**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
2565 PLYMOUTH ROAD
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MEMORANDUM

DATE:        March 3, 1999

SUBJECT:     A Modified Version of MOBILE5 for Evaluation of Proposed Tier 2 Evaporative
             Emission Standards

FROM:        David J. Brzezinski, OMS AMD
             Emission Inventory Group

TO:          Docket A-97-10


        I have completed work on a modification to the version of the MOBILE5b model used by
the Tier 2 team which will allow the evaluation of the effects of a proposed new evaporative
emission standard for Tier 2 vehicles.

        The effect of new evaporative emission standards for Tier 2 vehicles are assumed to:

o        Only affect hot soak, diurnal and resting loss evaporative emissions categories.

o        Apply only to the emissions of vehicles which passed both the EPA pressure and
         EPA purge functional test procedures. The emission levels of vehicles failing those
         tests would be assumed to be unaffected by the new evaporative emission
         standards for Tier 2 vehicles.

o        Apply only to passenger cars and light-duty trucks of less than 8500 lbs. gross
         vehicle weight rating.

o        Reduce existing vehicle emission estimates proportionally to the reduction in the
         passenger car standard.  (reduction = (2.0 grams - 0.95 grams)/2.0 grams or
         52.5% for passenger cars and light-duty trucks up to 6000 pounds gross vehicle
         weight rating (GVWR) and reduction = (2.0 grams - 1.2 grams)/2.0 grams or 40%
         for light-duty trucks over 6000 pounds GVWR.

o        For passenger cars and light-duty trucks up to 6000 pounds GVWR, phase in the
         new standard over four years (2004 through 2007) evenly; 25%, 50%, 75% and
         100% respectively.  All 2007 and newer model year passenger cars and light-duty
         trucks up to 6000 pounds GVWR would thus comply with the new standard.

o        For light-duty trucks over 6000 pounds GVWR, phase in the new standard over two years (2008 through 2009) evenly; 50%, and 100% respectively.  All 2009 and newer model year and light-duty trucks over 6000 pounds GVWR would thus comply with the new standard.

The MOBILE5b model was modified to adjust the constant proportional reduction by the fraction of vehicles for which the standard applies for each model year.   This reduction is applied to the emission level of passenger cars and light-duty trucks which passed both the EPA pressure and EPA purge functional test procedures before these emissions are weighted by the pass/fail rate.

Resting losses are not a function of pass/fail for the EPA pressure and EPA purge functional test procedures in MOBILE5b.  The total resting loss emissions of vehicles both passing and failing the EPA pressure and EPA purge functional test procedures were assumed to be reduced by 52.5% with the more stringent standard.

A flag was added to the Local Area Parameter Record (column 55), which controls whether the emission standard is applied or not.  The values for this flag are:

1 : Assume default MOBILE5b evaporative emission levels.
2 : Apply the new evaporative emission standard effects.

The default value for this flag is "1", meaning the evaporative results will be the same as the unmodified version of MOBILE5b.  A blank or any other character other than a "2" will be interpreted as a "1" for purposes of the model.  The output will indicate the version of the model and whether the evaporative emissions have been adjusted.  If the flag is not set the results of the modified version of the model will be identical to those from MOBILE5b.

An additional output file will be created when the modified version is run.  This file will always be called T2EVAP.TXT and will contain diagnostic output.  Changes were made in the following MOBILE5b modules to accomplish this task:

o DRIVER.FOR
o DIURNL.FOR
o HCCALX.FOR
o HOTSOK.FOR
o OUTLAP.FOR
o RDCITY.FOR
o RFORM2.I
o VNAME.I

Attached is an electronic comparison of the changed routines showing the precise changes in the code.  I will provide copies of this application to the Tier 2 team for evaluation of the

impact of these assumed changes on emission inventories and submit an electronic copy of the executable application and source code to the docket.

cc:    Phil Lorang
       Lois Platte
       Megan Beardsley
       John Koupal
       Rick Rykowski
       Mike Sklar

Attachment


Comparison of Modified MOBILE5b Code
To the Original MOBILE5b Code

March 3, 1999


Source 1 : Original Code
Source 2 : Modified Code



Modified Routines:

vname.i
rform2.i
driver.for
diurnl.for
hccalx.for
hotsok.for
outlap.for
rdcity.for

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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\vname.i> with File 2:<d:\temp\source2\vname.i>


 1    1>          VERSON='MOBILE5b (14-Sep-96)'
 2    1>          VERSON='MOBILE5b - Tier 2 Analysis Evap Version (3-Mar-99)'

 1   14>
```

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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\rform2.i> with File 2:<d:\temp\source2\rform2.i>


 1     2>          REAL RFGRVP
 1     3>          COMMON /RFORM2/ RFGSYR(3),RFGRVP(5,3)

 2     2>          REAL RFGRVP, T2EVAP
 2     3>          COMMON /RFORM2/ RFGSYR(3),RFGRVP(5,3),T2EVAP(3)
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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\driver.for> with File 2:<d:\temp\source2\driver.for>


 2    3> C  ** Altered to include the Tier 2 evaporative effect. DJB 10/21/98
 2    4> C  ** Modified to have separate Tier 2 evap effects for LDT2. DJB 03/03/99

 1  126>         WRITE(IOUASK,202)
 1  127>     202 FORMAT(///'&',
 1  128>       &          'Do you want to use the interactive input mode (Y/N)?')
 1  129>         READ(IOUASK,100) INTER
 1  130>     100 FORMAT(A1)
 2  128>         INTER='N'
 2  129> C       WRITE(IOUASK,202)
 2  130> C 202 FORMAT(///'&',
 2  131> C     &          'Do you want to use the interactive input mode (Y/N)?')
 2  132> C       READ(IOUASK,100) INTER
 2  133> C 100 FORMAT(A1)

 1  147>         WRITE(IOUASK,205)
 1  148>     205   FORMAT(/'&','Do you want to use the batch file',
 1  149>       *  ' input mode (Y/N)?')
 1  150>         READ(IOUASK,100) BATCH
 2  150> C       WRITE(IOUASK,205)
 2  151> C 205   FORMAT(/'&','Do you want to use the batch file',
 2  152> C     *  ' input mode (Y/N)?')
 2  153> C       READ(IOUASK,100) BATCH

 2  304>         OPEN(7,FILE='T2EVAP.TXT')

 2  312>         CLOSE(7)
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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\diurnl.for> with File 2:<d:\temp\source2\diurnl.for>


 2    3> C  ** Altered to include the Tier 2 evaporative effect. DJB 11/12/98
 2    4> C

 2   83>         INCLUDE 'RFORM2.I'

 1   86>         REAL MDU
 2   89>         REAL MDU,T2ADJ

 1  111> C  Grab resting loss rate first
 1  112> C
 1  113>         IVTEMP=IVGAS
 1  114>         IF(IVGAS.EQ.5) IVTEMP=8
 1  115>         RSTLS=RSTLOS(MY,IVTEMP,TEMEVP(1))
 1  116> C


 2  160> C  Grab resting loss rate first
 2  161> C
 2  162>         IVTEMP=IVGAS
 2  163>         IF(IVGAS.EQ.5) IVTEMP=8
 2  164>         RSTLS=RSTLOS(MY,IVTEMP,TEMEVP(1))
 2  165> C


 2  220> C  Apply the effect of Tier 2 evaporative emission standards to
 2  221> C  only the "pass" category diurnal emissions. LDV & LDT Only.
 2  222> C              LDGV & LDGT1   LDGT2
 2  223> C      2004  =     25%         0%
 2  224> C      2005  =     50%         0%
 2  225> C      2006  =     75%         0%
 2  226> C      2007  =    100%         0%
 2  227> C      2008  =    100%        50%
 2  228> C      2009+ =    100%       100%
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2  229> C  DJB 11/12/98
2  230> C  DJB 03/03/99

1  219>     10 IF(KEYEQ.EQ.1) DUPASS=DUPASS+DUPF
2  233>     10 T2ADJ=1.0
2  234>        IF(KEYEQ.EQ.1) THEN
2  235>          IF(IVGAS.LT.3.AND.MY.EQ.2004) T2ADJ=1+0.25*(T2EVAP(IVGAS)-1.0)
2  236>          IF(IVGAS.LT.3.AND.MY.EQ.2005) T2ADJ=1+0.50*(T2EVAP(IVGAS)-1.0)
2  237>          IF(IVGAS.LT.3.AND.MY.EQ.2006) T2ADJ=1+0.75*(T2EVAP(IVGAS)-1.0)
2  238>          IF(IVGAS.LT.4.AND.MY.GE.2007) T2ADJ=T2EVAP(IVGAS)
2  239>          IF(IVGAS.EQ.3.AND.MY.LT.2008) T2ADJ=1.0
2  240>          IF(IVGAS.EQ.3.AND.MY.EQ.2008) T2ADJ=1+0.50*(T2EVAP(IVGAS)-1.0)
2  241>          DUPF=DUPF*T2ADJ
2  242>          DUPASS=DUPASS+DUPF
2  243>        ENDIF

2  352>        IF(IVGAS.EQ.1) THEN
2  353>          JDX=MAXYRS+1-IDX
2  354>          ICY=JDX-1+MY
2  355>          IF(MY.EQ.1992.OR.MY.EQ.2000.OR.MY.EQ.2007) THEN
2  356>          WRITE(7,777) ICY,MY,(DU(I),I=1,5)
2  357>     777  FORMAT(2(1X,I4),5(1X,F8.5),' Full,3Partials,Multiple')
2  358>          ENDIF
2  359>        ENDIF
```

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Comparing File 1:<d:\temp\source1\hccalx.for> with File 2:<d:\temp\source2\hccalx.for>


```
2  109>        INCLUDE 'RFORM2.I'

2  115>        REAL T2ADJ

2  287> C  Apply the effect of Tier 2 evaporative emission standards to
2  288> C  all resting loss emissions. LDV & LDT Only.
2  289> C             LDGV & LDGT1    LDGT2
2  290> C     2004  =     25%          0%
2  291> C     2005  =     50%          0%
2  292> C     2006  =     75%          0%
2  293> C     2007  =    100%          0%
2  294> C     2008  =    100%         50%
2  295> C     2009+ =    100%        100%
2  296> C  DJB 11/12/98
2  297> C  DJB 03/03/99
2  298> C
2  299>        T2ADJ=1.0
2  300>        IF(IV.LT.3.AND.MY.EQ.2004) T2ADJ=1+0.25*(T2EVAP(IV)-1.0)
2  301>        IF(IV.LT.3.AND.MY.EQ.2005) T2ADJ=1+0.50*(T2EVAP(IV)-1.0)
2  302>        IF(IV.LT.3.AND.MY.EQ.2006) T2ADJ=1+0.75*(T2EVAP(IV)-1.0)
2  303>        IF(IV.LT.4.AND.MY.GE.2007) T2ADJ=T2EVAP(IV)
2  304>        IF(IV.EQ.3.AND.MY.LT.2008) T2ADJ=1.0
2  305>        IF(IV.EQ.3.AND.MY.EQ.2008) T2ADJ=1+0.50*(T2EVAP(IV)-1.0)
2  306>        RSLOSS=RSLOSS*T2ADJ
2  307> C
2  308> C  Write out diagnostic values
2  309> C
2  310>        IF(IV.EQ.1) THEN
2  311>          IF(MY.EQ.1992.OR.MY.EQ.2000.OR.MY.EQ.2007) THEN
2  312>          ICY=JDX-1+MY
2  313>          WRITE(7,777) ICY,MY,RSLOSS,T2ADJ,T2EVAP(IV)
```

```
2  314>   777    FORMAT(2(1X,I4),3(1X,F8.5),18X,' Resting Loss,T2ADJ,T2EVAP')
2  315>          ENDIF
2  316>        ENDIF
2  317> C

2  322> C
2  323> C  Write out diagnostic values
2  324> C
2  325>        IF(IV.EQ.1) THEN
2  326>          IF(MY.EQ.1992.OR.MY.EQ.2000.OR.MY.EQ.2007) THEN
2  327>          WRITE(7,778) ICY,MY,RSLOSS
2  328>   778    FORMAT(2(1X,I4),3(1X,F8.5),18X,' Resting Loss with ETP')
2  329>          ENDIF
2  330>        ENDIF
2  331> C
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COMPARE V2.2

Comparing File 1:<d:\temp\source1\hotsok.for> with File 2:<d:\temp\source2\hotsok.for>


2    3> C  ** Altered to include the Tier 2 evaporative effect. DJB 11/12/98
2    4> C

2   71>          INCLUDE 'RFORM2.I'

2   75>          REAL T2ADJ,RSTLS,T2ADJX
2   76>          INTEGER JDX,ICY

1  164>          HSPF=AMAX1(HSPF-RSTLOS(MY,IVTEMP,HSTEMP),0.0)
2  169>          RSTLS=RSTLOS(MY,IVTEMP,HSTEMP)
2  170>          HSPF=AMAX1(HSPF-RSTLS,0.0)

2  188> C  Apply the effect of Tier 2 evaporative emission standards to
2  189> C  only the "pass" category hot soak emissions. LDV & LDT Only.
2  190> C               LDGV & LDGT1      LDGT2
2  191> C      2004  =       25%             0%
2  192> C      2005  =       50%             0%
2  193> C      2006  =       75%             0%
2  194> C      2007  =      100%             0%
2  195> C      2008  =      100%            50%
2  196> C      2009+ =      100%           100%
2  197> C  DJB 11/12/98
2  198> C  DJB 03/02/99

1  184>       30 IF(KEYEQ.EQ.1) HSPASS=HSPASS+HSPF
2  201>       30 T2ADJ=1.0
2  202>          IF(KEYEQ.EQ.1) THEN
2  203>            IF(IVGAS.LT.3.AND.MY.EQ.2004) T2ADJ=1+0.25*(T2EVAP(IVGAS)-1.0)
2  204>            IF(IVGAS.LT.3.AND.MY.EQ.2005) T2ADJ=1+0.50*(T2EVAP(IVGAS)-1.0)
2  205>            IF(IVGAS.LT.3.AND.MY.EQ.2006) T2ADJ=1+0.75*(T2EVAP(IVGAS)-1.0)
2  206>            IF(IVGAS.LT.4.AND.MY.GE.2007) T2ADJ=T2EVAP(IVGAS)
```

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2  207>           IF(IVGAS.EQ.3.AND.MY.LT.2008) T2ADJ=1.0
2  208>           IF(IVGAS.EQ.3.AND.MY.EQ.2008) T2ADJ=1+0.50*(T2EVAP(IVGAS)-1.0)
2  209>           HSPF=HSPF*T2ADJ
2  210>           T2ADJX=T2ADJ
2  211>           HSPASS=HSPASS+HSPF
2  212>         ENDIF

2  245> C  Write out diagnostic values
2  246> C
2  247>         IF(IVGAS.EQ.1) THEN
2  248>           IF(MY.EQ.1992.OR.MY.EQ.2000.OR.MY.EQ.2007) THEN
2  249>           JDX=MAXYRS+1-IDX
2  250>           ICY=JDX-1+MY
2  251>           WRITE(7,777) ICY,MY,EVP(1),T2ADJX,T2EVAP(IVGAS)
2  252>   777     FORMAT(2(1X,I4),3(1X,F8.5),18X,' Hot Soak,T2ADJ,T2EVAP')
2  253>           ENDIF
2  254>         ENDIF
2  255> C
```

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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\outlap.for> with File 2:<d:\temp\source2\outlap.for>


 2     3> C  ** Altered to include the Tier 2 evaporative effect. DJB 10/21/98
 2     4> C

 2    45>        INCLUDE 'RFORM2.I'

 2    48> C
 2    49> C  Output statement when Tier 2 Evap Standards are applied.
 2    50> C  Reduction shown for each vehicle class.
 2    51> C  DJB 10/21/98
 2    52> C  DJB 03/03/99
 2    53> C
 2    54>        IF(T2EVAP(1).LT.1.0) WRITE(IOUREP,260)
 2    55>      * ((1.0 - T2EVAP(1)) * 100.),
 2    56>      * ((1.0 - T2EVAP(2)) * 100.),
 2    57>      * ((1.0 - T2EVAP(3)) * 100.)
 2    58>   260 FORMAT(' ',
 2    59>      *' With ',F5.1,'% Tier 2 LDV Evaporative Standard Reduction.',/,
 2    60>      *' With ',F5.1,'% Tier 2 LDT1 Evaporative Standard Reduction.',/,
 2    61>      *' With ',F5.1,'% Tier 2 LDT2 Evaporative Standard Reduction.')
 2    62> C
```

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COMPARE V2.2

 Comparing File 1:<d:\temp\source1\rdcity.for> with File 2:<d:\temp\source2\rdcity.for>


 2    3> C  ** Altered to include the Tier 2 evaporative effect. DJB 10/21/98
 2    4> C

 1   96>        CHARACTER*1 DSFCHR,OXYCHR,RFGCHR,IAFCHR,WINCHR,DTGCHR
 1   97>        INTEGER IAFLG,IERRFL
 2   98>        CHARACTER*1 DSFCHR,OXYCHR,RFGCHR,IAFCHR,WINCHR,DTGCHR,T2FCHR
 2   99>        INTEGER IAFLG,IERRFL,T2FLAG

 1  113>      *    RFGCHR,DTGCHR,IAFCHR,WINCHR
 1  114>   100 FORMAT(4A4,1X,A1,2F5.0,2F5.1,1X,I2,6(1X,A1))
 1  115> C
 1  116> C  Parse OXYFLG, DSFLAG, RFGFLG, DTGFLG, WINFLG and IAFCNT columns
 2  115>      *    RFGCHR,DTGCHR,IAFCHR,WINCHR,T2FCHR
 2  116>   100 FORMAT(4A4,1X,A1,2F5.0,2F5.1,1X,I2,7(1X,A1))
 2  117> C
 2  118> C  Parse OXYFLG, DSFLAG, RFGFLG, DTGFLG, WINFLG, T2EVAP and IAFCNT columns

 1  127>        IAFLG=9
 2  129>        IAFLG =9
 2  130>        T2FLAG=1

 2  138>        IF (T2FCHR.EQ.NUMBER(I)) T2FLAG=I-1
```

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2   141> C   The effect of Tier 2 evaportive standards on Hot Soak and Diurnal
2   142> C   evaporative emissions is the proportional to the value of the
2   143> C   LDV standards (2.0 g). If the flag (T2FLAG) is set to 1, there is no effect.
2   144> C   There are separate standards and effects for LDGV/LDGT1 and LDGT2 classes.
2   145> C   DJB 10/21/98
2   146> C   DJB 03/03/99
2   147> C
2   148>          T2EVAP(1) = 1.00
2   149>          T2EVAP(2) = 1.00
2   150>          T2EVAP(3) = 1.00
2   151>        IF(T2FLAG.EQ.2) THEN
2   152>          T2EVAP(1) = 0.95 / 2.00
2   153>          T2EVAP(2) = 0.95 / 2.00
2   154>          T2EVAP(3) = 1.20 / 2.00
2   155>        ENDIF
2   156> C
```