMPresentCoastingType3SpringAndFall.zip.
5.9.4.4. ANNUAL

The summary is developed in the EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label Summary_Present_Coasting_Type_3_Operation.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1,471,370 2,304</td>
<td>1,519,262 2,327</td>
<td>1,436,301 2,108</td>
<td>4,426,932 26,391</td>
</tr>
<tr>
<td>M2</td>
<td>950,599 1,422</td>
<td>985,965 1,472</td>
<td>928,653 1,379</td>
<td>2,853,128 16,605</td>
</tr>
<tr>
<td>M3</td>
<td>1,779,592 2,692</td>
<td>1,850,244 2,803</td>
<td>1,730,094 2,488</td>
<td>5,360,271 31,431</td>
</tr>
<tr>
<td>M4</td>
<td>676,067 1,028</td>
<td>717,408 1,089</td>
<td>648,560 908</td>
<td>2,042,975 11,799</td>
</tr>
<tr>
<td>M5</td>
<td>835,212 1,254</td>
<td>863,660 1,296</td>
<td>819,790 1,173</td>
<td>2,514,683 14,670</td>
</tr>
<tr>
<td>ALL</td>
<td>5,713,930 8,575</td>
<td>5,936,539 8,908</td>
<td>5,557,399 7,912</td>
<td>17,207,868 99,924</td>
</tr>
</tbody>
</table>

5.9.4.5. SAVINGS

The summary is developed in the EXCEL sheet as shown in the file: DCEEWorkbookForInstructionManual.xls at the label Summary_Present_Coasting_Type_3_Savings.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>0.66% 0.31%</td>
<td>0.64% 0.34%</td>
<td>0.68% 0.38%</td>
<td>0.66% 0.38%</td>
</tr>
<tr>
<td>M2</td>
<td>0.51% 0.42%</td>
<td>0.43% 0.34%</td>
<td>0.44% 0.38%</td>
<td>0.46% 0.38%</td>
</tr>
<tr>
<td>M3</td>
<td>0.49% 0.55%</td>
<td>0.49% 0.52%</td>
<td>0.53% 0.60%</td>
<td>0.50% 0.57%</td>
</tr>
<tr>
<td>M4</td>
<td>0.23% 0.29%</td>
<td>0.24% 0.27%</td>
<td>0.27% 0.33%</td>
<td>0.25% 0.30%</td>
</tr>
<tr>
<td>M5</td>
<td>0.56% 0.48%</td>
<td>0.47% 0.46%</td>
<td>0.50% 0.51%</td>
<td>0.51% 0.49%</td>
</tr>
<tr>
<td>ALL</td>
<td>0.52% 0.39%</td>
<td>0.49% 0.39%</td>
<td>0.52% 0.44%</td>
<td>0.51% 0.42%</td>
</tr>
</tbody>
</table>
6. INPUT FILE CONSTRUCTION AND SIMULATION – FUTURE OPERATION

6.1. DATA BASE AND DIRECTORY

The first step is to exit the TOM by clicking the Exit command button on the Train Operation Model screen or any other screen with an Exit command button. Next open the TOM again by clicking on its icon. This will assure that all procedures completed previously are erased from memory. This following screen should now be present.

The next step is to click on the Database Utility command button DB on the main TOM screen. This action will produce the following screen.
Click on DCEM followed by a click on the Delete command button will delete the database after confirmation of the delete action. This leads to the next screen.
The database is now recreated using the procedure outlined in Section 5.1. After completion of this procedure, extract the files from the archive file: `DCEMPresentNormalSummer.zip`.

Having created the Rail System Database and Directory for the DCEM Rail Transit System, the user is ready to proceed with developing the input files for the TOM for future operation.

The File Construction Module (FCM) is required to construct the input files for the TOM. To access this module, first select the DCEM item in the Rail System combo box and selecting the Metric item in the Default Units combo box.
Clicking the FCM command button, results in the following screen.
All of the input files can now be constructed from links to this screen.

### 6.2. TPS INPUT FILES
Selecting the TPS Input check box on the previous screen produces the following.
The user can now select from one of the TPS Input files, which are displayed on the screen. Only two types of new files need be constructed, these are the Train files and the Files of Filenames.

6.2.1. TRAIN FILE
The procedure for creation of the new train files for future operation was highlighted in Section 5.2.2.2. The CHO Car Unit will be used exclusively in the off peak periods and a mixture of 2-CAM Car Units and 2-CHO Car Units will be used during the peak periods. All of these files have already been created and reside in the Rail System Database and Directory.

6.2.2. TPS FILE OF FILENAMES
Modifying as little as possible of the work for present operation is the goal in developing the Files of Filenames for future operation. The File Construction Module – Main Screen is shown next, with Fname highlighted.
Click on the **Select** command button under the **TPS Input File** list box to produce the next screen.
A list of the entire TPS Files of Filenames appears. Since CHO Car Units will be used during both peak and off peak periods, it is wise (as well as less work) to consider this list to represent the CHO Car Units. One will be done in detail for the peak and off peak periods, while the remainder will just show the final screens.

6.2.2.1.  AM PEAK

6.2.2.1.1.  CHO CAR UNITS

6.2.2.1.1.1.  RG-FH

The next screen shows the file selected.
In the **Input File Type** list box, click the **Train Input File**, which results in the following screen.
Double-click the Train File T-fc2.dce to insert the file into the Input File Name list box, as shown in the next screen.
Change the **File Caption** text box and click the **Create File** command button to complete the creation of the file.
Click the Yes command button to review the file.
6.2.2.1.1.2. **FH-RG**

The completed file follows.
6.2.2.1.3. **RG-NE**

The completed file follows.
6.2.2.1.4. NE-RG

The completed file follows.
6.2.2.1.2. CAM CAR UNITS

6.2.2.1.2.1. RG-FH

Begin with the File Construction Module – File of Filenames Input screen.
Double-click the file: TPSrfa.dce to import it into the screen.
Click the **Train Input File** in the **Input File Type** list box to obtain the next screen.
Double-click the Train File T-fr2.dce to set it into the Input File Name list box, as shown in the next screen.
Change the **Name of File** text box, the **Power Profile** text box, the **Summary** text box and the **File Caption** text box to agree with that of the following screen.
Click the Create File command button to complete the procedure.
6.2.2.1.2.2. **FH-RG**

The appropriate completed file follows.

---

Page 396 of 764
The appropriate completed file follows.
6.2.2.1.2.4. **NE-RG**

The appropriate completed file follows.
6.2.2.2. **MID DAY [ALL CHO CAR UNITS]**

6.2.2.2.1. **RG-FH**
6.2.2.2. FH-RG

The appropriate completed file follows.
6.2.2.2.3. RG-NE

The appropriate completed file follows.
6.2.2.2.4. NE-RG

The appropriate imported file into the screen is as follows.
6.2.2.3. PM PEAK

6.2.2.3.1. CHO CAR UNITS

6.2.2.3.1.1. RG-FH

The appropriate completed file follows.
6.2.2.3.1.2. FH-RG

The appropriate completed file follows.
6.2.2.3.1.3. **RG-NE**

The appropriate completed file follows.
The appropriate completed file follows.
6.2.2.3.2. CAM CAR UNITS

6.2.2.3.2.1. RG-FH

The appropriate imported file into the screen is as follows.
6.2.2.3.2.2. **FH-RG**

The appropriate completed file follows.
The appropriate completed file follows.

---

### File Construction Module - File of Filenames Input

**TPS DCEM Rail System**

- **Name of File**: TPSfrp.dce
- **Input File Type**
  - Control Input File
  - Train Input File
  - Station Input File
  - Grade Input File
  - Curve Input File
  - Spd Res Input File
  - Spd Cmnd Input File
  - Route Input File

**Output Files Desired:**

- **Power**
- **Detailed**
- **Summary**

**Output Filenames:**

- **Power Profile**: P-frp.dce
- **Summary**: TSSfrp.dce

**File Caption**: Future FH-RG PM Peak CAM Car Units
6.2.2.3.2.4. NE-RG

The appropriate completed file follows.
6.2.2.4. EVENING [ALL CHO CAR UNITS]

6.2.2.4.1. RG-FH

The appropriate completed file follows.
6.2.2.4.2. FH-RG

The appropriate completed file follows.
6.2.2.4.3. RG-NE

The appropriate imported file into the screen is as follows.
### 6.2.2.4.4. NE-RG

The appropriate completed file follows.
6.3. **TPS RUNS**

Four will be required for each peak and off peak period for the **CHO Car Units** and four will be required for each peak period for the **CAM Car units** giving a total of 24 TPS runs for future operation. The **Summary Output File** of each of the 24 TPS runs is presented.

6.3.1. **AM PEAK**

6.3.1.1. **CHO CAR UNITS**

6.3.1.1.1. **RG – FH**

The summary file is as follows.

---

**Train Operations Model - File Viewer**

**Train Performance Simulation - Station Summary**

*Future 2 CHO Car Units*

**Rock Garden to Fenton Harbor AM Peak**

**Horizontal (+dir)**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden TO Marion Place</td>
<td>1.10</td>
<td>1.50</td>
<td>43.90</td>
<td>21.06</td>
</tr>
<tr>
<td>Marion Place TO Vernon Ave</td>
<td>2.40</td>
<td>2.60</td>
<td>55.44</td>
<td>43.40</td>
</tr>
<tr>
<td>Vernon Ave TO Billard Dock</td>
<td>1.30</td>
<td>1.60</td>
<td>42.59</td>
<td>20.09</td>
</tr>
<tr>
<td>Billard Dock TO Fenton Harbor</td>
<td>1.30</td>
<td>1.60</td>
<td>60.99</td>
<td>17.63</td>
</tr>
</tbody>
</table>

**TOTA SUMMARY**

6.10 7.21 50.76 101.18 2.76

---

6.3.1.1.2. **FH – RG**

The summary file is as follows.
6.3.1.1.3. RG – NE

The summary file is as follows.
6.3.1.1.4. NE – RG

The summary file is as follows.
6.3.1.2. CAM CAR UNITS

6.3.1.2.1. RG – FH

The summary file is as follows.
### 6.3.1.2.2. FH – RG

The summary file is as follows.

#### Train Operations Model

**Train Performance Simulation - Station Summary**

**Future 2 CM Car Units**

**Rock Garden to Fenton Harbor AM Peak**

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (km)</th>
<th>Time (min)</th>
<th>Speed (kph)</th>
<th>Energy (kwh)</th>
<th>Energy (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Garden to Marion Place</td>
<td>1.10</td>
<td>1.49</td>
<td>44.27</td>
<td>39.18</td>
<td>5.92</td>
</tr>
<tr>
<td>Marion Place to Vernon Ave</td>
<td>2.40</td>
<td>2.56</td>
<td>56.61</td>
<td>65.31</td>
<td>4.54</td>
</tr>
<tr>
<td>Vernon Ave to Billard Dock</td>
<td>1.30</td>
<td>1.62</td>
<td>42.75</td>
<td>35.67</td>
<td>4.57</td>
</tr>
<tr>
<td>Billard Dock to Fenton Harbor</td>
<td>1.30</td>
<td>1.36</td>
<td>61.67</td>
<td>35.56</td>
<td>4.56</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Time (min)</th>
<th>Speed (kph)</th>
<th>Energy (kwh)</th>
<th>Energy (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.10</td>
<td>7.12</td>
<td>51.30</td>
<td>175.63</td>
<td>4.80</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\tom\tomdata\dce\TSSnfa.dce  **DATE:** 12/5/2005  **TIME:** 15:57:1

**CAPTION:** Future FH-FN AM Peak CM Car Units
### 6.3.1.2.3. RG – NE

The summary file is as follows.
### 6.3.1.2.4. NE – RG

The summary file is as follows.

```
Train Operations Model
Train Performance Simulation - Station Summary

Future 2 CNW Car Units
Rock Garden to Noel End AM Peak
Hourly (+dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>min</td>
<td>m/h</td>
<td>Iph</td>
<td>Joules</td>
</tr>
<tr>
<td>Rock Garden</td>
<td>1.10</td>
<td>1.49</td>
<td>44.27</td>
<td>39.18</td>
</tr>
<tr>
<td>Marion Place</td>
<td>2.40</td>
<td>2.54</td>
<td>56.61</td>
<td>65.31</td>
</tr>
<tr>
<td>Vernon Ave</td>
<td>1.40</td>
<td>1.69</td>
<td>49.74</td>
<td>40.32</td>
</tr>
<tr>
<td>Wright Ending</td>
<td>1.00</td>
<td>2.03</td>
<td>10.10</td>
<td>38.69</td>
</tr>
</tbody>
</table>

RUM SUMMARY

<table>
<thead>
<tr>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.70</td>
<td>2.95</td>
<td>57.00</td>
<td>176.42</td>
</tr>
</tbody>
</table>

FILENAME: C:\ton\tondata\cnev-Prserra.dee    DATE: 12/5/2005  TIME: 15:57:4
CAPTION: Future RG-NE AM Peak CNW Car Units
```
6.3.2. MID DAY [ALL CHO CAR UNITS]

6.3.2.1. RG – FH

The summary file is as follows.
6.3.2.2. **FH – RG**

The summary file is as follows.
6.3.2.3. **RG – NE**

The summary file is as follows.

```
Train Operations Model
Train Performance Simulation - Station Summary

Future 1 CH0 Car Unit
Fenton Harbor to Rock Garden Mid Day
North (-dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenton Harbor TO Dillard Dock</td>
<td>1.30</td>
<td>1.65</td>
<td>47.37</td>
<td>11.31</td>
</tr>
<tr>
<td>Dillard Dock TO Vermon Ave</td>
<td>1.30</td>
<td>1.99</td>
<td>39.74</td>
<td>11.27</td>
</tr>
<tr>
<td>Vermon Ave TO Marion Place</td>
<td>2.40</td>
<td>2.35</td>
<td>61.16</td>
<td>11.10</td>
</tr>
<tr>
<td>Marion Place TO Rock Garden</td>
<td>1.10</td>
<td>1.16</td>
<td>50.00</td>
<td>7.73</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.10</td>
<td>7.13</td>
<td>51.36</td>
<td>44.45</td>
<td>2.66</td>
</tr>
</tbody>
</table>

FILENAME: C:\tom\tomsat\dce\FS\frmc.dce  DATE: 12/5/2005  TME: 15:56:33
CAPTION: Future CH0-NE Mid Day CH0 Car Units
```
6.3.2.4. NE – RG

The summary file is as follows.
6.3.3. PM PEAK

6.3.3.1. **CHO CAR UNITS**

6.3.3.1.1. **RG – FH**

The summary file is as follows.
6.3.3.1.2. FH – RG

The summary file is as follows.
6.3.3.1.3. RG – NE

The summary file is as follows.
6.3.3.1.4. NE – RG

The summary file is as follows.
6.3.3.2. CAM CAR UNITS

6.3.3.2.1. RG – FH

The summary file is as follows.
6.3.3.2.2. FH – RG

The summary file is as follows.
6.3.3.2.3. RG – NE

The summary file is as follows.
6.3.3.2.4. NE – RG

The summary file is as follows.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>min</td>
<td>mph</td>
<td>kWh</td>
<td>kwh</td>
</tr>
<tr>
<td>Noel End to Wright Landing</td>
<td>1.80</td>
<td>3.19</td>
<td>33.02</td>
<td>31.69</td>
</tr>
<tr>
<td>Wright Landing to Vesper Ave</td>
<td>1.40</td>
<td>1.89</td>
<td>44.56</td>
<td>41.35</td>
</tr>
<tr>
<td>Vesper Ave to Marion Place</td>
<td>2.40</td>
<td>2.33</td>
<td>64.12</td>
<td>56.91</td>
</tr>
<tr>
<td>Marion Place to Rock Garden</td>
<td>1.40</td>
<td>1.54</td>
<td>58.07</td>
<td>35.86</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.70</strong></td>
<td><strong>8.55</strong></td>
<td><strong>47.03</strong></td>
<td><strong>165.28</strong></td>
</tr>
</tbody>
</table>

*FILENAM*E: C:\tom\tomdata\mct\PS\rap.decc DATE: 19/5/2005 TIME: 15:56:59

*CAPTION: Future NE-RG PM Peak CNV Car Units*
6.3.4. EVENING [ALL CHO CAR UNITS]

6.3.4.1. RG – FH

The summary file is as follows.
### 6.3.4.2. FH – RG

The summary file is as follows.

#### Train Operations Model
Train Performance Simulation - Station Summary

Future 3 CHO Car Unit
Rock Garden to Fenton Harbor Evening
Normal (+dir)

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock Garden TO Marion Place</td>
<td>1.10</td>
<td>1.49</td>
<td>44.30</td>
<td>9.98</td>
</tr>
<tr>
<td>Marion Place TO Vermor Ave</td>
<td>2.40</td>
<td>1.55</td>
<td>56.32</td>
<td>26.39</td>
</tr>
<tr>
<td>Vermor Ave TO Billard Dock</td>
<td>1.30</td>
<td>1.69</td>
<td>42.73</td>
<td>16.31</td>
</tr>
<tr>
<td>Billard Dock TO Fenton Harbor</td>
<td>1.30</td>
<td>1.79</td>
<td>60.63</td>
<td>9.34</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.10</td>
<td>7.15</td>
<td>51.21</td>
<td>49.95</td>
</tr>
</tbody>
</table>
6.3.4.3. **RG – NE**

The summary file is as follows.
6.3.4.4. **NE – RG**

The summary file is as follows.
**Train Operations Model**

**Train Performance Simulation - Station Summary**

**Future 1 CHO Car Unit**

**Noel End to Rock Garden Evening**

**Normal (-dir)**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
<th>Energy</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noel End</td>
<td>1.00</td>
<td>3.10</td>
<td>33.95</td>
<td>10.45</td>
</tr>
<tr>
<td>Weight Ling To Verner Ave</td>
<td>1.40</td>
<td>1.91</td>
<td>44.00</td>
<td>11.79</td>
</tr>
<tr>
<td>Verner Ave To Marion Place</td>
<td>2.40</td>
<td>2.39</td>
<td>61.79</td>
<td>17.19</td>
</tr>
<tr>
<td>Marion Place To Rock Garden</td>
<td>3.40</td>
<td>3.33</td>
<td>58.22</td>
<td>7.69</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.70</td>
<td>8.55</td>
<td>47.01</td>
<td>47.52</td>
<td>2.36</td>
</tr>
</tbody>
</table>

**FILENAME:** C:\tom\tomdat\dc\TPSare.dce  
**DATE:** 12/5/2005  
**TIMESTAMP:** 15:56:38
6.4. ENS INPUT FILES

Click the FCM command button on the Train Operations Model screen to obtain the File Construction Module – Main Screen.

Click the ENS Input checkbox to obtain the next screen.
6.4.1. OPERATING TIME FILE

The Operating Time Files for future operation are specified in Section 4.3.3. Imported screens are shown for each of the four time periods.

6.4.1.1. AM PEAK

The imported screen follows.
6.4.1.2. MID DAY

The imported screen follows.
6.4.1.3. **PM PEAK**

The imported screen follows.
6.4.1.4. EVENING

The imported screen follows.
File Construction Module - Operating Time File Input

TMS or ENS

DCEM Rail System

Op Time input file

- OP-a.dce
- OP-b.dce
- OP-m.dce
- OP-p.dce

Simulation start time [hh:mm:ss] 20:00:00
Simulation end time [hh:mm:ss] 20:12:00
Time interval between snapshots [sec] 1.0

Create File
Reset *
Close

Name of File

path C:\tom\tomdata\dce
name OP-e.dce

File Caption:
Evening 20:00 - 20:12
6.4.2. TRAIN LOCATION FILE

The Train Location Files for Mid Day and Evening off peak periods will remain essentially the same, except for changes in the Train ID.

6.4.2.1. AM PEAK

An operating timetable, which shows one way of running the trains during the peak periods, is shown in the EXCEL spreadsheet DCEMWorkbookForInstructionManual.xls at label Schedule_Analysis__On_Peak (see index tab).

Referring to the EXCEL spread sheet, assign trains T1 to T7 as 2-CHO Car Units and trains T7 and T8 as 2-CAM Car Units. The completed Train Location file TL-a.dce is shown in the screen as follows.

This screen is the view of the screen with scroll bars at top.
This is the view of the screen with scroll bars at bottom. The direct association of **Train ID** with T1 to T8 in the **EXCEL** spreadsheet is:

- C2RF C2FR → T1 T2 T5 T6
- C2RN C2NR → T3 T4 T7
- R2RN R2NR → T8 T9

For the record, there are many other ways to assign trains.
6.4.2.2. **MID DAY**

The Train Location file `TL-m.dce` is shown imported into the Train Location File Input screen next.

One difference between this screen and its counterpart in present operation is the change in the train portion of the Train ID (C1) as compared to (R3) as seen in Section 5.4.3.2. The second and last difference is that the File Caption is different.
6.4.2.3. **PM PEAK**

The PM Peak operation is the same as the AM Peak operation, except shifted by 8 hours. The imported file is shown below.

![Image of Train Location File Input screen]

6.4.2.4. **EVENING**

The Train Location file TL-e.dce is shown imported into the Train Location File Input screen next.
6.4.3. ENS FILE OF FILENAMES

Except for the File Caption, the ENS Files of Filenames for future operation are the same for the off peak periods (Mid Day and Evening) as in present operation. For peak periods (AM and PM), additional p-files must be added to account for the CAM Car Units. The imported ENS Files of Filenames are shown in the File of Filename Input screens for each period for future operation.

6.4.3.1. AM PEAK

The imported file is shown in the screen.
6.4.3.2. MID DAY
The imported file is shown in the screen.

6.4.3.3. PM PEAK
The imported file is shown in the screen.
6.4.3.4. **EVENING**

The imported file is shown in the screen.
6.5. ENS RUNS

For Future, Normal, Summer Month Operation, four ENS runs will be required. For each of the periods, just the summaries of these runs are presented.

6.5.1. AM PEAK

The summary is provided below.

```
0.59:51.00   4604.920    .916
0.59:52.00  4431.342    .610
0.59:53.00  4336.580    .305
0.59:54.00  4271.003    .916
0.59:55.00  4204.705    1.293
0.59:56.00  4214.968    .916
0.59:57.00  4355.330    .305
0.59:58.00  4021.759    .610
0.59:59.00  3862.805    .610
  9:0:0.00  4033.675    1.326
```

<table>
<thead>
<tr>
<th>Summary at 9:0:0.00</th>
<th>kW</th>
<th>kVARh</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Energy Delivered</td>
<td>5281.6</td>
<td>3.39</td>
</tr>
<tr>
<td>Energy Regenerated</td>
<td>-1091.3</td>
<td>0.00</td>
</tr>
<tr>
<td>AC Network Losses</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>DC Network Losses</td>
<td>109.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Total Network Losses</td>
<td>308.6</td>
<td>0.20</td>
</tr>
</tbody>
</table>

6.5.2. MID DAY

The summary is provided below.
6.5.3. PM PEAK

The summary is provided below.
6.5.4. EVENING

The summary is provided below.
<table>
<thead>
<tr>
<th>Time</th>
<th>KM1</th>
<th>KM2</th>
<th>KM3</th>
<th>KM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>20:11:51.00</td>
<td>1341.900</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:52.00</td>
<td>1470.331</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:53.00</td>
<td>1616.410</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:54.00</td>
<td>1756.982</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:55.00</td>
<td>1820.761</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:56.00</td>
<td>1930.460</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:57.00</td>
<td>1905.330</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:58.00</td>
<td>37.928</td>
<td>305</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:11:59.00</td>
<td>.000</td>
<td>.000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20:12:00</td>
<td>.000</td>
<td>.000</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Summary at 20:12:00

**Net Energy Point Energy**: 244.5

**Energy Delivered to Vehicles**: 279.0

**Energy Regenerated by Vehicles**: -39.3

**AC Network Losses**: 0

**Converter Losses**: 1.6

**DC Network Losses**: 3.3

**Total Network Losses**: 5.0

**Energy Balance for Network**: -1.1

**Accumulated Car-Distance**: 76.80

**Number of Non-Convergent Snapshots**: 0

**Filename**: C:\tom\emtest\dcs\ENSc.dce

**Date**: 12/5/2000

**Time**: 17:8:5

**Caption**: Evening
6.6. DAILY LOAD CURVE CONSTRUCTION

6.6.1. LOAD CURVE EXTENSION
Only two out of the four Load Curves generated by the ENS need to be extended. Since the ENS runs in the peak periods were for one hour, these curves need not be extended.

6.6.1.1. AM PEAK
No Load Curve extension is necessary.

6.6.1.2. MID DAY
Follow the procedure in Section 5.6.2 to extend the Load Curve L-m.dce to L-mx.dce.

6.6.1.3. PM PEAK
No Load Curve extension is necessary.

6.6.1.4. EVENING
Follow the procedure in Section 5.6.4 to extend the Load Curve L-e.dce to L-ex.dce.

6.6.2. METER FILES

6.6.2.1. AM PEAK
The completed Energy Cost Module – Energy-Demand Computer screen is shown next.
6.6.2.2. *MID DAY*

Follow the procedure of Section 5.7.2 to obtain the Meter File *M-mx.dce*.

6.6.2.3. *PM PEAK*

The completed *Energy Cost Module – Energy-Demand Computer* screen is shown next.
6.6.2.4. **EVENING**

Follow the procedure of Section 5.7.4 to obtain the **Meter** file **M-ex.dce**.

6.6.3. **METER READER**

The **Meter** files are **M-a.dce**, **M-mx.dce**, **M-p.dce** and **M-ex.dce**.

6.6.3.1. **AM PEAK**

The **Meter Reader** screen is shown next.
6.6.3.2. MID DAY

The Meter Reader screen is shown next.
6.6.3.3. **PM PEAK**

The Meter Reader screen is shown next.
6.6.3.4. **EVENING**

The Meter Reader screen is shown next.
6.6.4. DAILY LOAD CURVES
All of the screens in the previous Section 6.6.3 provide the information necessary to develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureNormalSummer.
6.7. FUTURE OPERATION SUMMARIES

6.7.1. NORMAL OPERATION

6.7.1.1. SUMMER
All of the summer runs for future, normal operation have been completed and the load curves have been generated in the spreadsheet. At this point, all of the DCEM Rail System TOM files are archived in the zip file: **DCEMFutureNormalSummer.zip**. This process will allow the user to use the same files for all of the estimates, without going through the complicated effort of tracking file names.

6.7.1.2. WINTER
The following procedure is used develop the **Load Curves**.

Modify the Train Files as outlined in Section 5.9.1.2.1.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend **Load Curves** in an EXCEL sheet as shown in the file: **DCEMWorkbookForInstructionManual.xls** at the label **LoadCurveFutureNormalWinter**.
Archive the files in the Archive file: **DCEMFutureNormalWinter.zip**.

6.7.1.3. SPRING AND FALL
The following procedure is used develop the **Load Curves**.

Modify the Train Files as outlined in Section 5.9.1.3.1.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend **Load Curves** in an EXCEL sheet as shown in the file: **DCEMWorkbookForInstructionManual.xls** at the label **LoadCurveFutureNormalSpringAndFall**.
Archive the files in the Archive file: **DCEMFutureNormalSpringAndFall.zip**.
6.7.1.4. **ANNUAL**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](DCEMWorkbookForInstructionManual.xls) at the label **Summary_Future_Normal_Operation**.

<table>
<thead>
<tr>
<th>Summary Future Normal Operation</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter</td>
<td>Summer</td>
<td>Winter</td>
<td>Spring &amp; Fall</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>852,320</td>
<td>922,316</td>
<td>804,770</td>
<td>2,669,645</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>612,500</td>
<td>1,435</td>
<td>551,066</td>
<td>1,807,115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>1,088,820</td>
<td>1,147,718</td>
<td>974,164</td>
<td>3,210,702</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>420,681</td>
<td>455,127</td>
<td>354,613</td>
<td>1,231,421</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>514,838</td>
<td>538,212</td>
<td>468,852</td>
<td>1,521,932</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>2,528,208</td>
<td>3,706,922</td>
<td>3,373,388</td>
<td>9,608,518</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.7.1.5. **SAVINGS**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](DCEMWorkbookForInstructionManual.xls) at the label **Summary_Future_Normal_Savings**.

<table>
<thead>
<tr>
<th>Summary Future Normal Operation Savings</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
<th>Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter</td>
<td>Summer</td>
<td>Winter</td>
<td>Spring &amp; Fall</td>
<td>Annual</td>
</tr>
<tr>
<td>M1</td>
<td>40.43%</td>
<td>36.68%</td>
<td>44.35%</td>
<td>41.44%</td>
</tr>
<tr>
<td>M2</td>
<td>35.89%</td>
<td>35.92%</td>
<td>37.09%</td>
<td>39.92%</td>
</tr>
<tr>
<td>M3</td>
<td>39.13%</td>
<td>38.27%</td>
<td>39.96%</td>
<td>40.40%</td>
</tr>
<tr>
<td>M4</td>
<td>37.99%</td>
<td>37.31%</td>
<td>40.47%</td>
<td>39.92%</td>
</tr>
<tr>
<td>M5</td>
<td>38.70%</td>
<td>38.71%</td>
<td>39.61%</td>
<td>39.79%</td>
</tr>
<tr>
<td>ALL</td>
<td>55.98%</td>
<td>38.18%</td>
<td>40.77%</td>
<td>44.44%</td>
</tr>
</tbody>
</table>
6.7.2. COASTING TYPE 1 OPERATION

There are only two files that are changed for all coasting operations. These are the Control files. Control files have been created for Coasting Type 1. These are shown in Section 5.2.1.2.

6.7.2.1. SUMMER

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSummer.zip. Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType1Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5 Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType1Summer. Archive the files in the Archive file: DCEMFutureCoastingType1Summer.zip.

6.7.2.2. WINTER

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalWinter.zip. Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType1Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5 Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType1Winter. Archive the files in the Archive file: DCEMFutureCoastingType1Winter.zip.

6.7.2.3. SPRING AND FALL

The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSpringAndFall.zip. Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType1Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory. Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5 Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType1SpringAndFall. Archive the files in the Archive file: DCEMFutureCoastingType1SpringAndFall.zip.
6.7.2.4. **ANNUAL**

The summary is developed in the EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label **Summary_Future_Coasting_Type_1_Operation**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>859,525,1,443</td>
<td>897,337,1,507</td>
<td>765,742,1,320</td>
<td>2,042,655,16,812</td>
</tr>
<tr>
<td>M2</td>
<td>604,163,908</td>
<td>635,234,956</td>
<td>542,816,817</td>
<td>1,762,232,15,494</td>
</tr>
<tr>
<td>M3</td>
<td>1,088,416,1,648</td>
<td>1,147,123,1,734</td>
<td>973,549,1,482</td>
<td>3,209,079,19,038</td>
</tr>
<tr>
<td>M4</td>
<td>435,259,637</td>
<td>473,941,728</td>
<td>370,671,503</td>
<td>1,283,821,7,589</td>
</tr>
<tr>
<td>M5</td>
<td>512,444,768</td>
<td>535,408,801</td>
<td>465,858,669</td>
<td>1,513,710,8,901</td>
</tr>
<tr>
<td>ALL</td>
<td>3,503,776,5,336</td>
<td>3,689,042,5,614</td>
<td>3,138,627,4,773</td>
<td>10,331,447,61,500</td>
</tr>
</tbody>
</table>

6.7.2.5. **SAVINGS**

The summary is developed in the EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label **Summary_Future_Coasting_Type_1_Savings**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>41.97% 36.18%</td>
<td>41.31% 35.72%</td>
<td>46.96% 37.15%</td>
<td>42.94% 39.52%</td>
</tr>
<tr>
<td>M2</td>
<td>36.76% 36.41%</td>
<td>35.85% 35.41%</td>
<td>41.98% 38.29%</td>
<td>38.04% 37.04%</td>
</tr>
<tr>
<td>M3</td>
<td>39.15% 39.26%</td>
<td>38.31% 38.47%</td>
<td>44.02% 40.79%</td>
<td>40.43% 39.77%</td>
</tr>
<tr>
<td>M4</td>
<td>35.26% 32.40%</td>
<td>34.15% 31.41%</td>
<td>43.00% 34.91%</td>
<td>37.31% 33.28%</td>
</tr>
<tr>
<td>M5</td>
<td>38.99% 39.05%</td>
<td>38.30% 38.45%</td>
<td>43.18% 40.56%</td>
<td>40.11% 39.62%</td>
</tr>
<tr>
<td>ALL</td>
<td>39.00% 38.03%</td>
<td>38.16% 37.18%</td>
<td>43.81% 39.94%</td>
<td>40.26% 38.71%</td>
</tr>
</tbody>
</table>
6.7.3. COASTING TYPE 2 OPERATION
There are only two files that are changed for all Coasting Operations. These are the Control files. Control files have been created for Coasting Type 2. These are shown in Section 5.2.1.2.

6.7.3.1. SUMMER
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSummer.zip.
Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType2Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType2Summer.
Archive the files in the Archive file: DCEMFutureCoastingType2Summer.zip.

6.7.3.2. WINTER
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalWinter.zip.
Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType2Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType2Winter.
Archive the files in the Archive file: DCEMFutureCoastingType2Winter.zip.

6.7.3.3. SPRING AND FALL
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSpringAndFall.zip.
Modify the Control Files as outlined in Section 5.2.1.2. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType2Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType2SpringAndFall.
Archive the files in the Archive file: DCEMFutureCoastingType2SpringAndFall.zip.
6.7.3.4. **ANNUAL**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](DCEMWorkbookForInstructionManual.xls) at the label **Summary_Future_Coasting_Type_2_Operation**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>879,650 1,423</td>
<td>919,465 1,483</td>
<td>801,009 1,301</td>
<td>2,901,014 16,535</td>
</tr>
<tr>
<td>M2</td>
<td>627,944 900</td>
<td>638,306 947</td>
<td>545,630 809</td>
<td>1,791,000 10,395</td>
</tr>
<tr>
<td>M3</td>
<td>1,083,767 1,608</td>
<td>1,142,664 1,694</td>
<td>969,491 1,448</td>
<td>3,195,921 18,546</td>
</tr>
<tr>
<td>M4</td>
<td>439,199 650</td>
<td>454,650 720</td>
<td>354,041 502</td>
<td>1,228,800 7,365</td>
</tr>
<tr>
<td>M5</td>
<td>514,171 773</td>
<td>537,640 809</td>
<td>468,215 705</td>
<td>1,520,025 8,973</td>
</tr>
<tr>
<td>ALL</td>
<td>3,504,760 5,216</td>
<td>3,692,714 5,419</td>
<td>3,139,286 4,672</td>
<td>10,336,760 60,163</td>
</tr>
</tbody>
</table>

6.7.3.5. **SAVINGS**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](DCEMWorkbookForInstructionManual.xls) at the label **Summary_Future_Coasting_Type_2_Savings**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy Demand</th>
<th>Winter Energy Demand</th>
<th>Spring &amp; Fall Energy Demand</th>
<th>Annual Energy Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>40.61% 37.36%</td>
<td>39.87% 38.40%</td>
<td>44.55% 38.52%</td>
<td>41.63% 37.37%</td>
</tr>
<tr>
<td>M2</td>
<td>36.46% 36.97%</td>
<td>35.54% 36.01%</td>
<td>41.38% 38.96%</td>
<td>37.73% 37.63%</td>
</tr>
<tr>
<td>M3</td>
<td>39.41% 40.73%</td>
<td>38.55% 39.95%</td>
<td>44.26% 42.47%</td>
<td>40.68% 41.53%</td>
</tr>
<tr>
<td>M4</td>
<td>38.58% 36.95%</td>
<td>36.78% 35.91%</td>
<td>45.08% 39.41%</td>
<td>40.05% 37.77%</td>
</tr>
<tr>
<td>M5</td>
<td>38.78% 38.65%</td>
<td>38.94% 37.94%</td>
<td>42.89% 40.05%</td>
<td>39.88% 39.15%</td>
</tr>
<tr>
<td>ALL</td>
<td>38.98% 39.41%</td>
<td>38.10% 38.92%</td>
<td>43.80% 41.21%</td>
<td>40.23% 40.04%</td>
</tr>
</tbody>
</table>
6.7.4. COASTING TYPE 3 OPERATION
There are only two files that are changed for all Coasting Operations. These are the Control files. Control files have been created for Coasting Type 3. These are shown in Section 5.2.1.3.

6.7.4.1. SUMMER
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSummer.zip. Modify the Control Files as outlined in Section 5.2.1.3. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType3Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType3Summer.
Archive the files in the Archive file: DCEMFutureCoastingType3Summer.zip.

6.7.4.2. WINTER
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalWinter.zip. Modify the Control Files as outlined in Section 5.2.1.3. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType3Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType3Winter.
Archive the files in the Archive file: DCEMFutureCoastingType3Winter.zip.

6.7.4.3. SPRING AND FALL
The following procedure is used develop the Load Curves.

Extract the archived files from DCEMFutureNormalSpringAndFall.zip. Modify the Control Files as outlined in Section 5.2.1.3. An alternative is to extract the Control files from the archived file: DCEMPresentCoastingType3Summer.zip. These files must be recreated by importing them into the File Construction Module – Control file Input – Main Screen and clicking the Create command button. This will assure that the files appear in the Rail Systems Database as well as the Directory.
Repeat the procedure developed in Sections 5.9.1.2.2 through 5.9.1.2.5
Develop Weekday and Weekend Load Curves in an EXCEL sheet as shown in the file: DCEMWorkbookForInstructionManual.xls at the label LoadCurveFutureCoastingType3SpringAndFall.
Archive the files in the Archive file: DCEMFutureCoastingType3SpringAndFall.zip.
6.7.4.4. **ANNUAL**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](#) at the label **Summary_Future_Coasting_Type_3_Operation**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy</th>
<th>Demand</th>
<th>Winter Energy</th>
<th>Demand</th>
<th>Spring &amp; Fall Energy</th>
<th>Demand</th>
<th>Annual Energy</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>879,812</td>
<td>1,426</td>
<td>918,987</td>
<td>1,497</td>
<td>801,947</td>
<td>1,309</td>
<td>2,600,746</td>
<td>16,814</td>
</tr>
<tr>
<td>M2</td>
<td>609,581</td>
<td>958</td>
<td>640,823</td>
<td>970</td>
<td>548,243</td>
<td>813</td>
<td>1,798,647</td>
<td>19,443</td>
</tr>
<tr>
<td>M3</td>
<td>1,066,818</td>
<td>1,817</td>
<td>1,146,096</td>
<td>1,704</td>
<td>971,847</td>
<td>1,448</td>
<td>3,204,761</td>
<td>19,661</td>
</tr>
<tr>
<td>M4</td>
<td>420,586</td>
<td>651</td>
<td>455,127</td>
<td>742</td>
<td>354,327</td>
<td>503</td>
<td>1,230,039</td>
<td>7,377</td>
</tr>
<tr>
<td>M5</td>
<td>514,075</td>
<td>770</td>
<td>537,449</td>
<td>865</td>
<td>468,024</td>
<td>703</td>
<td>1,519,648</td>
<td>8,043</td>
</tr>
<tr>
<td>ALL</td>
<td>3,510,872</td>
<td>5,234</td>
<td>3,698,483</td>
<td>5,513</td>
<td>3,144,387</td>
<td>4,682</td>
<td>10,353,742</td>
<td>60,399</td>
</tr>
</tbody>
</table>

6.7.4.5. **SAVINGS**

The summary is developed in the EXCEL sheet as shown in the file: [DCEMWorkbookForInstructionManual.xls](#) at the label **Summary_Future_Coasting_Type_3_Savings**.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Summer Energy</th>
<th>Demand</th>
<th>Winter Energy</th>
<th>Demand</th>
<th>Spring &amp; Fall Energy</th>
<th>Demand</th>
<th>Annual Energy</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>40.80%</td>
<td>38.80%</td>
<td>39.00%</td>
<td>38.10%</td>
<td>44.54%</td>
<td>38.14%</td>
<td>41.64%</td>
<td>37.27%</td>
</tr>
<tr>
<td>M2</td>
<td>36.20%</td>
<td>36.69%</td>
<td>38.36%</td>
<td>39.53%</td>
<td>44.12%</td>
<td>42.15%</td>
<td>40.51%</td>
<td>41.00%</td>
</tr>
<tr>
<td>M3</td>
<td>39.24%</td>
<td>40.40%</td>
<td>38.06%</td>
<td>38.17%</td>
<td>42.92%</td>
<td>40.22%</td>
<td>39.88%</td>
<td>39.34%</td>
</tr>
<tr>
<td>M4</td>
<td>38.79%</td>
<td>38.34%</td>
<td>38.00%</td>
<td>38.17%</td>
<td>43.71%</td>
<td>40.96%</td>
<td>40.14%</td>
<td>39.81%</td>
</tr>
<tr>
<td>M5</td>
<td>38.87%</td>
<td>39.20%</td>
<td>38.00%</td>
<td>38.17%</td>
<td>43.71%</td>
<td>40.96%</td>
<td>40.14%</td>
<td>39.81%</td>
</tr>
<tr>
<td>ALL</td>
<td>38.87%</td>
<td>39.20%</td>
<td>38.00%</td>
<td>38.17%</td>
<td>43.71%</td>
<td>40.96%</td>
<td>40.14%</td>
<td>39.81%</td>
</tr>
</tbody>
</table>
7. POWER SYSTEM STUDY

7.1. PRESENT OPERATION

7.1.1. ANALYSIS OF SYSTEM

The worst condition for the power system under present, normal operation is the winter. The first step is to delete and recreate the DCEM Rail System Data Base and Directory. This procedure is given in Section 6.1. After completion, extract the files from the archive DCEMPresentNormalWinter.zip.

To determine the low voltage points in the power distribution system, use the Train Voltage graphic. On the Train Operation Model screen, which is shown next with the DCEM rail system selected and Metric chosen as the Default Units.
Click the **GRAPH** command button to produce the screen.

Click the **Electrical Graphs** check box to produce the next screen.
Click on the **DC Trains** check box to produce the next screen.
Click on the Train Voltage vs. Position check box to produce the following screen.
Select the file AO-a.dce in the Current Measurement Output file list box and select the file ST-rna.dce in the Station File list box to produce the following screen.
Enter “AM Peak Rock Garden to Noel End” in the **Supplementary Title** text box and click the **Complete Graph** command button to produce the graph.
By traction specifications, the minimum voltage should be 562.5 volts. Thus, the voltage exceeds the minimum.

### 7.2. FUTURE OPERATION

The worst condition for the power system under future, normal operation is the winter. The first step is to delete and recreate the **DCEM Rail System Data Base** and **Directory**. This procedure is given in Section 6.1. After completion, extract the files from the archive **DCEMFutureNormalWinter.zip**.

#### 7.2.1. ANALYSIS OF SYSTEM

Using the same graphing procedure as in Section 7.1 **Present Operation**, the following graph is produced.
In this case, the minimum voltage is higher. This is due to the effect of regeneration. Evaluation of a storage device in this area would be for the purpose of energy savings. One problem is that the storage device will compete with natural receptivity.
7.2.2. ENERGY STORAGE
The location and magnitude of the energy storage device for the best performance is a matter to be studied. This kind of study is beyond the scope of this manual.

A wayside generic energy storage device is inserted at the Tie Station T34. See the Network Nodal Diagram in Section 3.3.1. Specifications for the unit storage device are next.

<table>
<thead>
<tr>
<th>Storage Unit Specifications</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Variable</td>
</tr>
<tr>
<td>Max Discharge Power (MW)</td>
<td>1</td>
</tr>
<tr>
<td>Max Charge Power (MW)</td>
<td>0.8</td>
</tr>
<tr>
<td>Max Stored Energy (kWh)</td>
<td>325</td>
</tr>
<tr>
<td>Min Stored Energy (kWh)</td>
<td>0</td>
</tr>
<tr>
<td>Discharge Efficiency</td>
<td>0.98</td>
</tr>
<tr>
<td>Charge Efficiency</td>
<td>0.97</td>
</tr>
<tr>
<td>Decay Rate (Linear) (kWh/h)</td>
<td>32.5</td>
</tr>
</tbody>
</table>

7.2.2.1. NETWORK WITH STORAGE
Adding the storage device to the nodal diagram in Section 3.3.1 produces the following nodal diagram.
7.2.2.2. NETWORK FILE

Modifying the base network file can create the Network file. Having selected the DCEM rail system, The File Construction Module – Network File Input – Main Screen is shown in the next screen.
Import the Network file \texttt{N-b.dce} into the screen.
Click the DC Part of Nodal Diagram check box to obtain the next screen.
Scroll to the bottom of the Line Input Grid and add the following line.
Make a double carriage return to close the Line Input Grid followed by a click on T1 in the Node Input Grid in order to open the Node Input Grid. This action produces the next screen.
In the Node Input Grid, click on the Node Type cell of the Node DS1. In the Select Node Type combo box, select Storage. The procedure will produce the next screen.
The storage node DS1 has been created and the command button *Wayside Storage* becomes visible. Click the *Wayside Storage* command button to proceed to the next screen.
All power, voltage and energy values must be entered in the electrical unit values. These can be calculated in a spreadsheet and are shown next.

### Storage Unit Specifications

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Unit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>Max Discharge Power (MW)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Max Charge Power (MW)</td>
<td>0.8</td>
<td>0.16</td>
</tr>
<tr>
<td>Max Stored Energy (kWh)</td>
<td>32.5</td>
<td>0.0065</td>
</tr>
<tr>
<td>Min Stored Energy (kWh)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Discharge Efficiency</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>Charge Efficiency</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>Decay Rate (Linear) (kWh/h)</td>
<td>3.25</td>
<td>0.00065</td>
</tr>
</tbody>
</table>

Select a Set Volt of .985 and the storage device half full to begin, the completed **Storage Device Grid** is shown in the next screen.
Clicking the mouse on the **Decay Type** cell for the node **DS1** and then selecting **Linear** in the **Energy Decay** combo box select the **Decay Type**. Click the **Select** command button to return to the previous screen.
Click the **Select** command button to return to the main screen.
Name the file N-bsg.dce and insert “Base – Generic Storage” in the File Caption text box. Click the Create File command button, which results in the next screen.
Click the Yes command button to review the file.
This completes the Network file creation process with the storage device.

### 7.2.2.3. ENS FILE OF FILENAMES

The next step is to create the ENS File of Filenames for the storage device run. Beginning with the File Construction Module – File of Filenames Input screen, import the AM Peak File of Filenames: ENSa.dce to produce the following screen.
Conduct the following procedure.

Select the network file **N-bsg.dce**.
Rename the files **ENSa.dce**, **L-a.dce** and **AO-a.dce** to **ENSag.dce**, **Lasg.dce** and **AOSag.dce**, respectively.
Set the **File Caption** as “AM Peak – Generic Storage”
Click the **Create File** command button to complete.

The result is the next screen.
Click the Yes command button to verify file creation.
7.2.2.4. **ENS RUN**

The next step is to run the ENS, by clicking the ENS command button. After the run, the next screen is present.
Click the Yes command button and scroll to the bottom of the File Viewer screen results in the next screen.
The metering point energy is 3.57 kWhpCK (kilowatt-hours per car-kilometer).

7.2.2.5. OPTIMIZATION OF STORAGE DEVICE

In the previous example, the storage device voltage was set at 0.975 per unit. This equates to 731 volts. The next step is to vary the Set Voltage of the storage device to determine where an optimum Set Voltage might exist. There are two conditions for this optimization.

- Voltage improvement of +77 volts must be realized.
- Additional daily energy used must be minimal.
- The storage device should never be depleted of stored energy.

The strategy for operating the storage device is to activate it for the peak periods each day, since this is the time when the voltage must be improved. Train Location files must be built for the Transition thru the AM Peak and the PM Peak periods.

For the AM Peak Period it is assumed that no trains are operating before 6:00 AM. All operation starts at 6:00 AM and the trains are AM Peak trains (i.e. 6 cars). Trains departing after 9:00 AM are Mid Day trains (i.e. 3 cars). Simulation is from 6:00 – 9:00 AM. This simulation is called Transition thru AM Peak.

For the PM Peak Period it is assumed that trains departing before 3:00 PM are Mid Day trains (i.e. 3 cars). Beginning at 3:00 PM, all departing trains are PM Peak trains (i.e. 6 cars), until 6:00 PM, after which departing trains are Evening trains (i.e. 3 cars). Simulation is from 3:00 – 6:00 PM. This simulation is called Transition thru PM Peak.
The results are shown in the next graph.

![Graph showing Additional Daily Energy (kWh)]

The additional energy is negative, which means the storage device will actually save energy. The Set Voltage of 0.98 (735) can no longer maintain the 77-volt improvement. Maximum energy savings occurs with the set voltage in the vicinity of .975.

The energy savings, which result from operating the storage device, are a result of fewer losses in the distribution system.

The table from which this graph was produced is shown below.

<table>
<thead>
<tr>
<th>Set Voltage Per Unit</th>
<th>Operation</th>
<th>Final Energy in Storage (kWh) Per Unit Voltage Improvement = +77 v</th>
<th>Energy Used (kWh)</th>
<th>Additional Energy Used (kWh)</th>
<th>Additional Energy Used Daily (kWh)</th>
<th>Set Voltage (volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.955</td>
<td>Transition Thru AM Peak</td>
<td>26.7 0.00534 36088.4 -235.9 -418.4</td>
<td></td>
<td></td>
<td></td>
<td>716.25</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>26.7 0.00534 36125.1 -235.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.96</td>
<td>Transition Thru AM Peak</td>
<td>24.0 0.00480 36084.0 -240.3 -420.6</td>
<td></td>
<td></td>
<td></td>
<td>720</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>24.0 0.00480 36120.7 -240.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.965</td>
<td>Transition Thru AM Peak</td>
<td>20.9 0.00418 36081.9 -242.4 -424.4</td>
<td></td>
<td></td>
<td></td>
<td>723.75</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>20.9 0.00418 36118.6 -242.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.97</td>
<td>Transition Thru AM Peak</td>
<td>16.1 0.00322 36074.9 -249.4 -462.5</td>
<td></td>
<td></td>
<td></td>
<td>727.5</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>16.2 0.00324 36111.7 -249.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.975</td>
<td>Transition Thru AM Peak</td>
<td>2.7 0.00054 36057.1 -267.2 -500.8</td>
<td></td>
<td></td>
<td></td>
<td>731.25</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>2.7 0.00054 36093.8 -267.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.98</td>
<td>Transition Thru AM Peak</td>
<td>Voltage is no longer improved. 361252.1 -72.2 -144.5</td>
<td></td>
<td></td>
<td></td>
<td>735</td>
</tr>
<tr>
<td></td>
<td>Transition Thru PM Peak</td>
<td>Voltage is no longer improved. 36288.7 -72.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Original voltage near 399 v. Improved voltage near 476 volts.

To satisfy the last condition, namely that the storage device does not deplete its energy, view the graph of energy stored in the device at the set voltage = 0.975.
For this voltage setting, the storage device is depleting its energy. On the other hand, for a set voltage of 0.97, it does not. This is seen in the next graph.
The minimum energy in the storage device is 11.4 kWh. Thus it would be more prudent to select this set voltage for the operation, with a daily savings of energy of 467 kWh.

Two cases are investigated; namely, **Transition thru AM Peak** and **Transition thru Mid Day**.

Transition thru AM Peak was described in Section 7.2.2.5. **Transition thru Mid Day** is a simulation between 9:00 AM – 3:00 PM. Trains before 9:00 AM depart as AM Peak trains (6 cars) and trains after 9:00 AM depart as Mid Day trains (3 cars).

The results of the simulations are shown in the next graphs. For the **Transition thru AM Peak**, the plot is shown next.
The maximum energy saved is approximately 100 kWh during the peak period at a set voltage of 0.98. Likewise, the graph for *Transition thru Mid Day* is shown next.

The maximum energy saved in this case is approximately 500 kWh at set voltage 1.00. The full table, from which these graphs were produced, is shown below.
### Storage Analyses - Future Winter Normal Operation

<table>
<thead>
<tr>
<th>Set Voltage Per Unit</th>
<th>Operation</th>
<th>Final Energy In Storage (kWh)</th>
<th>Energy Used Per Unit (kWh)</th>
<th>Additional Energy Used (kWh)</th>
<th>Set Voltage (volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Storage Unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.960</td>
<td>Transition Thru AM Peak</td>
<td>30.9</td>
<td>0.00618</td>
<td>20,038</td>
<td>-12.8</td>
</tr>
<tr>
<td>0.970</td>
<td>Transition Thru AM Peak</td>
<td>24.3</td>
<td>0.00486</td>
<td>20,002</td>
<td>-48.0</td>
</tr>
<tr>
<td>0.980</td>
<td>Transition Thru AM Peak</td>
<td>14.0</td>
<td>0.00280</td>
<td>19,944</td>
<td>-106.8</td>
</tr>
<tr>
<td>0.990</td>
<td>Transition Thru AM Peak</td>
<td>0.0</td>
<td>0.00000</td>
<td>19,943</td>
<td>-107.3</td>
</tr>
<tr>
<td>1.000</td>
<td>Transition Thru AM Peak</td>
<td>0.0</td>
<td>0.00000</td>
<td>19,949</td>
<td>-101.5</td>
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<tr>
<td>1.010</td>
<td>Transition Thru AM Peak</td>
<td>0.0</td>
<td>0.00000</td>
<td>19,961</td>
<td>-89.6</td>
</tr>
<tr>
<td>1.020</td>
<td>Transition Thru AM Peak</td>
<td>0.0</td>
<td>0.00000</td>
<td>19,972</td>
<td>-78</td>
</tr>
<tr>
<td>0.960</td>
<td>Transition Thru Mid Day</td>
<td>32.4</td>
<td>0.00648</td>
<td>11,103</td>
<td>30.6</td>
</tr>
<tr>
<td>0.970</td>
<td>Transition Thru Mid Day</td>
<td>32.5</td>
<td>0.00650</td>
<td>11,100</td>
<td>27.1</td>
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<tr>
<td>0.980</td>
<td>Transition Thru Mid Day</td>
<td>32.5</td>
<td>0.00650</td>
<td>11,093</td>
<td>20.1</td>
</tr>
<tr>
<td>0.990</td>
<td>Transition Thru Mid Day</td>
<td>32.5</td>
<td>0.00650</td>
<td>11,059</td>
<td>-14.2</td>
</tr>
<tr>
<td>1.000</td>
<td>Transition Thru Mid Day</td>
<td>9.4</td>
<td>0.00188</td>
<td>10,578</td>
<td>-494.6</td>
</tr>
<tr>
<td>1.010</td>
<td>Transition Thru Mid Day</td>
<td>0.4</td>
<td>0.00008</td>
<td>10,613</td>
<td>-460.1</td>
</tr>
<tr>
<td>1.020</td>
<td>Transition Thru Mid Day</td>
<td>0.0</td>
<td>0.00000</td>
<td>10,652</td>
<td>-421.2</td>
</tr>
<tr>
<td>1.030</td>
<td>Transition Thru Mid Day</td>
<td>0.0</td>
<td>0.00000</td>
<td>10,700</td>
<td>-372.4</td>
</tr>
</tbody>
</table>

In both cases, **Transition Thru AM Peak** and **Transition Thru Mid Day**, setting the storage device voltage at 1.00 per unit or 750 volts results in nearly the largest energy savings.

### 8. RAIL VOLTAGE ESTIMATES

The estimates of rail voltage along the track are accomplished using a single train running from beginning terminals to end terminals. Thus, rail voltage of single trains running from **RG-FH**, **FH-RG**, **RG-NE** and **NE-RG** for AM Peak operation for the future, normal, winter scenario will be investigated. The first step is to build all of the input files.

#### 8.1. INPUT FILES

Before building the input files needed for the rail voltage study, the **TOM** data files for future, normal winter operation are loaded. Follow the procedure outlined in Section 6.1 to delete and reestablish the DCEE Rail System Data Base and Directory. Extract the archived files from the file: [DCEEFutureNormalWinter.zip](https://example.com/DCEEFutureNormalWinter.zip).

Open the File Construction Module – Main Screen.
Click the **RVM Input** check box to go to the next screen.
8.1.1. NEGATIVE NETWORK FILE

Select the **Neg Network** entry in the **RVM Input** list box to obtain the next screen.
The Negative Network File is developed from the Network File. Select the Network File \texttt{N-b.dce}, which is shown in the next screen.
Click the **Show Nodal Diagram** command button to obtain the next screen.
Section 3.3.3 shows the data, which can be entered into the screen. Entry produces the following screen.
Clicking on each of the three **Insert** command buttons next to the resistance data, inserts the information into the **Line Input** grid. The result is the next screen.
Since no changes are required in the Node Input grid, click the Select command button to go to the previous screen, shown next.
Click the Create File command button to create the file.
Click the Yes command button to review the file.
Click the Close command button.

Click the Close command button to return to the File Construction Module – Main Screen.
Double-click on the **DCEE** rail system followed by a double-click on **RV Table** leads to the following screen.

### 8.1.2. RAIL VOLTAGE TABLE FILE
The Ratio of Ground Leakage to Rail Resistance is 1,647,446. The Ratio of Ground to Rail Resistance is 16,474. The Maximum Inter-nodal Distance in the Negative Network is 1.2 mi. Thus, the screen is set up as follows.
Click the **Create File** command button to complete the Rail Voltage Table. This action produces the following screen.
Click the **Yes** command button to review the file.
8.1.3. CURRENT MEASUREMENT OUTPUT FILES

It is necessary to develop Current Measurement Output Files for single trains running through the system. Since these trains are the same as those used in the AM Peak, each will have 2-Units.

8.1.3.1. ENS INPUT FILES

8.1.3.1.1. OPERATING TIME FILES

Two Operating Time Files will be built: one file for 10 minutes and one file for 11 minutes, since these times slightly exceed the terminal to terminal running time of RG-FH; FH-RG and RG-NE; NE-RG, respectively. The imported files are shown next.

8.1.3.1.1.1. RG – FH; FH – RG

8.1.3.1.1.2. NE – RG; RG – NE

Click the Close command button.
8.1.3.1.1.2. RG – NE; NE - RG
8.1.3.1.2. TRAIN LOCATION FILES

Train Location Files must be built for both the CHO Car Units and the CAM Car Units for all terminal-to-terminal runs. The imported screens are shown next.

8.1.3.1.2.1. 2-CHO CAR UNITS

8.1.3.1.2.1.1. RG – FH
8.1.3.1.2.1.2. FH – RG
8.1.3.1.2.1.3. RG – NE
8.1.3.1.2.1.4. NE – RG
8.1.3.1.2.2.  2-CAM CAR UNITS

8.1.3.1.2.2.1.  RG – FH
8.1.3.1.2.2. FH – RG
8.1.3.1.2.2.3. RG – NE
8.1.3.1.2.2.4. NE – RG
8.1.3.1.3. ENS FILES OF FILENAMES

The final set of files, the ENS Files of filenames must be built for both the CHO Car Units and the CAM Car Units for all terminal-to-terminal runs. The imported screens are shown next.

8.1.3.1.3.1. 2-CHO CAR UNITS

8.1.3.1.3.1.1. RG – FH
8.1.3.1.3.1.2. FH – RG
8.1.3.1.3.1.3. RG – NE
8.1.3.1.3.1.4. NE – RG
8.1.3.1.3.2. 2-CAM CAR UNITS

8.1.3.1.3.2.1. RG – FH
8.1.3.1.3.2.2. FH – RG
8.1.3.1.3.2.3. RG – NE
8.1.3.1.3.2.4. NE – RG
8.1.3.2. ENS RUNS TO PRODUCE AO-FILES

The ENS runs can now be completed to produce the AO-Files. The ENS Summary, scrolled to the bottom, is shown for each.

8.1.3.2.1. CHO CAR UNITS

8.1.3.2.1.1. RG - FH
8.1.3.2.1.2. FH - RG
8.1.3.2.1.3. RG - NE
8.1.3.2.1.4. NE - RG
8.1.3.2.2. CAM CAR UNITS

8.1.3.2.2.1. RG - FH
8.1.3.2.2.2. FH – RG
8.1.3.2.2.3. RG – NE

<table>
<thead>
<tr>
<th>Time</th>
<th>kWh</th>
<th>kWh/km</th>
<th>kWh/km²</th>
<th>kWh/km²/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:51</td>
<td>0.00</td>
<td></td>
<td>0.305</td>
<td></td>
</tr>
<tr>
<td>0:52</td>
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<td>0:53</td>
<td>0.00</td>
<td></td>
<td>0.305</td>
<td></td>
</tr>
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<td>0:54</td>
<td>0.00</td>
<td></td>
<td>0.305</td>
<td></td>
</tr>
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<td>0:57</td>
<td>0.00</td>
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<td>0.305</td>
<td></td>
</tr>
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<td>0:58</td>
<td>0.00</td>
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<td>0.305</td>
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<td>0:59</td>
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<td>0.305</td>
<td></td>
</tr>
<tr>
<td>0:10</td>
<td>0.00</td>
<td></td>
<td>0.305</td>
<td></td>
</tr>
</tbody>
</table>

Summary: 36.60

Energy Balance for Network: 0.0

Accumulated Car-Distance: 36.60

Number of Non-Convergent Snapshots: 0

Filename: C:\tom\last\inc\unsfr\inc
Date: 8/12/2004 Time: 6:18:34
Caption: RH Peak Rail Voltage EM-RG 2-CRM Car Units
### 8.1.3.2.2.4. NE – RG

<table>
<thead>
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<th>Time</th>
<th>MTR</th>
<th>KVHR</th>
<th>KWHPCD</th>
<th>KVHRPCD</th>
</tr>
</thead>
<tbody>
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<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:52:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:53:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:54:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:55:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:56:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:57:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:58:00</td>
<td>0.000</td>
<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:10:59:00</td>
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<td></td>
<td></td>
<td>0.305</td>
</tr>
<tr>
<td>0:11:00:00</td>
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<td></td>
<td>0.305</td>
</tr>
</tbody>
</table>

**Summary at 0:11:00**

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<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
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<td>Measuring Point Energy</td>
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<td>.0</td>
<td>6.31</td>
<td>.0</td>
</tr>
<tr>
<td>Energy Delivered to Vehicles</td>
<td>236.9</td>
<td>.0</td>
<td>5.89</td>
<td>.0</td>
</tr>
<tr>
<td>Energy Regenerated by Vehicles</td>
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<td>.0</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>AC Network Losses</td>
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<td>.0</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Converter Losses</td>
<td>4.2</td>
<td>.0</td>
<td>.11</td>
<td>.0</td>
</tr>
<tr>
<td>DC Network Losses</td>
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<td>.0</td>
<td>.31</td>
<td>.0</td>
</tr>
<tr>
<td>Total Network Losses</td>
<td>16.7</td>
<td>.0</td>
<td>.42</td>
<td>.0</td>
</tr>
<tr>
<td>Energy Balance for Network</td>
<td>.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Accumulated Car Distance:** 40.20

**Number of Non-Convergent Snapshots:** 0

**File Name:** C:\tom\enstrom.out  **Date:** 8/12/2004  **Time:** 6:28:18

**Caption:** DC Peak Rail Voltage RG-HE 2-CAR Car Units
8.1.4. RVM FILE OF FILENAMES

The next step is to develop the RVM Files of Filenames. On the File Construction Module – Main Screen click the RVM Input check box to obtain the following screen.
Double-click **Fnames** in the **RVM Input** list box to obtain the following screen.
All of the imported files for both types of trains for all terminal-to-terminal runs are shown next.

8.1.4.1. **CHO CAR UNITS**

8.1.4.1.1. RG – FH
8.1.4.1.2. FH – RG
8.1.4.1.3. RG – NE
8.1.4.1.4. NE – RG
8.1.4.2. CAM CAR UNITS

8.1.4.2.1. RG – FH
8.1.4.2.2. FH – RG
8.1.4.2.3. RG – NE
8.1.4.2.4. NE – RG
8.2. RVM RUNS

The RVM runs can now be completed. The Train Operations Model screen is shown next.
Click the **Rail Voltage Model** command button to produce the next screen.
The 2-CHO Units Rock Garden to Fenton Harbor run will be done step by step. The final results will be shown for the remainder of the runs. Select the RVMcrf.dce file of filenames to produce the next screen.
8.2.1. CHO CAR UNITS

8.2.1.1. RG – FH

Click the Yes command button to produce the next screen.
Only the results are shown for the following cases.

8.2.1.2. **FH – RG**
Maximum Rail Voltage = 10.05 at Position = 5.058

8.2.1.3. **RG – NE**
Maximum Rail Voltage = 12.50 at Position = 0.349

8.2.1.4. **NE – RG**
Maximum Rail Voltage = 13.26 at Position = 6.952

8.2.2. **CAM CAR UNITS**

8.2.2.1. **RG – FH**
Maximum Rail Voltage = 16.47 at Position = 0.327
8.2.2.2. FH – RG
Maximum Rail Voltage = 12.88 at Position = 5.065

8.2.2.3. RG – NE
Maximum Rail Voltage = 16.47 at Position = .327

8.2.2.4. NE – RG
Maximum Rail Voltage = 18.29 at Position = 6.967

8.2.3. SELECTED GRAPHS OF RVM RESULTS

A click on the GRAPH command button on the main screen of the TOM yields the following screen.

Click on the Electrical Graphs checkbox to obtain the next screen.
Select the **DC Trains** check box to get the next screen.
Click on the **Rail Voltage vs. Position** check box to develop the next screen.
Graphs may now be developed for all of the following cases

8.2.3.1. **CHO CAR UNITS**

8.2.3.1.1. RG – FH
8.2.3.1.2. FH – RG
8.2.3.1.3. RG – NE
8.2.3.1.4. NE – RG
8.2.3.2. CAM CAR UNITS

8.2.3.2.1. RG – FH
8.2.3.2.2. FH – RG
8.2.3.3. RG – NE
8.2.3.2.4. NE – RG
8.2.4. ARCHIVE FILES

9. TRAIN CONTROL AND TRAIN MOVEMENT SIMULATION

9.1. INPUT FILES

In order to begin train movement simulation under train control systems, it is necessary to construct the input files.

Given the main screen of the TOM with the DCEE rail system selected.
Click the **FCM** command button to expose the **File Construction Module – Main Screen**.
Choose the **TMS Input** check box to reveal the list of input files to the **TMS**.
The list of input files is shown in the TMS Input list box. These files are:
TMS File of Filenames (Fnames)
Track Layout (TrkLayout)
Network (Network) [Also an input to the ENS]
Operating Time (Op Time) [Also an input to the ENS]
Train Location (Trn Loc) [Also an input to the ENS]
Current Measurement (Cur Meas) [Also an input to the ENS]
Station Description (Sta Dscrp)
Stop Distance (StopDist) [This is not an input file. It is used to produce a table of stop distances.]

Four of the eight input files in the list box are also inputs to the ENS and were described in Section 5.4.

The Network, Operating Time, Train Location and Current Measurement files, which are common to both the ENS and TMS, have already been constructed as input to the ENS runs.

In the following sections, the Track Layout, Station Description and TMS File of Filenames files will be developed.

9.1.1. TRACK LAYOUT FILE

The Track Layout file is built using the following procedure. Double click the TrkLayout entry in the TMS Input list box to obtain the following screen.

Since no Track Layout files have yet been built, click the Generate Track Layouts command button to obtain the following screen.
In order to produce the track layout, speed command files are required. These will now be built. The speed command files are generated from P-files representing the movement of crush-loaded trains, since this will be the most restrictive case. The first step is to construct Station files with 100% load factors.

9.1.1.1. TPS FOR CRUSH LOAD TRAINS

On the File Construction Module - Main Screen, click the TPS Input check box and select the Fnames item in the TPS Input list box.
Click the **Select** command button to produce the next screen.
The **TPS Files of Filenames** for running the crush-loaded trains are built using the **Files of Filenames** for AM Peak operation, in a manner similar to the previous building of the **Station files**. Import the file **TPSfra.dce** by selecting it in the list of files.
To build the file `TPSfr.dce`, which is the File of Filenames for TPS running of a crush loaded train use the following procedure.

In the Input File Type list box click on the Station Input File, which results in the following screen.

![File Construction Module - File of Filenames Input](image)

To build the file `TPSfr.dce`, which is the File of Filenames for TPS running of a crush loaded train use the following procedure.

In the Input File Type list box click on the Station Input File, which results in the following screen.

![File Construction Module - File of Filenames Input](image)
Select the **Station** file `ST-fr.dce` from the **List of Files** list box. Edit the name of the file `TPSfra.dce` to `TPSfr.dce`, the file `P-fra.dce` to `P-fr.dce` and the file `TSSfra.dce` to `TSSfr.dce`. Edit the **File Caption** to read “Crush Load” instead of “AM Peak”.
The file TPSfr.dce is then constructed by clicking the Create File command button as shown in the next screen.
Likewise, use the files TPSna.dce to build the file TPSn.dce, TPSrfa.dce to build the file TPSrf.dce and TPSrna.dce to build the file TPSrn.dce.

Creation of the file TPSrn.dce, the last of the sequence, results in the following screen.
The next step is to run the TPS with the newly created crush load Files of Filenames. On the main screen of the TOM, click the TPS command button to produce the next screen.
Double click the File of Filenames TPSfr.dce, which runs the TPS. After completion, review the summary output to ascertain that the TPS ran correctly.

Repeat this procedure for the Files of Filenames: 
- TPSnr.dce
- TPSrf.dce
- TPSrn.dce

These actions produce the P-files necessary for creation and modification of the Speed Command files.

### 9.1.1.2. STATION FILES FOR CRUSH LOAD TRAINS

On the File Construction Module – Main Screen, click the TPS Input check box to produce the screen.
Double click on the **Station** entry in the **TPS Input** list box to produce the next screen.
Double click the ST-fra.dce file to import it into the text box of the screen.
Set the load factor of each inter-station run to 100%, rename the file caption and name the file ST-fr.dce to produce the next screen.
Create the file, which is shown in the next screen.
Likewise, use the files ST-nra.dce to build the file ST-nr.dce, ST-rfa.dce to build the file ST-rf.dce and ST-rna.dce to build the file ST-rn.dce.

Creation of the file ST-rn.dce, the last of the sequence, results in the following screen.
The next step is to create the **File of Filenames** files for each of the **TPS** runs with the crush loaded trains.

**9.1.1.3. SPEED COMMAND FILES FOR CRUSH LOAD TRAINS**

On the **File Construction Module – Main Screen** click the **TPS Input** checkbox and then click the **Spd Cmd** item in the **TPS Input** list box. The result is the next screen.
Clicking the **Select** command button under the **TPS Input** list box results in the next screen.
Click the **Create Using Power Profile** check box to produce the next screen.
Select the file P-fr.dce in the Select P-File list box, enter the file caption and name the speed command file to be created. These actions result in the next screen.
Clicking the **Create File** command button produces the next screen.
Clicking the Yes command button results in the next screen.
This file contains the speed commands for an AM Peak train, which runs from Fenton Harbor to Rock Garden. Since the run is in the decreasing kilometerpost direction, the speed command file is interpreted as follows:

- From the beginning of the run to kilometerpost 5.241, the speed command is 64.76.
- From kilometerposts 5.241 to 5.04, the speed command is 0., which tells the train to stop.
  The stop will be made at kilometerpost 5.04, which is the station **Dillard Dock**.
- From kilometerposts 5.04 to 4.276, the speed command is 62.40.
- From kilometerposts 4.276 to 3.861, the speed command is 50, for transition through the switch at **Lazy Junction**.
- From kilometerposts 3.861 to 3.74, the speed command is 0., which tells the train to stop.
  The stop will be made at kilometerpost 3.74, which is the station **Verner Avenue**.
- From kilometerposts 3.74 to 1.59, the speed command is 70.
- From kilometerposts 1.59 to 1.34, the speed command is 0., which tells the train to stop.
  The stop will be made at kilometerpost 1.34, which is the station **Marion Place**.
- From kilometerposts 1.34 to 0.451, the speed command is 66.21.
- From kilometerposts 0.451 to the end, the speed command is 0., which tells the train to stop.
  The stop will be made at kilometerpost 0.24, which is the station **Rock Garden**.

Speed commands are generally given in larger increments, rather than the kind of accuracies (e.g. 66.21) shown in the file. Thus, the speed command file should be modified to reflect this action.
Begin by importing the SC-fr.dce back into the File Construction Module – Speed Command File Input screen. To accomplish this action, click the Reset command button and then double click on the SC-fr.dce file in the file list box to produce the next screen.

Using multiples of 5 mph, round up the speed commands not divisible by 5 to the next highest speed command which is divisible by 5. Multiples of 10 mph could have been used as well. The results are shown in the next screen.
Re-create the file by clicking on the Create File command button, which results in the next screen.
Click the Yes command button to review the file shown in the next screen.
The same procedure is now used to create the remaining speed command files, which results in the next screen.
9.1.1.4. TRACK LAYOUT

The File Construction Module – Track Layout File Input – Generate Track Layout screen now shows the speed command files.
Reference is made to the Track Layout diagram of Section 3.2.1. The two tracks from Rock Garden to Noel End (Tracks 1&2) have end positions of MP 0.0 and MP 7.2. Track 1 has the **Grade** file `GR-rn.dce`, the **Curve** file `CU-t.dce` and the **Speed Command** file `SC-rn.dce`. This information is added to the screen.
Click the **Generate Layout for Track 1** command button to generate the track 1 layout and produce the next screen.
Likewise, Track 2 has the **Grade** file `GR-rn.dce`, the **Curve** file `CU-t.dce` and the **Speed Command** file `SC-nr.dce`. This information is added to the screen and the **Generate Layout for Track 2** command button is clicked to produce the following screen.
The two tracks from Lazy Junction to Fenton Harbor (Tracks 3 & 4) have end positions of MP4.0 and MP 6.6. Track 3 has the **Grade** file `GR-rf.dce`, the **Curve** file `CU-t.dce` and the **Speed Command** file `SC-rf.dce`. This information is added to the screen and the **Generate Layout for Track 3** command button is clicked to produce the next screen.
Likewise, Track 4 has the Grade file GR-rf.dce, the Curve file CU-t.dce and the Speed Command file SC-fr.dce. This information is added to the screen and the Generate Layout for Track 4 command button is clicked to produce the following screen.
All four of the main tracks have now been generated. Click the **Close** command button to close the screen and expose the **File Construction Module – Track Layout File Input** screen.
The entries to the grids have been automatically produced by the previous procedure. At this time, it is a good idea to save the file. Add a File Caption and a file name and click the Create File command button to save the file. This action results in the following screen.
Click the Yes command button on the Query to continue to the next screen.
Click the **Yes** command button on the **Query** to view the track layout at this point.
To view the blocks, select the Nodes Visible item on the Action menu.
Close the tomTrackLayout Viewer – [Track and Train Display] screen and expose the
The next step is to add the switches and crossovers as well as the connecting track to complete the track layout. To accomplish this procedure, begin by clicking the Graphic Input command button to produce the next screen.
Click the Open Grid command button to view the layout.
The end nodes on tracks 3 & 4 were placed at MP 4.0, which is the position of the junction. The junction has length, which we choose to make about 0.1 mile or 530 ft. MP 4.0 will be in the center. Thus the first step in constructing the junction will be to move the end nodes from 4.0 to 4.05 on tracks 3 & 4. Right click the mouse on the node at MP 4.0 on track 3 to obtain the next screen.
Click the **Move** item on the menu to obtain the next screen.
Add the node position in the **New Node Position** text box
Click the Move Node command button to effect the change as is seen in the next screen.
To assure that the node has been moved, right click on the node again and select the **Identify** item.
Move the end node on Track 4 from 4.00 to 4.05 as well, which results in the next screen.
The next step is to insert nodes on tracks 1 and 2 to build the switches and crossover. In order to accomplish these actions, it is convenient to zoom into the area of interest. In order to accomplish the zoom, set the **Track Zone Feature** combo box to 200% and activate the **Position Zoom Feature** between approximately 3.5 and 4.5. To activate the Position Zoom Feature, click the mouse at approximately 3.5 and again at approximately 4.5. (Note that the position of the mouse is always recorded at the upper left of the screen.) This action results in the next screen.
The next step is to add the switch nodes on tracks 1 & 2 at position 3.95. This action is accomplished by going to position 3.95 on track 1 and click the mouse twice (Note that this is not a double click.), followed by the same on track 2. This is shown in the next screen.
The next step is to add the crossover node on track 2, located at 4.0. Addition of this node is shown in the next screen.
It is appropriate to create blocks before and after the switch nodes and crossover node. These nodes will be created at a distance of 0.02 on either side of the switch point as shown in the next screen.
The next step is to draw the connecting tracks. The first connecting track is from the switch point on track 1 to the crossover node on track 2 as shown in the next screen.
The next line connects the crossover node on track 2 to the end node on track 3 as shown in the next screen.
The next line connects the switch node on track 2 to the end node on track 4, as shown in the next screen.
Click the **Close** command button to expose the **File Construction Module – Track Layout File Input** screen.
Click the Create File command button to generate the next screen.
Click the **Yes** command button to obtain the next screen.
Click the Yes command button to obtain the next screen.
The nodes are made visible by selecting the Nodes Visible item in the Action menu.
This action results in the next screen.
Use the zoom feature by a mouse down, horizontal left to right drag and mouse up, to view the area around the junction.
To determine all of the features available with the tomTrackLayoutViewer – [Track and Train Display], click the Contents item of the Help menu.
9.1.2. STATION DESCRIPTION FILE

The Station Description file is used primarily for the display in the TMS. On the File construction Module – Main Screen, click the TMS Input check box and select Sta Dscrp in the TMS Input list box.
Click the **Select** command button under the **TMS Input** list box to obtain the next screen.
The station is always placed above the designated track number, so that filling in the screen results in the next screen.
Clicking the Create command button completes the process.
9.1.3. MODIFICATION OF INPUT FILES

Some of the input files must now be modified to more closely simulate the track layout. These files include the Route files, the Speed Restriction files, the Speed Command files and the Track Layout file, itself.

The first step is to build route files, which take into account the non-main, or connecting tracks.

9.1.3.1. NEW ROUTE FILES

The original route files considered Lazy Junction to be a point located at MP 4.0. These route files will be expanded to now include the connecting tracks.
On the **File construction Module – Main Screen**, click the **TPS Input** check box and select **Route** in the **TPS Input** list box.

Click the **Select** command button under the **TPS Input** list box to expose the next screen.
All of the route files have to be changed. These are changed to reflect the following conditions.

- Rock Garden to Noel End: Track 2 (crn)
- Rock Garden to Fenton Harbor: Track 2 to MP 3.95, Track 51 to MP 4.05, Track 4 (crf)
- Noel End to Rock Garden: Track 1 (cnr)
- Fenton Harbor to Rock Garden: Track 3 to MP 4.05, Track 50 to MP 3.95, Track 1 (cfr)

(Note that the connecting track number can be determined by importing the track layout file in the File Construction Module – Track Layout File Input screen, clicking the Track Layout Viewer command button and then, selecting the Trk Seg Info Mode of the State menu, point to the track with the mouse and click.).
Modify the input to reflect the transition from track 2 to track 4 via track 51.
Click the Create File command button to create the file.
Create the remaining route files.
9.1.3.2. NEW SPEED RESTRICTION FILES

New Speed Restriction files for the runs must be constructed to reflect the lower speed through the switches and crossover. On the File Construction Module – Main Screen, click the TPS Input check box and select Spd Res item in the TPS Input list box.
Click the Select command button under the TPS Input list box.
Import the file `SP-rf.dce` in the file list box by double clicking on it.
Modify the speed restrictions to reflect a 20 mph speed through the switches and crossover from MP 3.95 to MP 4.05.
Click the Create File command button to save the modified file.
Import the file SP-rn.dce into the screen.
Modify the speed restrictions to reflect the 20 mph between MP 3.95 and MP 4.05 and click the **Create File** command button.
9.1.3.3. **NEW TPS FILES OF FILENAMES**

The TPS Files of Filenames with the changed routes and speed restrictions may now be constructed. On the File Construction Module – Main Screen, click the TPS Input check box and select FNames in the TPS Input list box.
Click the Select command button under the TPS Input list box to expose the next screen.
Import the **TPSfra.dce** file into the screen to produce the screen.
Click the Route Input File item in the Input File Type list box to produce the following screen.
Double click the RU-cfr.dce filename in the Select From: List of Files file list box to place it into the Input File Name list box. This action results in the next screen.
Change the names of the TPSfra.dce, P-fra.dce and TSSfra.dce filenames and the File Caption to reflect the new TPS run.
Click the **Create File** command button to create the file.
Click the TPS command button to run the TPS with the new file.
Click the Yes command button to review the summary output.
9.1.3.4. **RERUNNING THE TPS**

The TPS is now rerun for all of the cases using the same procedure outlined in the previous section. A list of all TPSc*.dce files is shown in the next screen.

<table>
<thead>
<tr>
<th>Route Description</th>
<th>Distance</th>
<th>Time (minutes)</th>
<th>Speed (mph)</th>
<th>Energy (kWh)</th>
<th>Energy (kWh/mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenton Harbor TO Dillard Dock</td>
<td>1.10</td>
<td>2.83</td>
<td>38.42</td>
<td>65.09</td>
<td>0.34</td>
</tr>
<tr>
<td>Dillard Dock TO Vernon Ave</td>
<td>1.30</td>
<td>2.31</td>
<td>33.81</td>
<td>63.34</td>
<td>0.29</td>
</tr>
<tr>
<td>Vernon Ave TO Marion Place</td>
<td>2.40</td>
<td>2.91</td>
<td>49.01</td>
<td>72.50</td>
<td>5.91</td>
</tr>
<tr>
<td>Marion Place TO Rock Garden</td>
<td>1.10</td>
<td>1.44</td>
<td>45.79</td>
<td>49.28</td>
<td>7.47</td>
</tr>
</tbody>
</table>

**RUN SUMMARY**

| | Distance (miles) | Time (minutes) | Speed (mph) | Energy (kWh) | Energy (kWh/mile) |
| | 6.10 | 0.72 | 41.99 | 250.84 | 6.85 |
9.1.3.5. MODIFICATION OF THE TRACK LAYOUT FILE

The Track Layout has changed as a consequence of the new Speed Restriction files. Thus it is appropriate to develop a new Track Layout file.

9.1.3.5.1. TPS RUNS FOR CRUSH LOAD TRAINS (MODIFIED)

On the File Construction Module – Main Screen, click the TPS Input checkbox and select the Fnames item in the TPS Input list box.
Click the Select command button under the TPS Input list box to obtain the next screen.
Import the file TPSfr.dce by double clicking it in the **Select from: List of Files** file list box.
Click the **Route Input File** item in the **Input file Type** list box.
Select the file `RU-cfr.dce` by double clicking it in the `Select from: List of Files` file list box.
Rename the **TPS File of Filenames**, the **Power Profile** file and the **Summary** file and change the **File Caption**.
Click the **Create File** command button to build the new file.
Click the TPS command button to execute the new file.
Click the **Yes** command button to view the **Summary** output.
This procedure is now repeated to create and execute the files TPScnr.dce, TPScrf.dce and TPSrn.dce.

9.1.3.5.2. MODIFIED SPEED COMMANDS

The Power Profiles resulting from the modified crush load train TPS runs are now used to develop new Speed Command files using the same procedure outlined in Section 9.1.1.3. These Speed Command files are named SC-c*.dce following the convention.

9.1.3.5.3. MODIFIED TRACK LAYOUT

Using the new Speed Command files for crush load trains, SC-C*.dce, construct a new Track Layout using the same procedure as in Section 9.1.1.4

After the Track Layout is made and before the Track Layout file is created, the File Construction Module – Track Layout File Input screen is shown with the Track Segment Input grid scrolled to the bottom.
The connecting tracks are highlighted. All have the value of 5 mph as the speed code. This is the default value. These are changed to 20 mph, as shown in the next screen.
The file is then created and saved as TW-n.dce.

**9.1.4. NETWORK FILE**

Because the TMS requires the trains to run on connecting tracks, it is necessary to electrify these tracks, which means modification of the Network file.

The Nodal Diagram, showing the modification is shown next.
Using the original **Network** file, six lines must be added, four of which tie the tracks to the DC side of substation D3. The other two lines tie the connecting tracks, 50 and 51, together. The additional lines and nodes added to the Network file, N-b.dce, are shown next.
9.1.5. CURRENT MEASUREMENT INPUT FILE

The Current Measurement Input file must be modified to account for the other feeds from the DC side of substation D3. On the File Construction Module – Main Screen, click the TMS Input check box and select the Cur Meas item in the TMS Input list box.

The new Network File is saved as N-bm.dce.
Click the Select command button under the TMS Input list box to produce the next screen.
Double click AM-b.dce in the file list box to import it into the screen.
Viewing the Network for TMS, there are four additional lines coming out of the substation D3. These points are placed into the screen.
Naming the file and changing the **File Caption** produces the next screen.
Click the **Create File** command button to build the file.
9.1.6. TMS FILE OF FILENAMES

Two types of TMS Files of Filenames will be created. The first type will be without electrification and the second type will be with electrification. The first type will be generated first to assure that the TMS runs properly with the input.

On the File Construction Module – Main Screen, select the TMS Input checkbox and the Fnames item in the TMS Input list box.
9.1.6.1. **NO ELECTRIFICATION CASES**

Click the **Select** command button under the **TMS Input** list box to expose the next screen.
This will be the normal run for the AM Peak without electrification. Click the **Track Layout File** item in the **Input File Type** list box to obtain the next screen.
Double click on the filename TW-n.dce in the Select From: List of Files file list box to select the Track Layout File.
There will be no Network file, since the layout is not electrified. Click the Op Time Input File item in the Input File Type list box to obtain the next screen.
Double click on the filename OP-a.dce in the Select From: List of Files file list box to select the Operating Time File.
Click the Train Loc Input File item in the Input File Type list box to obtain the next screen.
Double click on the filename **TL-a.dce** in the **Select From: List of Files** file list box to select the **Train Location File**.
Because of no electrification, skip the **Cur Meas Input File** item in the **Input File Type** list. Click the **Sta Dscrp Input File** item in the **Input File Type** list box to obtain the next screen.
Double click on the filename **SD-a.dce** in the **Select From: List of Files** file list box to select the **Station Description File**.
Click the Power Profile Inputs item in the Input File Type list box to obtain the next screen.
Double click on the filenames P-cfra.dce, P-cnra.dce, P-crfa.dce and P-erna.dce in the Select From: List of Files file list box to select the Power Profiles for the AM Peak run.
Click the **Alarm** check box under the **Output Files Desired** to obtain the next screen.
Name the **TMS File of Filenames** and the **Alarm File** (output) and enter the **File Caption** to obtain the next screen.
Click the Create File command button to create the file and produce the next screen.
In a like manner, create the TMS Files of filenames for the Midday, PM Peak and Evening periods of operation. First the Midday is shown in the next screen.
PM Peak operation is shown in the next screen.
Evening operation is shown in the next screen.
9.1.6.2. ELECTRIFICATION CASES

The TMS Files of Filenames for the electrified operation cases can be created directly from the non-electrified operation cases. Begin by double clicking on the AM Peak TMS Files of Filenames, TMSna.dce, in the Select From: List of Files file list box to produce the next screen.
Add the Network file and Current Measurement Input files to the Input File Name list box.
Click the Cur Meas check box under the Output Files Desired: label. This action produces the following screen.
Rename the **TMS File of Filenames**, the **Current Measurement** output file and the **Alarm** output file. Correct the **File Caption**. All of these actions produce the following screen.
Click the Create File command button to produce the next screen.
Similar files are then created for Evening, Midday and PM Peak operation. The last screen is shown next.
9.2. TMS RUNS

9.2.1. TMS WITHOUT ELECTRIFICATION

9.2.1.1. TMS TEST RUN AM PEAK

The first step is to make sure that all of the TMS runs without electrification work and correct all of the problems, which may arise.

Begin with the TMSna.dce run.
Click the TMS command button on the TOM main screen to obtain the next screen.
Select the TMS File of Filenames TMSna.dce in the file list box to obtain the next screen.
In the **Action** menu:
Select the **Start** item to begin the simulation.
In the Action menu:
Select the **Nodes Visible** item.
In the **Infrastructure** menu:
Select the Stations On item.
In the Train Control menu:
Select the **ATC Fixed Block On** item. This action will turn automatic train control with fixed blocks on, so that all switching is done automatically. In the **Action** menu:
Select the **Advance to End** item.
Click the **OK** command button, which results in the same screen. The conflicting train is on track 1, just to the left of the switch. Its yellow rather than white color indicates that the train has a conflict.

The reason for the conflict is clear. It has tried to enter the block occupied by the train to the left of it. There are several ways to remedy this situation.

- Change the dwell time at stations.
- Change the timetable, so that the trains are not that close.
- Add a block.
- Move a node.

The first two changes interfere with operations. It may not be desirable to make these changes.

It is recognized that the block occupied by the previous train is very long. It is actually 2.15 mi. Thus adding a node on both tracks 1 and 2 at MP 2.7 would divide the single block into two blocks of near equal length.

On the **File Construction Module – Main Screen**, click the **TMS Input** check box and click the **TrkLayout** item in the **TMS Input** list box.
Click the **Select** command button under the **TMS Input** list box to produce the next screen.
Double click the TW-n.dce filename in the TrkLayout Input File list box to obtain the next screen.
Click the Graphic Input command button in the Aids For Track Layout Construction frame.
Click the Open Grid command button.
Insert two nodes at MP 2.7, one on track 1 and the other on track 2.
Click the Close command button.
Create the file and rerun the TMS under the same conditions.
On the **Action** menu:
Click the **Advance to End** item.
The TMS ran to the end with no alarms. This indicates that there were no more train conflicts.

On the Action menu:
Click the End TMS item.
Click the Yes command button to review the summary output.
There is no energy information because this was a non-electrified run. To view the Alarm output file, click the DB command button on the Train Movement Simulator screen.
Click the **TMS Files** check box.
Double click the **Alarm Out** item in the **TMS Files** list box.
Double click the **TMAna.dce** filename in the file list box to obtain the next screen.
This file shows the conflicts that were automatically resolved by the train control.

The test procedure just described show that the train conflict due to a long block was a problem in the TMS of TMSna.dce. Once this problem was resolved by dividing the long block into two blocks, there were no more train conflicts.

The same test procedure will be run for TMSne.dce, TMSnm.dce and TMSnp.dce.

9.2.1.2.  TMS TEST RUN EVENING

TMSne.dce tested OK.
9.2.1.3. **TMS TEST RUN MIDDAY**

TMSnm.dce tested OK.
9.2.1.4. **TMS TEST RUN PM PEAK**

TMSnp.dce has a problem as is shown in the next screen.
Click the **OK** command button and then click on the **State** menu:
Click on the Train Info Mode item in the menu and click the mouse on the yellow colored train (the one in conflict).
Information on the train to the left of the conflicting train can also be obtained.
Since the front end of the train is at MP .993 and the train length is 0.09091 mi., placing a node at MP 1.09 means that the train will have cleared the new block and there will be no conflict.
9.2.2. TMS WITH ELECTRIFICATION

9.2.2.1. TMS TEST RUN AM PEAK

On the TMS main screen, click the TMS File of Filenames TMSena.dce.
Click the Select command button under the File of Filenames file list box.
On the Action menu:
Click the **Start** item.
On the Action menu:
Click the **Nodes Visible** item.
On the Train Control menu:
Click the ATC Fixed Block On item.

On the Infrastructure menu:
Click the Stations On and Substations On items.
On the **Action** menu:
Click the **Advance to End** item.
On the **Action** menu:
Click the **End TMS** item.
Click the Yes command button.
<table>
<thead>
<tr>
<th>SHAP/SHT TYPE</th>
<th>kW</th>
<th>VAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00</td>
<td>22491.510</td>
<td>25.330</td>
</tr>
<tr>
<td>00:00:02</td>
<td>24020.590</td>
<td>29.907</td>
</tr>
<tr>
<td>00:00:03</td>
<td>24491.060</td>
<td>30.003</td>
</tr>
<tr>
<td>00:00:04</td>
<td>24604.790</td>
<td>31.710</td>
</tr>
<tr>
<td>00:00:05</td>
<td>24703.160</td>
<td>32.349</td>
</tr>
<tr>
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<td>32.959</td>
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<td>24925.720</td>
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</tr>
<tr>
<td>00:00:11</td>
<td>24496.920</td>
<td>29.607</td>
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<td>00:00:12</td>
<td>20209.700</td>
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<tr>
<td>00:00:13</td>
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<td>10.021</td>
</tr>
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<td>22.503</td>
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<td>20594.410</td>
<td>21.057</td>
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<td>00:00:24</td>
<td>18060.710</td>
<td>15.059</td>
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<tr>
<td>00:00:25</td>
<td>14657.330</td>
<td>10.071</td>
</tr>
</tbody>
</table>

Scroll the text to the bottom, to view the summary.
9.2.2.2. **TMS TEST RUN EVENING**

Follow the same procedure as outlined in the previous Section 9.2.2.1. The summary file is shown next.

<table>
<thead>
<tr>
<th>Time</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:51:00</td>
<td>5832.424</td>
<td>1.221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:52:00</td>
<td>5010.667</td>
<td>1.031</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:53:00</td>
<td>5013.497</td>
<td>1.396</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:54:00</td>
<td>5000.661</td>
<td>1.431</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:55:00</td>
<td>5023.693</td>
<td>1.811</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:56:00</td>
<td>5592.317</td>
<td>1.221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:57:00</td>
<td>9339.687</td>
<td>5.100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:58:00</td>
<td>10689.240</td>
<td>7.214</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:59:00</td>
<td>10725.100</td>
<td>5.324</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td>18693.790</td>
<td>11.090</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY AT 10:00**

- **Net Energy Point Energy**: 1181.8
- **Energy Delivered to Vehicles**: 1071.5
- **Energy Regenerated by Vehicles**: 0
- **AC Network Losses**: 0
- **Converter Losses**: 68.2
- **DC Network Losses**: 82.2
- **Total Network Losses**: 130.5
- **Energy Balance for Network**: -2

**Accumulated Car Distance**: 116.89

**Number of Non-Convergent Snapshots**: 0

**File Path**: C:\ton\tom\stats\deltas\TMS\TMSa.dcc

**Date**: 10/28/2003

**Time**: 10:10:14

**Caption**: Normal Operation - AM Peak - Electrification
### 9.2.2.3. TMS TEST RUN MIDDAY

Follow the same procedure as outlined in Section 9.2.2.1. The summary file is shown next.

```
<table>
<thead>
<tr>
<th>Time</th>
<th>kWh</th>
<th>kVArh</th>
<th>kVArh/km</th>
<th>kVArh/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>20:11:51.00</td>
<td>2819.336</td>
<td>.305</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:52.00</td>
<td>2796.211</td>
<td>.305</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:53.00</td>
<td>2690.939</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:54.00</td>
<td>2397.308</td>
<td>- .610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:55.00</td>
<td>2353.308</td>
<td>- .610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:56.00</td>
<td>1935.961</td>
<td>- .305</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:57.00</td>
<td>1791.376</td>
<td>- .610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:58.00</td>
<td>1702.452</td>
<td>- .610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:11:59.00</td>
<td>1646.507</td>
<td>- .305</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:12:00.00</td>
<td>3219.355</td>
<td>- .610</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

**SUMMARY**

- **Net Energy Delivered to Vehicles:** 2819.336 kWh
- **Energy Regenerated by Vehicles:** 2796.211 kWh
- **AC Network Losses:** 2397.308 kWh
- **Converter Losses:** 2353.308 kWh
- **DC Network Losses:** 1935.961 kWh
- **Total Network Losses:** 1791.376 kWh
- **Energy Balance for Network:** -4 kWh

**Accumulated Car Distance:** 76.81 km

**Number of Non-Convergent Snapshots:** 0
9.2.2.4. **TMS TEST RUN PM PEAK**

Follow the same procedure as outlined in Section 9.2.2.1. The summary file is shown next.
9.2.3. TMS MENU ITEMS

The TMS graphical screen contains several menus, which include File, Edit, View, State, Action, Train Control, Infrastructure, Simulation and Help.
These menu items serve a variety of functions, which are briefly described.

**File** - Includes the following items and functions related to peripherals:

- **Start** – Starts the simulation at the first snapshot.
- **Restart** – Reverts the simulation to the second snapshot.
- **Exit** - Exits the program. No files are saved.

**Edit** - Includes the standard windows editing functions of **Select Text**, **Select Graphics**, **Select All**, **Copy** and **Paste**. At any time during the simulation, a click on the **Select All** item, followed by a click on the **Copy** item, copies the screen to the clipboard, from which it may be pasted into any other program such as **WORD**, **EXCEL**, **POWERPOINT**, etc. for presentation or preservation purposes.

**View** - Includes the standard window’s type views of **Size to Fit** and **Full Screen**, both of which are self-explanatory. Use of these functions can sometime cause problems with the simulation and are not recommended.

**State** – Includes the following functions as related to the state of the TMS:

- **Normal Mode** – Enables the Normal State of the TMS, in which trains are running on the system.
- **Switch Set Mode** – Enables the Switch Set State of the TMS, in which switch and crossover position interlockings can be changed.
Train Info Mode – Enables the Train Information State of the TMS, in which information on each of the trains on the screen can be displayed. A click of the mouse on the train will display the train number, ID, length, position (front end), track number, speed, speed command, stop distance, and if the ENS is running simultaneously with the TMS, the train voltage and power.

Trk Seg Info Mode – Enables the Track Segment Information State of the TMS, in which information on each of the track segments (blocks) on the screen can be displayed. A click of the mouse on the track segment will display the segment ID, the end node IDs and positions, the average grade and curvature, the speed command and the segment type.

Node Info Mode – Enables the Node Information State of the TMS, in which information on each of the nodes on the screen may be displayed. A click of the mouse on the node will display the node ID, position and type.

Action – Includes the following functions as related to actions by the user:

Start – Starts the simulation at the first snapshot.
Proceed One Step – Moves the trains forward by one time step or snapshot.
Blocks Visible – Enables the track segment endpoints.
Blocks Invisible – Disables the track segment endpoints.
Interlocking On – Enables the interlocking of switches and crossovers
Interlocking Off – Disables the interlocking feature.
Advance Time 5 Snapshots – Advances the simulation time by 5 Snapshots
Advance Time 10 Snapshots – Advances the simulation time by 10 Snapshots
Advance Time 30 Snapshots – Advances the simulation time by 30 Snapshots
Advance Time 60 Snapshots – Advances the simulation time by 60 Snapshots
Advance Time 120 Snapshots – Advances the simulation time by 120 Snapshots
Set Time Manually – Allows the setting of any time, to which the TMS will proceed. The time can be an advanced time or a previous time.
End TMS – Ends the simulator in such a way as to save all output files.

Train Control – Includes the following items as related to train control

MTC Conflicts On – Manual Train Control with conflicts recognized setting alarms.
MTC Conflicts Off – Manual Train Control with conflicts ignored.
ATC Fixed Block On – Automatic Train Control with self-settings of switch and crossover interlockings.
ATC Fixed Block Off – Automatic Train Control fixed block turned off.
ATC Moving Block On – Automatic Train Control with self-settings of switch and crossover interlockings and moving block protection on main track.
ATC Moving Block Off – Automatic Train Control moving block turned off.

Infrastructure – Includes the following items related to wayside facilities such as passenger stations or stops, substations or tie stations (breaker houses) and current measurement devices.

Stations On – Displays the passenger stations or stops.
Stations Off – Turns the passenger stations or stops display off.
Station Information – Enables information about the passenger stations to be displayed with a mouse click on the station. Information includes station name, position of platform mid-point and platform length.

If the ENS is running with the TMS then:
Substations On – Displays the substations and tiestations (breaker houses).
Substations Off – Turns substations and tiestations (breaker house) display off.
Substation Information – Enables information about the substations and tiestations (breaker houses) to be displayed with a mouse click on the station. Information includes substation or tiestation ID, position, track number and feed voltage.
Cur Meas On – Displays current measurement devices (ammeters) along the track.
Cur Meas Off – Turns current measurement device display off.
Cur Meas Information – Enables information about current measurement devices (ammeters) to be displayed with a mouse click on the device. Information includes device ID, position, track number and current.
Simulation – Includes the following items related to simulation environment.

Set No Real Time – Allows the simulator to run as fast as the computer will allow it to run.
Set Real Time – Allows the simulator to run in real time, if the computer runs the simulation faster than real time.
Set 60x Real Time – Allows the simulator to run 60x faster than real time, if the computer runs the simulation faster than 60x faster than real time.
Set 30x Real Time – Allows the simulator to run 30x faster than real time, if the computer runs the simulation faster than 30x faster than real time.
Set 10x Real Time – Allows the simulator to run 10x faster than real time, if the computer runs the simulation faster than 10x faster than real time.
Set 5x Real Time – Allows the simulator to run 5x faster than real time, if the computer runs the simulation faster than 5x faster than real time.
Set 2x Real Time – Allows the simulator to run 2x faster than real time, if the computer runs the simulation faster than 2x faster than real time.

Help - Includes the following items.

Contents – Displays the main contents of help available. This display includes more detailed information about the menus and menu items and operation of the TMS.
About the TMS – Lists copyright info on the TMS.

Much more detailed information is included in the TOM Program Manual.