Luminant

Rafael Flores
Senior Vice President &
Chief Nuclear Officer
rafael.flores@luminant.com

Luminant Power
P O Box 1002
6322 North FM 56
Glen Rose, TX 76043

T 254.897.5590
F 254.897.6652
C 817.559.0403

CP-201001398
Log # TXNB-10073

Ref. # 10 CFR 52
10 CFR 2.390

October 21, 2010

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555
ATTN: David B. Matthews, Director
Division of New Reactor Licensing

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4
DOCKET NUMBERS 52-034 AND 52-035
SUPPLEMENTAL INFORMATION FOR RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION NO. 4725 (SECTION 2.5.2) AND 4841 (SECTION 2.5.4)

Dear Sir:

Luminant Generation Company LLC (Luminant) submits herein supplemental information for the response to Request for Additional Information (RAI) No. 4725 and 4841 for the Combined License Application for Comanche Peak Nuclear Power Plant Units 3 and 4. The RAIs involve seismic sources and excavation plans.

When the response to RAI No. 4841 was submitted on September 19, 2010 (letter TXNB-10062), the NRC determined that the figures in the response contained Security-Related Information and withheld the figures from public dissemination. Therefore, Luminant has annotated the same type of figures provided herein as containing Security-Related Information. This letter is declassified upon separation from Attachment 3.

The supplemental information for the response to RAI No. 4841 impacts the response to RAI No. 2818 and No. 2819 provided in the last quarter of 2009. Luminant will provide supplemental information for those responses by November 30, 2010. This is being tracked as Regulatory Commitment #8131 and is the only new commitment in this letter.

Submittal of the additional figures for RAI No. 4841 completes Regulatory Commitment #7781 made in letter TXNB-10063 (ML102660625).

Should you have any questions regarding this response, please contact Don Woodlan (254-897-6887, Donald.Woodlan@luminant.com) or me.

D09D
NRD

I state under penalty of perjury that the foregoing is true and correct.

Executed on October 21, 2010.

Sincerely,

Luminant Generation Company LLC

Donald R. Woodlan for

Rafael Flores

Attachments:
1. Supplemental Response to Request for Additional Information No. 4725 (CP RAI #168)
2. Supplemental Response to Request for Additional Information No. 4841 (CP RAI #170)
3. Supplemental Figures for Response to Request for Additional Information No. 4841 (CP RAI #170) (Security-Related Information)

cc: Stephen Monarque w/all attachments

Electronic distribution w/out Attachment 3:

Rafael.Flores@luminant.com
mlucas3@luminant.com
jeff.simmons@energyfutureholdings.com
Bill.Moore@luminant.com
Brock.Degeyter@energyfutureholdings.com
rbird1@luminant.com
Allan.Koenig@luminant.com
Timothy.Clouser@luminant.com
Ronald.Carver@luminant.com
David.Volkening@luminant.com
Bruce.Turner@luminant.com
Eric.Evans@luminant.com
Robert.Reible@luminant.com
donald.woodlan@luminant.com
John.Conly@luminant.com
JCaldwell@luminant.com
David.Beshear@txu.com
Ashley.Monts@luminant.com
Fred.Madden@luminant.com
Dennis.Buschbaum@luminant.com
Carolyn.Cosentino@luminant.com
NuBuild Licensing files

Luminant Records Management (.pdf files only)

shinji_kawanago@mnes-us.com
masanori_onozuka@mnes-us.com
ck_paulson@mnes-us.com
joseph_tapia@mnes-us.com
russell_bywater@mnes-us.com
william_mcconaghy@mnes-us.com
mutsumi_ishida@mnes-us.com
nan_sirirat@mnes-us.com
nicholas_kellenberger@mnes-us.com
ryan_sprengel@mnes-us.com
katsunori_kawai@mnes-us.com
masaya_hoshi@mnes-us.com
rjb@nei.org
kak@nei.org
michael.takacs@nrc.gov
cp34update@certrec.com
michael.johnson@nrc.gov
David.Matthews@nrc.gov
Balwant.Singal@nrc.gov
Hossein.Hamzehee@nrc.gov
Stephen.Monarque@nrc.gov
jeff.ciocco@nrc.gov
michael.willingham@nrc.gov
john.kramer@nrc.gov
Brian.Tindell@nrc.gov
Alicia.Williamson@nrc.gov
Elmo.Collins@nrc.gov
Loren.Plisco@nrc.com
Laura.Goldin@nrc.gov
James.Biggins@nrc.gov
Susan.Vrahoretis@nrc.gov
ComanchePeakCOL.Resource@nrc.gov
sfrantz@morganlewis.com
jrund@morganlewis.com
tmatthews@morganlewis.com
regina.borsh@dom.com
diane.aitken@dom.com

Attachment 1

Supplemental Response to
Request for Additional Information No. 4725 (CP RAI #168)

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4725 (CP RAI #168)

SRP SECTION: 02.05.02 - Vibratory Ground Motion

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 6/9/2010

QUESTION NO.: 02.05.02-22

In response to RAI 2.5.2-2 (ML092820486), you stated "The list of contributing seismic sources in Tables 2.5.2-202 through 2.5.2-207 were taken from the original EPRI PSHA study, and were confirmed with the updated calculations that used the EPRI (2004) ground motion equations." Your statement suggests that the use of the new ground motion equations did not result in any increase in hazard contributions of those EPRI-SOG seismic sources that originally contributed less than 1% of the total hazard and were not used in the final hazard calculations. As a result, you revised the FSAR text to state this explicitly (ML092820486). However, in your responses to RAI 2.5.2-16 (ML092740182; ML0935611011; ML100550203), you presented additional seismic sources in the updated tables (FSAR Tables 2.5.2-202 through 2.5.2-207) which show new seismic sources that did not exist in the earlier version. In response to RAI 2.5.2-16 you also eliminated the revised text of the FSAR and removed the revisions inserted as part of the response to RAI 2.5.2-2 without providing justification. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion", please:

a. Clarify these apparent discrepancies between the two RAI responses and provide revised answers to the respective RAIs, as necessary.

b. Add brief geologic descriptions of these new sources in the appropriate subsections of the FSAR.

c. Describe why you added the new sources that do not appear to be contributing to the total hazard. Did the original submission not list the original EPRI-SOG sources correctly?

ANSWER:

During a public conference call with the NRC on September 23, 2010, the NRC indicated that the discussion of the revised Mmax values for Bechtel zone BZ1 in FSAR Subsection 2.5.2.4.2.2.3 provided in the response to this question was unclear with respect to the pairings between magnitude values and weights. The text of the FSAR has been changed to clarify the correct pairings for the updated Mmax distribution of Bechtel zone BZ1.

The NRC also requested digital files for the team source geometries for all noncontributing sources. The attached file "SOURCE_GEOM_NC.TXT" contains the requested information. The previously submitted file "SOURCE_GEOM.TXT" containing the geometries of the contributing sources is also attached for the reviewer's convenience.

Attachments

SOURCE_GEOM_NC.TXT

SOURCE_GEOM.TXT

Impact on R COLA

See attached marked-up FSAR Revision 1 page 2.5-100.

Impact on DCD

None.

RAI 168 Question 02.05.02-22
Attachment

SOURCE_GEOM_NC.TXT

```
Note: This file includes team source geometries that do not contribute to hazard.
$$$$$ ESRI   73 BECHTEL         L(55)  **BECDBM 032  1 055 00**    13  55
   97.74   35.83   97.78   35.98   97.67   36.46   97.37   36.72   94.96   35.77
   94.58   35.41   94.44   34.91   94.83   34.19   95.87   33.92   96.54   34.12
   97.16   34.56   97.58   35.44   97.74   35.83
$$$$$ ESRI   74 BECHTEL         M(65)  **BECDBM 033  1 056 00**     9  56
   97.74   35.83   97.59   35.43   97.58   35.23   97.78   35.11   98.04   35.12
   98.34   35.61   98.15   35.85   97.96   35.92   97.74   35.83
$$$$$ ESRI    4 BECHTEL       BZ1  **BECDBM 160  1 006 00**    43   6
   99.88   27.43   98.26   27.76   97.10   28.74   96.64   29.35   96.50   30.05
   95.94   30.98   95.32   32.28   94.84   32.94   94.11   33.44   92.37   34.00
   91.70   33.85   90.99   32.99   90.82   32.45   89.84   31.78   88.75   31.53
   88.37   31.58   86.88   31.41   86.27   31.41   85.76   31.63   85.33   31.75
   84.34   31.87   83.67   31.85   83.07   31.73   81.18   30.97   80.45   30.84
   78.48   31.35   78.02   31.33   77.19   31.53   78.18   30.36   78.19   28.23
   78.41   27.15   78.78   26.24   79.47   25.44   80.21   25.07   81.71   25.15
   87.92   25.28   92.71   25.29   96.56   25.30   98.06   25.40   98.75   25.51
   99.60   26.25   99.90   27.29   99.88   27.43
$$$$$ ESRI   43 DAMES & MOORE  26B **BECDBM 082  2 026 02**    17  26
  101.04   30.05  101.59   30.38  101.94   30.52  102.19   30.56  102.55   30.54
  102.96   30.42  103.24   30.30  103.55   30.09  105.12   31.88  105.34   32.47
  105.33   33.07  104.95   33.60  104.09   33.87  103.35   33.33  102.82   32.61
  101.86   31.37  101.04   30.05
$$$$$ ESRI   61 DAMES & MOORE  29  **BECDBM 079  2 029 00**    14  29
  101.95   34.96  101.64   34.94  101.11   34.89   99.36   34.59   98.44   34.33
   97.05   33.76   97.17   33.63   98.69   34.15  100.03   34.51  101.27   34.70
  101.66   34.73  102.13   34.77  102.11   34.92  101.95   34.96
$$$$$ ESRI   62 DAMES & MOORE  30  **BECDBM 077  2 030 00**    14  30
  101.95   34.96  101.85   35.30  101.21   35.15  100.23   35.00   99.20   34.77
   97.89   34.37   96.74   33.94   96.80   33.77   97.05   33.76   98.44   34.33
   99.36   34.59  101.11   34.89  101.64   34.94  101.95   34.96
$$$$$ ESRI   64 DAMES & MOORE  32  **BECDBM 075  2 032 00**    12  32
  100.83   35.33  100.90   35.44  100.77   35.52   99.36   35.22   97.91   34.88
   96.40   34.30   96.42   34.21   96.64   34.14   97.67   34.56   98.91   34.93
```

```
  100.50    35.27  100.83    35.33
$$$$$ ESRI   37 DAMES & MOORE   33  **BECDBM 035  2 033 00**    21  33
  101.22    35.84  101.34    36.13  101.37    36.38  100.91    36.63  100.05    36.66
   99.06    36.53   98.24    36.25   98.10    36.18   98.15    35.67   97.13    35.29
   97.09    35.65   96.56    35.31   96.07    35.05   95.61    34.79   95.45    34.59
   95.82    34.44   96.15    34.27   97.35    34.79   98.89    35.19  100.50    35.53
  101.22    35.84
$$$$$ ESRI  22 LAW ENGINEERING 119 **BECDBM$061  5 054 01**    26  54
   97.12    38.23   96.69    38.34   96.16    38.28   95.62    38.02   93.91    37.80
   94.18    37.32   94.11    36.96   93.34    36.23   92.28    35.93   92.41    35.20
   92.65    34.90   94.17    34.29   95.09    33.63   95.37    33.24   95.75    32.73
   95.75    32.73   98.64    34.42   99.41    34.69   99.29    34.93   98.66    35.86
   98.55    36.45   97.76    37.20   97.57    37.43   97.25    37.97   97.18    38.12
   97.12    38.23
$$$$$ ESRI  16 LAW ENGINEERING 120 **BECDBM$055  5 055 01**    41  55
  102.54    43.47  102.29    43.09  100.28    43.03   97.86    42.67   96.00    43.05
   94.52    43.66   93.38    44.23   93.31    44.25   93.18    43.49   93.56    42.71
   94.27    42.15   94.91    41.71   96.57    40.62   96.83    40.14   96.91    39.83
   97.18    39.35   97.38    39.05   97.62    38.58   97.34    38.17   97.12    38.23
   97.18    38.12   97.25    37.97   97.57    37.43   97.76    37.20   98.55    36.45
   98.66    35.86   99.29    34.93   99.41    34.69  100.46    35.05  102.16    35.26
  103.55    35.51  104.15    35.74  104.82    36.16  105.01    36.72  105.17    37.68
  105.05    38.79  105.18    39.45  105.27    40.04  105.39    41.99  104.21    42.62
  102.54    43.47
$$$$$ ESRI  27 LAW ENGINEERING 126 **BECDBM$065  5 060 01**    76  60
   92.65    34.90   91.98    34.85   91.20    34.50   91.02    34.40   90.64    33.85
   90.29    33.04   89.67    32.44   88.58    32.13   87.53    31.80   86.37    31.58
   86.00    31.59   85.35    31.79   83.82    31.88   82.92    31.70   80.51    30.83
   78.12    31.46   76.90    32.04   77.26    30.82   77.06    30.21   76.82    30.03
   76.15    30.13   76.09    30.00   76.59    29.65   76.73    29.49   76.56    27.21
   76.60    27.12   76.89    27.09   76.91    27.03   76.65    26.82   77.05    25.03
   80.00    25.00   84.46    25.01   84.77    25.54   84.89    26.45   85.38    27.17
   85.77    27.74   86.65    28.07   87.41    28.44   87.52    28.87   87.73    28.92
```

```
   89.98    28.22    90.73    28.04    91.22    27.93    91.50    27.87    91.81    27.88
   92.02    27.93    92.09    27.93    92.16    27.91    92.51    27.95    92.78    27.82
   93.58    27.85    95.16    27.88    95.99    27.46    96.30    27.05    96.31    25.87
   96.43    25.03   100.00    25.00   104.04    25.02   105.25    29.21   105.32    29.51
  105.16    29.24   104.61    28.60   103.31    27.88   101.94    27.62   100.55    27.58
   99.41    28.02    98.23    28.50    97.15    29.35    96.68    30.19    96.36    31.76
   95.75    32.73    95.75    32.73    95.37    33.24    95.09    33.63    94.17    34.29
   92.65    34.90
$$$$$ ESRI     2 RONDOUT SORCE   52 $**BECDBM 000   6 052 00**    136   52
   69.50    51.89    70.81    51.88    71.70    51.97    76.19    52.29    83.41    52.38
   86.16    52.29    89.87    51.94    93.37    52.05   101.85    52.27   105.07    51.92
  107.58    51.28   109.24    50.38   109.74    49.74   109.84    48.88   109.40    46.48
  109.39    44.79   108.84    42.14   108.42    39.61   108.30    38.21   107.84    35.66
  107.47    32.05   107.02    31.84   106.68    32.31   104.56    30.66   103.82    31.51
  102.75    32.68   100.87    34.41    99.93    34.25   103.08    35.22   104.14    35.49
  105.84    35.73   105.94    36.24   105.44    37.73   104.29    37.58   103.64    37.41
  101.29    36.65    99.00    36.11   100.29    37.52   102.43    40.06   104.81    41.56
  106.34    42.73   107.29    44.03   107.56    44.91   107.64    46.21   107.60    49.02
  107.25    50.31   106.18    50.67   103.56    50.80   101.68    50.54   100.91    50.24
  100.86    49.93   101.05    49.31   101.13    48.30   100.60    46.85    99.27    45.02
   96.09    46.12    93.46    46.89    92.23    47.13    92.14    46.74    98.16    44.05
   97.36    43.15    96.03    41.78    94.62    40.38    94.31    40.56    90.92    34.55
   91.26    34.25    90.05    33.34    89.06    32.32    88.40    32.78    87.04    33.96
   85.95    35.30    86.12    35.42    86.03    35.54    85.54    36.20    85.52    36.22
   85.07    36.80    84.85    37.19    84.69    38.46    84.70    39.17    84.78    40.05
   85.87    41.20    86.62    41.97    89.31    40.53    90.86    39.61    92.56    38.52
   91.42    37.46    91.15    37.63    90.84    37.86    91.38    38.42    91.40    38.65
   91.29    38.78    90.46    39.24    90.12    39.40    89.69    39.46    89.52    39.39
   89.16    39.04    89.00    38.98    88.85    39.03    87.55    39.79    86.36    40.20
   86.15    40.20    85.56    39.49    85.61    39.39    86.03    39.06    87.46    37.62
   88.88    36.35    89.34    35.95    90.29    35.11    90.91    34.56    94.30    40.57
   88.35    43.91    87.62    43.19    86.64    43.73    85.62    42.65    84.49    41.56
```

```
  84.42   41.85   84.27   42.31   84.21   42.91   84.02   43.63   83.84   44.04
  82.83   45.05   81.11   46.32   79.98   46.84   80.80   47.32   80.26   47.65
  81.14   48.29   82.62   49.44   82.82   49.77   82.76   50.09   81.31   50.57
  80.31   50.24   76.93   48.00   74.90   49.02   73.80   49.78   72.32   50.57
  69.50   51.89
$$$$$ ESRI   55 WOODWARD/CLYDE 52   **BECDBM 021  4 052 00**    18   52
  96.56   34.17   97.54   34.65   97.59   34.68   98.22   35.27   98.22   35.61
  98.13   35.70   97.57   35.82   96.70   35.87   96.70   35.87   95.72   35.81
  94.96   35.65   94.97   35.30   95.33   34.89   95.93   34.39   96.00   34.24
  96.11   34.11   96.47   34.14   96.56   34.17
$$$$$ ESRI   41 WESTON SEISMIC 37   **BECDBM 031  3 037 00**    12   37
 105.60   32.38  103.69   33.61  102.30   33.92  100.99   33.49  100.24   32.37
 100.57   31.45  101.34   30.65  102.55   29.87  103.59   30.32  103.92   30.67
 104.67   31.44  105.60   32.38
```

RAI 168 Question 02.05.02-22 Attachment


```
$$$$$ ESRI    65 BECHTEL          38   **BECDBM 037  1 038 00**     15   38
   90.99   32.99   91.70   33.85   92.37   34.00   94.11   33.44   94.84   32.94
   95.32   32.28   95.69   32.71   95.97   33.34   96.28   34.34   95.52   34.81
   94.74   34.80   92.26   35.13   91.46   34.96   90.57   34.10   90.99   32.99
$$$$$ ESRI    70 BECHTEL          39   **BECDBM 040  1 039 00**     17   39
  105.11   37.68  104.60   37.03  103.49   36.32  102.67   36.07  101.09   35.87
   99.09   35.35   97.82   34.85   95.43   33.45   95.22   33.01   95.69   32.62
   95.85   32.61   97.90   34.04  100.71   35.16  103.25   35.44  104.82   36.20
  105.03   36.82  105.11   37.68
$$$$$ ESRI     1 BECHTEL         BZ2   **BECDBM 159  1 014 00**     17   14
  106.01   32.13  106.05   33.80  105.65   34.85  104.82   36.20  103.25   35.44
  100.71   35.16   97.90   34.04   95.85   32.61   95.32   32.28   95.94   30.98
   96.50   30.05   96.64   29.35   97.10   28.74   98.26   27.76   99.88   27.43
   99.78   27.78  106.01   32.13
$$$$$ ESRI     2 BECHTEL         BZ3   **BECDBM 152  1 018 00**     77   18
   72.44   51.77   74.81   51.80   84.87   51.89   95.20   52.05  106.37   51.78
  106.20   50.50  105.88   41.87  105.91   41.12  105.68   39.49  105.49   38.86
  105.27   38.35  105.11   37.68  105.03   36.82  104.82   36.20  103.25   35.44
  100.71   35.16   97.90   34.04   95.85   32.61   95.32   32.28   94.84   32.94
   94.11   33.44   92.37   34.00   91.70   33.85   90.99   32.99   90.82   32.45
   89.84   31.78   88.75   31.53   88.37   31.58   87.41   31.81   87.53   31.88
   85.65   34.75   85.85   35.71   85.80   35.89   86.06   35.93   86.12   35.49
   86.75   34.06   87.06   33.52   87.66   32.75   88.99   33.12   90.11   33.96
   91.10   34.62   91.46   34.96   92.26   35.13   92.54   35.10   92.56   36.23
   92.51   36.54   92.26   36.79   91.81   36.92   91.38   37.51   91.47   37.74
   91.39   38.05   91.26   38.27   90.84   38.53   90.74   38.91   90.14   39.46
   89.65   39.53   89.14   39.49   88.58   39.38   87.94   39.15   87.13   38.76
   85.93   37.91   85.98   36.53   86.02   36.20   85.73   36.17   85.19   38.30
   85.02   39.48   84.94   41.21   84.15   42.12   82.31   43.73   82.36   44.80
   81.89   45.78   80.98   46.53   78.96   47.59   77.75   47.90   76.21   48.62
   73.09   51.52   72.44   51.77
$$$$$            BECHTEL         C04 **BECDBM        1 004 00**     29 08     1
   90.57   34.10   91.46   34.96   92.26   35.13   94.74   34.80   95.52   34.81
   96.28   34.34   96.13   33.86   97.82   34.85   99.09   35.35  101.09   35.87
  102.67   36.07  103.49   36.32  104.60   37.03  105.11   37.68  105.03   36.82
  104.82   36.20  103.25   35.44  100.71   35.16   97.90   34.04   95.85   32.61
   95.69   32.62   95.64   32.66   95.32   32.28   94.84   32.94   94.11   33.44
   92.37   34.00   91.70   33.85   90.99   32.99   90.57   34.10
$$$$$ ESRI    42 DAMES & MOORE  20   **BECDBM 040  2 020 00**     78   20
   90.46   34.29   88.50   34.19   88.81   33.81   88.69   33.66   88.73   33.61
   88.52   33.34   87.86   33.01   87.67   32.99   87.68   32.91   87.57   32.85
   87.54   32.46   87.19   31.52   86.83   30.83   86.36   30.30   85.53   29.90
   84.60   29.81   84.35   29.83   83.75   30.20   83.38   30.86   83.05   31.40
   82.66   31.58   82.24   31.63   81.65   31.48   81.04   31.27   80.26   31.11
   79.70   29.79   79.26   28.67   78.87   27.10   78.94   25.62   79.29   25.02
   80.00   25.00   82.57   25.03   83.11   26.09   83.69   27.36   84.73   28.31
   85.87   28.53   87.45   28.44   88.12   28.03   89.24   27.64   90.49   27.80
   91.80   27.66   93.97   27.68   95.21   27.09   95.91   26.04   96.20   25.30
   96.72   25.06   98.40   25.03   99.45   25.16  100.30   25.79  101.17   26.89
  102.22   27.41  103.23   27.31  104.11   26.54  105.85   25.02  105.91   26.14
  104.36   27.80  103.13   29.12  102.60   29.46  102.15   29.46  100.64   28.95
   98.97   28.77   98.12   29.07   97.58   29.53   96.65   31.37   96.26   32.68
   95.65   33.56   95.04   33.89   93.62   34.03   91.47   33.73   91.02   33.45
   90.39   32.87   89.74   31.91   89.29   31.53   89.03   31.75   89.06   32.22
   89.10   32.74   89.63   33.47   90.46   34.29
$$$$$ ESRI    41 DAMES & MOORE  25   **BECDBM 039  2 025 00**     53   25
   95.45   34.59   95.82   34.44   96.15   34.27   96.40   34.07   96.62   33.86
   96.66   33.78   96.84   33.40   96.94   33.11   97.21   32.48   98.08   30.72
   99.13   29.64  100.28   29.61  101.04   30.05  101.59   30.38  101.94   30.52
  102.19   30.56  102.55   30.54  102.96   30.42  103.24   30.30  103.55   30.09
  103.89   29.78  104.80   28.70  105.89   27.43  105.91   26.14  104.36   27.80
  103.13   29.12  102.60   29.46  102.15   29.46  100.64   28.95   98.97   28.77
   98.12   29.07   97.58   29.53   96.65   31.37   96.26   32.68   95.65   33.56
```

```
  95.04    33.89    93.62    34.03    91.47    33.73    91.02    33.45    90.39    32.87
  89.74    31.91    89.29    31.53    89.03    31.75    89.06    32.22    89.10    32.74
  89.63    33.47    90.46    34.29    91.07    34.45    91.42    34.56    92.47    34.66
  93.76    34.77    94.83    34.76    95.45    34.59
$$$$$ toh dames and moore      25a **BECDBM 086  2 025 01**     8   25
  96.31    32.72    96.90    33.08    96.55    33.86    96.12    34.23    95.42    34.53
  95.06    33.94    95.66    33.64    96.31    32.72
$$$$$ ESRI   40 DAMES & MOORE  28   **BECDBM 038  2 028 00**    16   28
  96.84    33.40    99.28    34.16   100.50    34.47   101.26    34.70   101.56    34.86
 101.68    35.04   101.35    35.65   101.01    35.68   100.50    35.53    98.89    35.19
  97.35    34.79    96.15    34.27    96.40    34.07    96.62    33.86    96.66    33.78
  96.84    33.40
$$$$$ ESRI   39 DAMES & MOORE  28B **BECDBM 038  2 028 02**    17   28
 101.22    35.84   100.50    35.53   101.01    35.68   101.35    35.65   101.68    35.04
 101.56    34.86   101.26    34.70   100.50    34.47    99.28    34.16    96.84    33.40
  96.94    33.11    99.34    33.85   102.02    34.41   102.29    34.68   102.20    35.21
 101.74    35.69   101.22    35.84
$$$$$           DAMES & MOORE B67  **BECDBM       2 104 00**    39 04    1
  96.94    33.11    99.34    33.85   102.02    34.41   102.39    34.50   102.86    34.68
 103.37    34.92   103.83    35.24   104.42    35.79   104.76    36.29   105.03    36.70
 105.18    36.76   105.16    36.32   105.25    35.70   105.48    34.78   105.82    33.72
 105.98    32.55   106.00    31.77   105.96    31.60   105.81    30.75   105.85    29.91
 105.84    28.86   105.89    27.43   104.80    28.70   103.89    29.78   103.55    30.09
 105.12    31.88   105.34    32.47   105.33    33.07   104.95    33.60   104.09    33.87
 103.35    33.33   102.82    32.61   101.86    31.37   101.04    30.05   100.28    29.61
  99.13    29.64    98.08    30.72    97.21    32.48    96.94    33.11
$$$$$           DAMES & MOORE  C08 **BECDBM 000  2 908 00**    64   8    1 0

  96.26    32.68    96.23    32.73    96.28    32.77    96.31    32.72    96.90    33.08

  96.55    33.86    96.12    34.23    95.42    34.53    95.06    33.94    95.66    33.64

  96.27    32.78    96.21    32.75    95.65    33.56    95.04    33.89    93.62    34.03

  91.47    33.73    91.02    33.45    90.39    32.87    89.74    31.91    89.29    31.53

  89.03    31.75    89.06    32.22    89.10    32.74    89.63    33.47    90.46    34.29

  91.07    34.45    91.42    34.56    92.47    34.66    93.76    34.77    94.83    34.76

  95.45    34.59    95.82    34.44    96.15    34.27    96.40    34.07    96.62    33.86

  96.66    33.78    96.84    33.40    96.94    33.11    97.21    32.48    98.08    30.72

  99.13    29.64   100.28    29.61   101.04    30.05   101.59    30.38   101.94    30.52

 102.19    30.56   102.55    30.54   102.96    30.42   103.24    30.30   103.55    30.09

 103.89    29.78   104.80    28.70   105.89    27.43   105.91    26.14   104.36    27.80

 103.13    29.12   102.60    29.46   102.15    29.46   100.64    28.95    98.97    28.77

  98.12    29.07    97.58    29.53    96.65    31.37    96.26    32.68
$$$$$ ESRI   88 LAW ENGINEERING 26   **BECDBM 018  5 026 00**    18   26
 105.17    37.68   105.01    36.72   104.82    36.16   104.15    35.74   103.55    35.51
 102.19    35.26   100.46    35.05    98.64    34.42    95.75    32.73    95.37    33.24
  97.60    34.52    99.25    35.24   101.60    35.79   102.39    35.81   103.16    35.96
 103.80    36.29   104.45    36.73   105.17    37.68
$$$$$ ESRI   24 LAW ENGINEERING 124 **BECDBM$062  5 059 00**    25   59
 104.82    36.16   104.15    35.74   103.55    35.51   102.16    35.26   100.44    35.05
  99.41    34.69    98.64    34.42    95.75    32.73    96.36    31.76    96.68    30.19
  97.15    29.35    98.23    28.50    99.41    28.02   100.55    27.58   101.94    27.62
 103.31    27.88   104.61    28.60   105.16    29.24   105.32    29.51   105.57    30.12
```

```
  105.75    31.13  105.84    33.36  105.67    34.79  105.22    35.51  104.82    36.16
$$$$$ ESRI    16 RONDOUT SORCE  16 $**BECDBM 044  6 016 00**      22   16
  101.29    36.65   99.00    36.11   98.26    36.08   98.02    36.13   98.31    35.33
   98.39    34.49   97.53    34.39   97.14    35.43   96.84    36.51   96.39    36.47
   95.21    36.22   93.60    35.94   93.09    35.47   92.38    34.94   91.26    34.25
   91.15    34.03   91.26    33.40   95.86    33.17   96.98    33.25  102.16    34.95
  101.77    35.75  101.29    36.65
$$$$$             RONDOUT            C02 **BECDBM 000  6 902 00**     184   10
   74.76    41.30   74.85    41.25   76.36    42.34   75.91    42.96   78.47    43.67
   80.34    43.89   80.71    43.04   77.96    42.57   76.39    42.30   76.37    42.33
   74.87    41.24   75.84    40.74   76.69    40.39   77.20    40.28   77.98    40.05
   78.08    40.00   78.48    39.60   79.01    38.57   79.02    38.45   78.96    38.39
   79.40    37.37   79.04    37.34   79.27    37.16   79.27    36.79   79.41    36.56
   80.24    35.89   80.80    35.51   80.94    35.26   81.90    36.16   81.79    36.25
   81.17    36.59   81.09    36.56   79.72    37.27   80.18    37.87   81.53    37.26
   81.69    37.47   81.93    37.35   82.38    37.12   82.56    40.71   80.56    40.80
   80.51    41.88   82.62    41.91   82.68    40.69   82.57    40.70   82.39    37.12
   83.60    36.50   83.11    40.31   83.08    41.03   82.99    41.76   82.73    42.51
   82.37    43.17   82.45    43.25   83.93    43.60   85.94    35.30   85.57    35.07
   85.62    35.04   85.14    34.29   84.04    34.99   83.04    33.99   83.59    33.65
   83.56    33.44   83.66    33.26   84.44    32.68   85.52    32.14   86.79    31.65
   87.75    31.44   88.40    31.82   89.04    32.31   95.87    33.16   96.48    32.74
   96.85    32.11   96.97    31.78   97.36    30.56   97.85    29.77   98.62    29.40
   99.51    29.40  101.58    29.95  102.23    30.01  102.42    29.94  102.57    29.78
  102.69    29.40  102.85    29.25  104.56    30.66  103.82    31.51  102.75    32.68
  100.87    34.41   99.93    34.25   96.98    33.25   95.86    33.17   89.06    32.32
   88.40    32.78   87.62    32.14   86.68    32.93   85.67    33.71   85.59    33.80
   85.20    34.25   85.15    34.28   85.63    35.03   85.80    34.94   85.94    34.82
   86.44    34.43   87.04    33.96   85.95    35.29   83.94    43.61   84.02    43.63
   83.84    44.04   82.83    45.05   81.11    46.32   79.98    46.84   79.38    46.48
   79.11    46.55   78.41    46.04   77.93    45.78   76.91    47.99   76.93    48.00
   74.90    49.02   73.80    49.78   72.32    50.57   69.50    51.89   68.19    52.47
   65.93    53.05   63.86    53.08   61.78    53.30   59.99    53.64   59.14    53.84
   57.69    53.65   56.96    53.44   56.01    53.00   55.49    52.59   55.00    51.61
   55.00    50.34   55.91    50.19   56.70    49.90   57.93    48.88   58.77    48.37
   59.60    48.02   60.38    47.74   60.91    47.72   61.60    47.80   62.51    48.00
   63.89    48.06   64.75    48.02   65.58    48.17   66.32    48.05   67.35    47.51
   67.72    47.31   68.51    46.87   70.14    45.70   70.48    45.46   70.60    45.38
   70.71    45.53   70.98    46.32   70.10    46.81   69.46    47.26   68.80    47.74
   68.27    48.24   66.66    48.79   64.71    49.06   63.70    48.79   63.07    49.20
   62.73    49.87   62.68    50.73   65.43    50.98   65.96    50.84   66.12    50.65
   68.91    49.67   69.44    48.96   69.84    48.78   71.03    47.91   72.07    47.17
   73.39    46.47   74.93    47.15   76.56    47.83   76.90    47.98   77.91    45.78
   75.75    44.78   75.63    44.72   74.54    44.40   75.16    42.85   75.13    42.67
   73.88    42.54   74.08    42.37   74.06    41.78   74.76    41.30
$$$$$ ESRI    23 RONDOUT SORCE  23 $**BECDBM 045  6 023 00**       9   23

   98.02    36.13   97.54    36.27   97.17    36.44   96.84    36.51   97.14    35.43

   97.53    34.39   98.39    34.49   98.31    35.33   98.02    36.13
$$$$$ ESRI     4 ROUNDOUT         51 $**BECDBM 052  6 051 00**      56   51

   91.26    34.25   90.05    33.34   89.06    32.32   88.40    31.82   87.75    31.44

   86.38    30.53   84.38    29.21   82.26    27.92   79.55    26.10   78.11    25.16

   78.23    25.03   80.00    25.00   85.00    25.00   85.50    25.01   86.54    25.30

   88.46    25.45   91.51    25.50   93.18    25.52   95.35    25.40   96.31    25.22

   97.37    25.04   98.54    25.03   99.27    25.15  100.31    25.48  101.22    26.04

  103.20    27.07  104.45    27.57  105.70    28.55  107.19    29.82  107.31    31.25
```

```
  107.33   31.29  107.37   31.41  107.36   31.45  107.35   31.47  107.34   31.50

  107.47   32.05  107.15   31.91  107.02   31.84  107.32   31.42  103.58   28.36

  102.85   29.25  102.69   29.40  102.57   29.78  102.42   29.94  102.23   30.01

  101.58   29.95   99.51   29.40   98.62   29.40   97.85   29.77   97.36   30.56

   96.85   32.11   96.48   32.74   95.86   33.17   91.26   33.40   91.15   34.03

   91.26   34.25
$$$$$ ESRI   51 WOODWARD/CLYDE 46   **BECDBM 022  4 046 00**    19  46
   98.01   34.59   97.60   34.38   96.70   33.96   96.15   33.69   96.17   33.48
   96.33   33.44   96.66   33.46   98.35   34.06  100.84   35.02  101.30   35.19
  101.44   35.32  101.35   35.61  101.22   35.72  101.09   35.73  101.09   35.73
  100.86   35.69   99.22   35.10   98.33   34.75   98.01   34.59
$$$$$ ESRI   51 WOODWARD/CLYDE 46A **BECDBM 022  4 046 01**    22  46
  101.30   35.19  103.01   35.14  103.28   35.27  105.68   35.69  105.90   36.23
  105.34   37.10  102.49   36.30  101.09   35.73  100.86   35.69   99.22   35.10
   98.41   34.78   98.33   34.75   98.01   34.59   97.60   34.38   96.70   33.96
   96.15   33.69   96.17   33.48   96.33   33.44   96.66   33.46   98.35   34.06
  100.84   35.02  101.30   35.19
$$$$$ 44      COMANCHE PEAK        WCC-B44 $$$$$
  100.40   35.40   94.40   35.40   94.40   29.40  100.40   29.40  100.40   35.40
$$$$$ ESRI   52 WOODWARD/CLYDE 48   **BECDBM 024  4 048 00**    18  48

   98.01   34.59   98.06   34.64   98.14   34.73   98.11   34.80   97.98   34.80

   97.98   34.80   97.54   34.65   96.56   34.17   95.79   33.82   95.60   33.69

   95.53   33.62   95.56   33.51   95.68   33.47   95.99   33.59   96.15   33.69

   96.70   33.96   97.60   34.38   98.01   34.59
$$$$$ ESRI   40 WESTON SEISMIC 36   **BECDBM 027  3 036 00**    22  36
   98.61   36.90   98.04   36.74   96.80   36.45   95.12   36.18   91.53   35.88
   91.09   35.48   91.37   35.10   90.76   34.65   90.73   34.60   91.51   33.33
   96.06   33.31   98.49   33.63  101.56   34.50  104.88   35.85  105.11   36.29
  105.12   36.86  104.53   37.71  103.49   38.10  102.03   38.04  101.41   37.89
  100.43   37.50   98.61   36.90
$$$$$ESRI109 WESTON BCK (10)  109   **BECDBM$048  3 059 00**    26  59
  110.00   43.16  109.50   43.18  106.80   43.22  106.41   42.63  102.03   38.04
  103.49   38.10  104.53   37.71  105.12   36.86  105.11   36.29  104.88   35.85
  101.56   34.50   98.49   33.63   96.06   33.31   96.50   31.96   97.42   30.26
   97.65   30.02   98.23   29.53   98.78   29.23   99.28   28.96  100.58   28.98
  102.55   29.87  103.59   30.32  105.60   32.38  107.71   32.54  110.00   32.71
  110.00   43.16
$$$$$          WESTON GEOPHYSIC C31 **BECDBM     3 931 00**    31 31    1
   96.06   33.31   98.49   33.63  101.56   34.50  104.88   35.85  105.11   36.29
  105.12   36.86  104.53   37.71  103.49   38.10  102.03   38.04  106.41   42.63
  106.80   43.22  109.50   43.18  110.00   43.16  110.00   32.71  107.71   32.54
  105.60   32.38  103.69   33.61  102.30   33.92  100.99   33.49  100.24   32.37
  100.57   31.45  101.34   30.65  102.55   29.87  100.58   28.98   99.28   28.96
   98.78   29.23   98.23   29.53   97.65   30.02   97.42   30.26   96.50   31.96
   96.06   33.31
$$$$$ESRI107 WESTON BCK (08)  107   **BECDBM$053  3 057 00**    32  57

   96.06   33.31   91.51   33.33   90.98   33.26   90.61   32.79   90.04   32.82

   89.47   32.30   89.08   31.98   88.59   32.00   88.38   31.80   88.07   31.76

   87.84   31.61   87.15   31.74   86.93   31.65   86.61   31.50   84.48   31.44
```

```
   82.88    31.06    80.79    30.29    79.90    26.62    80.00    25.00    90.55    25.01

   95.46    25.10    99.99    25.00   101.89    25.03   101.11    27.42   100.58    28.98

   99.28    28.96    98.78    29.23    98.23    29.53    97.65    30.02    97.42    30.26

   96.50    31.96    96.06    33.31
Blytheville geometry 1
 90.376  35.553
 89.910  35.966
 89.629  36.549
Blytheville geometry 2
 90.376  35.553
 89.485  36.298
Reelfoot geometry 1
 89.983   36.560
 89.577   36.591
 89.448   36.512
 89.42    36.33
 89.3     36.15
Reelfoot geometry 2
 89.577  36.591
 89.448  36.512
 89.42   36.33
 89.349  36.223
New Madrid north geometry 1
   89.629  36.549
   89.288  36.995
New Madrid north geometry 2
   89.629  36.549
   89.288  36.995
   89.02  37.27
Meers geometry
   98.64  34.85
   98.29  34.71
```

The Bechtel Group's methodology for defining Mmax distributions is described within their EST volume (Reference 2.5-369) and can be applied to Zone BZ1 as follows (Table 2.5.2-210): RCOL2_02.05.02-22 S01 RCOL2_02.05.02-22 RCOL2_02.05.02-16 S02

- The lower bound magnitude of the distribution is defined as the greater of the largest observed earthquake within the zone or m_b 5.4. For Zone BZ1, this lower-bound Mmax value is m_b 6.1 with a weight of 0.1.
- The next higher magnitude is 0.3 magnitude units greater than the minimum and is given a weight of 0.4. For Zone BZ1, this results in a Mmax value of m_b 6.4 with a weight of 0.4.
- The third magnitude is mb 6.6, interpreted by the Bechtel EST as the largest intraplate earthquake in the CEUS with specific exceptions, and is given a weight of 0.1.
- The fourth magnitude is 0.6 magnitude units above the minimum and is given a weight of 0.4. For Zone BZ1, this results in a Mmax value of mb 6.7 with a weight of 0.4. RCOL2_02.05.02-22

2.5.2.4.2.2.4 Mmax Update for Rondout Gulf Coast to Bahamas Fracture Zone RCOL2_02.05.02-16 S02

Rondout Associates assigned Mmax values of 4.8, 5.5, and 5.8 to the Gulf Coast to Bahamas Fracture Zone source zone (zone 51) (Table 2.5.2-210). Because both the 2006 Emb 5.5 and Emb 6.1 earthquakes in the Gulf of Mexico occur within this zone, and because these magnitudes are greater than the lowest Mmax values for the source zone, the Mmax distribution for this source zone has been updated.

The updated Mmax values of 6.1, 6.3, and 6.5 with weightings of 0.3, 0.55, and 0.15, respectively, used here (Table 2.5.2-210) follow from reclassifying the source zone as one capable of producing moderate earthquakes instead of the original classification of the source zone as one only capable of producing smaller than moderate earthquakes (Reference 2.5.2-369). The original Rondout Mmax distribution for moderate earthquake source zones is 5.2, 6.3, and 6.5 with weightings of 0.3, 0.55, and 0.15, respectively. The updated Mmax distribution follows this distribution with the exception of an increase in the lower bound of the distribution to 6.1 to account for the observed Emb 6.1 earthquake within this zone.

2.5.2.4.2.2.5 Mmax Update for Weston Gulf Coast

Weston Geophysical Corporation assigned Mmax values of 5.4 and 6.0 to the Gulf Coast source zone (zone 107) (Table 2.5.2-210). Both the 2006 Emb 5.5 and Emb 6.1 earthquakes in the Gulf of Mexico occur within this zone. Because these magnitudes are greater than the original Mmax values for the source zone, the Mmax distribution for this source zone has been revised.

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4725 (CP RAI #168)

SRP SECTION: 02.05.02 - Vibratory Ground Motion

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 6/9/2010

QUESTION NO.: 02.05.02-23

In response to RAI 2.5.2-1 (ML093080116), you provided an updated supplementary earthquake catalog which extended the spatial coverage of the initial Comanche Peak Nuclear Power Plant (CPNPP) earthquake catalog to enclose all seismic sources used in the CPNPP hazard study. In your response, you stated that based on the supplementary earthquake catalog there are two seismic sources whose maximum earthquake magnitude (Mmax) values need to be updated and you did not discuss updates to the probability of activity (Pa) values based on the occurrence of earthquakes. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion", please explain the following:

a. While you stated that the updated earthquake catalog required only updates to two of the Electric Power Research Institute (EPRI) sources Mmax values, as part of your response to RAI 2.5.2-16 you updated FSAR Table 2.5.2-10 which shows five additional Mmax updates to the EPRI sources. Please clarify this apparent discrepancy and explain the source of Mmax updates shown in the RAI 2.5.2-16 response.

b. The supplementary earthquake catalog includes a moderate-sized earthquake that occurred on 08/10/2005 with a magnitude of 5.4 within a few of the seismic sources used for the CPNPP hazard study. Although you evaluated the impacts of this earthquake on Mmax model parameters and conducted a sensitivity study to assess its impacts as part of your RAI response, your response did not address the issue of Pa values of these sources. The Law Engineering Earth Science Team's (EST's) seismic source zone 26, for which you updated the Mmax value, has a Pa value of 0.6. Since there is now already a large earthquake in this source, its Pa value requires updating. Similarly, this earthquake also falls within the Bechtel EST's zone 39 with a Pa value of 0.2 and the Woodward Clyde EST's zone 46a with a Pa value of 0.08. Please provide an update to your RAI 2.5.2-1 response considering the impacts of Pa updates.

c. Please also provide an assessment of the impacts of the updated Mmax and Pa values on the EPRI-Seismicity Owners (SOG) seismic sources that were not used in the original calculations because their initial hazard contributions were less than 1% of the total hazard, such as the Gulf coast sources and the

Rondout and Dames & Moore ESTs sources. Do these sources still contribute less than 1% of the total hazard after the necessary Mmax and Pa updates?

ANSWER:

During a public conference call with the NRC on September 23, 2010, the NRC requested further information concerning the magnitude of several earthquakes included in the supplemental catalog.

As described in the response to this question (ML102370659), the August 10, 2005 earthquake in New Mexico (referred to as the New Mexico earthquake) is best described as an Emb 5.0 earthquake based on the original EPRI-SOG methodology that dictates using a measured mb magnitude as the best Emb estimate rather than a conversion to Emb from another magnitude scale (i.e., Mw to Emb) (EPRI, 1986-1989, 1989). However, the response to RAI No. 1889 (CP RAI #11) Question 02.05.02-1 (ML093080096) describes the New Mexico earthquake as a Mw 5.0 (~ Emb 5.4), because the supplemental catalog was compiled at a screening level and did not consider the observed mb 5.0 magnitude. The response below more accurately describes the magnitude of the New Mexico earthquake as Emb 5.0 and supersedes the description in the response to Question 02.05.02-1.

> Based on the supplemental catalog, there is one zone with earthquakes outside of the updated catalog region with magnitude greater than the lower-bound Mmax for the host zones. This zone and the associated earthquakes are:
>
> - Rondout zone C02 (Grenville Crust)
>
>   - The 11 November 1988 Mw 5.9 Saguenay earthquake in Quebec (Figure 1); and
>
>   - The September 25, 1998 mb 5.2 Pymatuning earthquake in western Pennsylvania (Figure 1).

The potential impact of the earthquakes is discussed in the paragraph below. This paragraph supersedes the corresponding paragraph in the response to Question 02.05.02-1.

> This passage indicates that zone C02 is a background zone that was created as a default for all of the "leftover pieces" of CEUS crust that Rondout did not identify as a unique source zone. As such, the five different zones that make up zone C02 are not combined into a source zone by any geologic, tectonic, or geophysical characteristic that Rondout used to define source characteristics. Based on the Rondout methodology and the fact that both the Saguenay and Pymatuning earthquakes are at great distances from the Comanche Peak site (2800 km and 1800 km, respectively) and in different zone C02 polygons than that hosting the site (Figure 1), it was determined that these earthquakes do not have any implications for the Mmax distributions used for Comanche Peak. This conclusion is supported by research on the Saguenay earthquake that has shown the earthquake is most likely related to faults associated with the Iapetan St. Lawrence rift (Adams and Basham, 1991; Atkinson, 2007; Hasegawa, 1991; Roy et al., 1993), and thus the zone containing this earthquake represents a distinctly different tectonic setting and geologic history than that experienced by the crust surrounding the site.

Finally, the following information supersedes the corresponding segment in the response to Question 02.05.02-23 (i.e., the first paragraph under the heading "New Mexico Earthquake"):

> In the response to Question 02.05.02-1, the New Mexico earthquake is reported as a Emb 5.0 event based on a reported mb 5.0 magnitude within the National Earthquake Information Center (NEIC) catalog, (NEIC, 2010). The basis for this magnitude is that the methodology of the EPRI-SOG study to estimate Emb was to use direct measurements of mb magnitudes instead of conversions from other magnitude estimates (e.g., Ms to Emb) as the best magnitude estimate. This methodology is outlined on page 3-6 of Volume 1, Part 1 of the EPRI-SOG documentation (EPRI, 1986-1989), page 4-8 of Volume 1, Part 2 of the EPRI-SOG documentation (EPRI, 1986-1989), and page 3-2 of the EQHAZARD Primer (EPRI, 1989). Based on this methodology, the appropriate Emb magnitude for the New Mexico earthquake for comparison to the existing EPRI-SOG source characterizations is 5.0.

References

(EPRI, 1986-1989), Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 1-3 & 5-10, EPRI.

(EPRI, 1989), EQHAZARD Primer (NP-6452-D), EPRI, prepared by Risk Engineering for Seismicity Owners Group and EPRI

(NEIC, 2010), NEIC PDE-W earthquake summary for 10 August 2005 earthquake, USGS, ftp://hazards.cr.usgs.gov/edr/mchedr/mchedr200508.dat.Z.

Attachment

Figure 1 "Rondout contributing sources and the extended earthquake catalog"

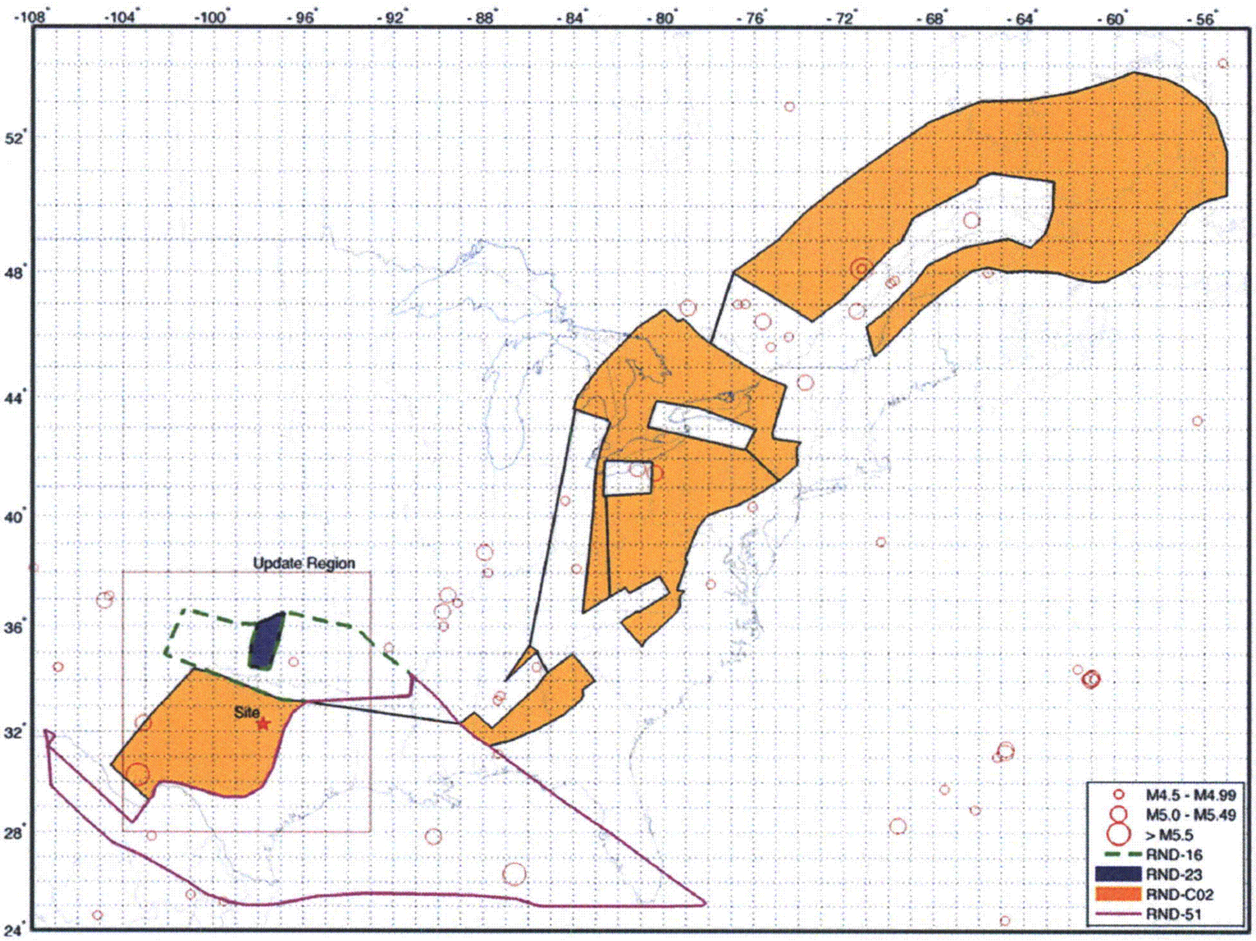
Impact on RCOLA

None.

Impact on DCD

None.

Figure 1 – Rondout contributing sources and the extended earthquake catalog



Contributing EPRI-SOG source zones for the Rondout team with earthquakes from the supplemental catalog (red circles). Region of updated catalog is shown as a red box. The Mw 5.9 Saguenary earthquake is located in southern Quebec at -71.2° E and 48.1° N in the northernmost polygon of zone C02. The mb 5.2 Pymatuning earthquake is located in western Pennsylvania at -80.4° E and 41.5° N in the second northernmost polygon of zone C02.

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4725 (CP RAI #168)

SRP SECTION: 02.05.02 - Vibratory Ground Motion

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 6/9/2010

QUESTION NO.: 02.05.02-24

In response to RAI 2.5.2-4 (ML092820486), you stated that "1) the EPRI-SOG model does not adequately describe the Alpine earthquake and 2) it is not legitimate technical interpretation of the earthquake to account for its occurrence by updating the Mmax values of the contributing EPRI-SOG source zones that contain the earthquake." You stated that you reached this conclusion by using your expert judgment and based on input you received from Dr. Diane Doser, and subsequently you created a new seismic source model to incorporate the potential contributions of such similar future earthquakes in your hazard estimations. You have not conducted a Senior Seismic Hazard Analysis Committee (SSHAC) study for the development of your new seismic source. The staff examined the e-mail correspondence between you and Dr. Doser at the site audit conducted on April 7-8, 2010, and found that even though she believes this earthquake is a result of the tectonic forces related to the Rio Grande Rift system, she clearly indicated that the scientific work on this earthquake is quite limited and uncertainties exist. Given the uncertainty surrounding the tectonic causes of this earthquake, the staff is concerned that your model does not adequately represent the potential hazard at the site. Because this event is within the area of the several EPRI-SOG source models that host the CPNPP site and all of these sources have Mmax values lower than the observed earthquake, and based on the criteria in NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion", please update these models, similar to what you did in many of the other EPRI sources you used in your hazard calculations (FSAR Table 2.5.2-210). The updated analysis should incorporate the impacts of the Mmax updates to the EPRI-SOG sources based on the occurrence of this magnitude 5.8 earthquake. Also, please evaluate if any of the unused seismic sources should now be used because their seismic source model parameters need to be updated due to the occurrence of this earthquake (i.e., will this update bring the unused seismic sources' hazard contributions above the 1% threshold?)

ANSWER:

During a public conference call with the NRC on September 23, 2010, the NRC indicated that the response to RAI No. 4725 (CP RAI #168) Question 02.05.02-24 (ML102370659) entitled "EPRI-SOG ESTs' Tectonic Characterization of the Alpine Earthquake Region" did not clearly describe whether the

Alpine earthquake occurred within 4 or 5 EPRI-SOG source zones. The Alpine earthquake occurs within 5 source zones from 4 different EPRI-SOG Earth Science Teams (ESTs). To clarify this point, the following modified statement replaces the first sentence in that subsection:

> The Alpine earthquake occurs within a total of 5 EPRI-SOG source zones from four of the ESTs. The ESTs and their respective zones are: Dames and Moore 26b, Law 124, Rondout C02, and Weston 37 and 109.

A revised estimated body-wave magnitude (Emb) for the Alpine earthquake was developed for the response to Question 02.05.02-24. This revision lowered the Emb magnitude from 5.8 to 5.7. The magnitude of the Alpine earthquake within the updated seismicity catalog presented in FSAR Subsection 2.5.2.1 has been revised to reflect this revised magnitude.

Revising the updated catalog required: (1) modifying the response to Question 02.05.02-24 so that the Emb 5.7 magnitude is described as having come from the seismicity catalog, (2) modifying the response to Question 02.05.02-4 so that the Alpine earthquake is referred to as an Emb 5.7 earthquake, and (3) modifying selected tables and sections of text in FSAR Subsection 2.5.2 that refer to the magnitude of the Alpine earthquake. All of these revisions have been made.

Therefore, the first paragraph of the subheading "*Alpine Earthquake*" of the response to Question 02.05.02-24 is replaced with the following:

> In the updated seismicity catalog developed for the CPNPP 3 and 4 COLA (see FSAR Section 2.5.2.1.2 and FSAR Table 2.5.2-201), the Alpine earthquake has an Emb 5. 7 magnitude based on the average Emb magnitude from: (1) a conversion from an Ms 5.7 magnitude to an Emb 5.8 magnitude, and (2) a directly-reported mb magnitude of 5.6. The basis for using the average of these two Emb estimates is that the original methodology of the EPRI-SOG study was to use direct measurements of mb magnitudes instead of conversions from other magnitudes as the best estimate of the Emb magnitude (e.g., an mb magnitude would be used as the preferred Emb over an Ms-to-Emb conversion). This methodology is outlined on page 3-6 of Volume 1, Part 1 of the EPRI-SOG documentation (EPRI, 1986-1989), page 4-8 of Volume 1, Part 2 of the EPRI-SOG documentation (EPRI, 1986-1989), and page 3-2 of the EQHAZARD Primer (EPRI, 1989). Based on this methodology, it could be argued that the appropriate Emb magnitude for the Alpine earthquake would be Emb 5.6. However, to represent uncertainty in the magnitude of the Alpine earthquake, an Emb 5.7 magnitude was used for the earthquake.

Finally, in the response to Question 02.05.02-4, the Alpine earthquake was described as having an Emb of 5.8. As described above, that value should be modified to Emb 5.7. The FSAR text and table that incorporated the 5.8 value have been revised to reflect the corrected value.

<u>Impact on R COLA</u>

See attached marked-up FSAR Revision 1 pages 2.5-72 and 2.5-307.

<u>Impact on DCD</u>

None.

2.5.2.1.3.1 Recent Earthquakes

No significant earthquakes, defined as earthquakes with an impact on the seismic hazard at CPNPP Units 3 and 4 or seismic source characterization of sources relevant to CPNPP Units 3 and 4, have occurred within the site region since the end date of the EPRI-SOG seismicity catalog (i.e., post-1984). For example, the largest post-1984 earthquake within the site region is the September 6, 1997, Emb 4.5 earthquake in south-central Oklahoma, approximately 180 mi from CPNPP Units 3 and 4. However, ~~three~~four earthquakes have occurred outside of the site region with relevance to seismic hazard at CPNPP Units 3 and 4 and seismic source characterizations for CPNPP Units 3 and 4. Two of these earthquakes, the January 2, 1992, Emb 5.0 in southeast New Mexico and the April 14, 1995, Emb ~~5.8~~5.7 Alpine earthquake in west Texas (Figure 2.5.2-201), are documented within the updated seismicity catalog (see Subsection 2.5.2.1.2). The ~~third~~other two events, the February 10, 2006, Ms 5.3 and September 10, 2006 earthquakes in the Gulf of Mexico (Reference 2.5-377), ~~is~~are well outside the update region (Figure 2.5.2-205) and ~~is~~are not in the updated catalog. Each of these events is discussed below.

RCOL2_02.05.02-16 S02
RCOL2_02.05.02-24 S01
RCOL2_02.05.02-16 S02

January 2, 1992, Emb 5.0 Rattlesnake Canyon, New Mexico

The January 2, 1992, Emb 5.0 earthquake near Rattlesnake Canyon, New Mexico (Table 2.5.2-201) was felt over an area of approximately 440,000 km^2 and had a maximum Modified Mercalli Intensity of V (Reference 2.5-378). CPNPP Units 3 and 4 are outside of the felt area as defined by Frohlich and Davis (Reference 2.5-378), and no damage was reported from this earthquake within the felt area (Reference 2.5-378). A focal mechanism of the event determined by Sanford, et al. (Reference 2.5-379) shows that the event was characterized by thrust motion with an east-west compression axis. The event occurred within the central basin platform of the Permian basin, a region of active hydrocarbon exploration. Exploration within the basin produces some seismicity, but it is unknown if this earthquake is of tectonic or man-induced origin (References 2.5-379 and 2.5-380).

April 14, 1995, Emb ~~5.8~~5.7 Alpine, Texas RCOL2_02.05.02-24 S01

The April 14, 1995, Emb ~~5.8~~5.7 earthquake near Alpine, Texas, (Table 2.5.2-201) was felt over an area of approximately 760,000 km^2 and had a maximum intensity of MMI VI (Reference 2.5-378). CPNPP Units 3 and 4 are within the MMI I to III intensity isoseismal region defined by Frohlich and Davis (Reference 2.5-378). Near the epicenter, reported damage includes broken gas mains, cracked walls, and broken windows (Reference 2.5-378). Frolich and Davis (Reference 2.5-378) report that the earthquake was felt in Dallas, Texas, only in high-rise buildings. No known felt reports come from the region immediately surrounding CPNPP Units 3 and 4. A focal mechanism of the event determined by the Global Centroid Moment Tensor Project shows that the event was an earthquake with normal faulting motion with a tensile axis oriented approximately north-northeast (Reference 2.5-317). The event occurred along the eastern boundary of the Rio Grande Rift

CP COL 2.5(1)

Table 2.5.2-201 (Sheet 3 of 6)
Updated Seismicity Catalog for CPNPP 3 & 4 With Time of Event, Location of Event, Best Estimate Body-wave Magnitude (Emb), Estimate of Standard Deviation of Magnitude (Smb), Uniform Magnitude (Rmb), and Source Catalog

Year	Mon	Day	Hr	Min	Sec	Lat	Lon	Emb	Smb	Rmb	Cat
1994	4	29	3	28	58.68	36.25	-98.09	3.00	0.10	3.01	PDE
1995	1	18	15	51	39.90	34.7120	-97.5420	4.20	0.10	4.21	OGS
1995	4	5	5	31	16.23	35.20	-99.03	3.00	0.10	3.01	PDE
1995	4	14	0	32	56.17	30.28	-103.35	~~5.82~~5.71	0.10	~~5.83~~5.71	PDE
1995	4	14	2	19	38.50	30.30	-103.35	3.30	0.10	3.31	PDE
1995	4	15	14	33	29.51	30.27	-103.32	4.00	0.10	4.01	PDE
1995	6	1	1	6	15.70	30.30	-103.35	3.50	0.10	3.51	PDE
1995	6	1	4	49	27.70	34.1340	-96.6830	3.30	0.10	3.31	OGS
1995	9	15	0	31	33.26	36.87	-98.69	4.10	0.10	4.11	PDE
1995	11	12	17	45	59.40	30.30	-103.35	3.60	0.10	3.61	PDE
1995	12	1	14	37	43.00	35.1550	-98.8970	3.00	0.10	3.01	OGS
1996	3	25	6	43	46.86	35.61	-102.60	3.50	0.10	3.51	PDE
1996	11	23	10	54	18.50	35.0400	-100.5040	3.09	0.41	3.28	ANSS
1997	2	12	23	53	10.77	34.9470	-100.8900	3.09	0.41	3.28	ANSS
1997	2	15	9	8	55.46	34.9730	-100.5690	3.25	0.41	3.45	ANSS
1997	3	16	19	7	28.00	34.2700	-93.4900	3.42	0.41	3.61	ANSS
1997	5	31	3	26	41.34	33.1820	-95.9660	3.42	0.41	3.61	ANSS

RCOL2_
.05.02-24
S01

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4725 (CP RAI #168)

SRP SECTION: 02.05.02 - Vibratory Ground Motion

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 6/9/2010

QUESTION NO.: 02.05.02-26

As part of the site audit conducted on April 7-8, 2010, the staff inspected Calculation Report, TXUT-1908-01, which discusses issues, related to induced seismicity within the site region. In accordance with the guidance in NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion".

Section 2.5.1.2.5.10.2.3 of the FSAR documents that of the ~130 earthquakes identified within Texas in the past 150 years, 22 appear to be associated with oil and gas production (approximately 17% of the total). This estimate does not include the recent swarm of earthquakes that has occurred near the Dallas-Fort Worth airport (DFW). These events are located within the Fort Worth Basin and appear to be located at depths consistent with ongoing oil and gas stimulation activities (pers. comm., Prof. Brian Stump, SMU). The Comanche Peak NPP is also located within the Fort Worth Basin and is underlain by the same major geologic units (Ellenburger Limestone and Barnett Shale) as the DFW region. Figure 2.5.1-228 shows that there are a large number of active gas production wells within 10 miles of the Comanche Peak NPP site.

Section 2.5.1.2.5.10.3 contains a qualitative discussion of the bases for concluding that seismic hazards associated with induced seismicity do not need to be considered in the site-specific PSHA for the Comanche Peak site. In particular the last paragraph of this section concludes that it is unlikely that any earthquake induced by gas production or fluid injection in the Fort Worth Basin would exceed mb 5.0 The staff requests the applicant submit calculations and quantitative evaluations that support the applicant's conclusion regarding the maximum earthquake size associated with gas production or fluid injection in the Fort Worth Basin.

ANSWER:

During a public conference call on September 23, 2010, the NRC staff requested clarification on Luminant's assessment of recommendations contained in Report TX-UT-1908-01, Revision 0, which accompanied the response to Question 02.05.02-26. The requested information is provided in the attached evaluation.

Reference

(TLE 2010) The Leading Edge. Frohlich, Cliff, E. Potter, C. Hayward, and B. Stump. Dallas-Fort Worth earthquakes coincident with activity associated with natural gas production. March 2010 (Pages 270 to 275).

Attachment

White Paper entitled: Evaluation of Recommendations included in the December 3, 2007 William Lettis & Associates, Inc. Data Report, "Technical Issues Related to Hydraulic Fracturing and Fluid/Extraction/Injection near the Comanche Peak Nuclear Facility in Texas"

Impact on R-COLA

None.

Impact on DCD

None.

RAI 168 Question 02.05.02-26
Attachment

Evaluation of Recommendations included in the December 3, 2007 William Lettis & Associates, Inc. Data Report, "Technical Issues Related to Hydraulic Fracturing and Fluid/Extraction/Injection near the Comanche Peak Nuclear Facility in Texas".

Luminant

Prepared for
Luminant Inc.
Comanche Peak Nuclear Power Plant

MNES
Mitsubishi Nuclear Energy Systems

ENERCON
Excellence—Every project. Every day.

Prepared by
Mitsubishi Nuclear Energy Systems
Enercon Services, Inc.

October 5, 2010

Objective

Evaluate the necessity of implementing recommendations included in the December 3, 2007 William Lettis & Associates, Inc. (WLA) Data Report, "Technical Issues Related to Hydraulic Fracturing and Fluid/Extraction/Injection near the Comanche Peak Nuclear Facility in Texas".

Background

Luminant's response to CP RAI #168 (Question 02.05.02-26) regarding vibratory ground motion included WLA report TX-UT-1908-01 Rev. 0, "Technical Issues Related to Hydraulic Fracturing and Fluid/Extraction/Injection near the Comanche Peak Nuclear Facility in Texas". The NRC reviewed the report and in a public conference call on September 23, 2010, questioned what actions will be taken with respect to the recommendations included in the WLA Data Report TX-UT-1908-01.

<u>WLA Data Report</u>
The WLA Data Report presents the work commissioned to Dr. Ellen Rathje and Dr. Jon Olson, University of Texas-Austin, to assess hazards associated with oil and gas production in the vicinity of the Comanche Peak site. Data from the report was used in Subsection 2.5.1.2.5.10 of the Final Safety Analysis Report (FSAR) for Units 3 and 4, which addresses manmade hazards. Statements and conclusions presented in the report are considered to be expert opinion, and no formal calculations were produced in support of these statements.

The WLA Data Report identified two potential issues related to hydraulic fracturing: changes to the rock properties and induced seismicity; and three potential issues related to long-term fluid extraction or injection in the Comanche Peak area: changes to the rock properties due to the gas production, induced compaction/subsidence due to gas production, and induced seismicity due to gas production and fluid injection (WLA 2007).

The report concluded that various issues have been identified related to well stimulation, long-term gas production, and long-term fluid injection in Fort Worth Basin near the Comanche Peak facility; however, the report concluded that the only issue that presents any concern is induced seismicity due to gas extraction from the Barnett Shale or fluid injection into the Ellenburger Limestone (WLA 2007).

With respect to induced seismicity, the report concluded that it is unlikely that seismicity will be induced in the Fort Worth Basin as a result of gas production or water injection based on the following: (1) although Texas has had intense oil and gas activity, as well as fluid injection, for nearly 100 years, there have been very few instances of associated seismicity, and none documented in the Fort Worth Basin of body wave magnitude 3 or greater, and (2) the technical assessment of the potential for fault slip in the Barnett Shale due to gas production is low. Additionally, even under the most favorable conditions, the largest earthquake that likely would be induced would be on the order of body wave magnitude = 4.0 to 4.5 (based on observed, human-induced seismicity within Texas), yet these magnitudes are smaller than the minimum magnitude considered in Probabilistic Safety Hazards Analysis (PSHA) for nuclear facilities (WLA 2007).

The WLA Data Report included the following technical recommendations for the Comanche Peak facility:

1. Develop a local seismic monitoring program that can detect small earthquakes (body wave magnitude = 1 to 3). Monitor the location and size of each earthquake, and periodically (i.e. every six months) investigate whether the rate of seismicity is changing. Because fluid injection slowly builds pressure in a reservoir, it is likely that seismicity, if conditions were favorable for it to occur, would build in intensity with time, allowing remedial action before an event of damaging magnitude would occur.

2. A moratorium on injection within a certain distance of the site might be considered to reduce potential future risk of induced earthquakes. Such a restriction should have little economic effect on the region (this is not limiting economic development of a resource), so it seems a reasonable measure considering the uncertainty in assessing the true risk.

3. The production of gas development should be allowed to proceed naturally to avoid the project site being a place of pore pressure gradient which could potentially increase the risk of seismicity.

4. Further study may be warranted to more comprehensively model the potential risk of seismicity along the lines of the methods of Segall and Fitzgerald (1998) and Davis and Pennington (1989). A problem with the modeling approach is the inability to eliminate uncertainty in the input data (in situ stress magnitudes, permeability distributions, locations and condition of pre-existing faults, etc.), so local monitoring of body wave magnitude <3 earthquakes is probably a preferable initial route.

Recent Studies on Fort Worth Basin Earthquakes

On October 31, 2008 and the following day, nine small (between magnitudes 2.5 and 3.0) earthquakes were recorded by regional USGS seismic stations in the Dallas-Ft. Worth area. On May 16, 2009, this scenario repeated itself as four earthquakes were recorded (largest = magnitude 3.3). A third sequence of small earthquakes (yet to be studied in detail) began on June 2, 2009, approximately 65 km southwest of the Dallas-Ft. Worth area near the city of Cleburne (TLE 2010).

Following the October earthquakes, seismologists from Southern Methodist University (SMU) operated six, three-component, broadband seismographs at sites in Tarrant and Dallas Counties between November 9, 2008 and January 2, 2009. Although the National Earthquake Information Center (NEIC) reported no felt earthquakes during this period, the SMU stations recorded numerous local events, including 11 earthquakes between November 20, 2008 and December 2, 2008 with exceptionally well-recorded data (TLE 2010).

SMU and University of Texas at Austin seismologists prepared a paper ("Dallas-Fort Worth earthquakes coincident with activity associated with natural gas productions") summarizing their analysis of seismograms of the DFW sequence and reporting precise locations for 11 well-recorded but "non-felt" events. Using seismological data and other information available in the public record, the seismologists show that: (1) In 2008 prior to October 29, no earthquakes were detected near DFW, including earthquakes too small to be locatable by the NEIC; (2) the 11 hypocenters had a preferred focal depth of

4.4 km and were oriented along a 1.1-km SW-NE line; and (3) the mean epicenter estimate of the 11 events was less than 0.5 km from a 4.2-km deep saltwater disposal (SWD) well where injection began on September 12, 2008, seven weeks before the DFW focus became active. On the basis of time and spatial correlations, the seismologists conclude the DFW sequence may be the result of fluid injection at the SWD well, but are puzzled as to why earthquakes occur at this particular location but not near other SWD wells in the region. The paper includes a discussion of DFW earthquakes in the context of regional historical seismicity, which includes both natural and induced earthquakes, and the observation that historical induced earthquakes in the Texas region have all been less than magnitude 4.6 and have not produced substantial damage (TLE 2010).

The paper states that more than 12,000 wells have been completed in the Barnett Shale of the Fort Worth Basin in the past decade, all of which have received hydraulic fracture treatments, and more than 200 saltwater disposal wells are active in the area of Barnett production.

The paper further states that fracture stimulation and saltwater disposal are critical components of the current development strategy for shale gas, and that enhanced geothermal projects rely on fracturing and fluid injection have also raised concerns about induced earthquakes. Additionally, geological carbon sequestration is one approach being researched to combat global climate change, and it involves pumping large volumes of carbon dioxide into targeted geologic formations. To allay public concerns, the authors state that more needs to be known about how these activities interact with in-situ stresses and possibly affect seismic activity, and that energy producers, policymakers and researchers would all benefit from an improved understanding of induced seismicity (TLE 2010).

Response

Luminant has evaluated the conclusions of the WLA report as well as the recent DFW area earthquake study and concludes that it is unlikely that seismicity will be induced in the Fort Worth Basin in excess of the minimum magnitude of 5.0 considered in PSHA for nuclear facilities as a result of gas production or water injection.

Further, Luminant has evaluated each of the technical recommendations of the WLA Data Report and has concluded the following:

1. Development of a seismic monitoring program may be appropriate from a research standpoint; however, it is Luminant's position that development of such a program is not necessary for the safe operation of Comanche Peak Units 1 through 4. The Comanche Peak site is adequately monitored for seismic activity as described in the Combined Operating License (COL) Application and Design Control Document (DCD).

2. A moratorium on injection within a certain distance of the site to reduce potential future risk of induced earthquakes is not practical as Luminant has no authority or control over injection activities beyond the site boundary.

3. Luminant agrees that the production of gas development should be allowed to proceed naturally to avoid the Comanche Peak site being a place of pore pressure gradient which could potentially increase the risk of seismicity; however, Luminant has no authority or control over gas development in the region.

4. Regarding further study to more comprehensively model the potential risk of seismicity, it is Luminant's position that there is no need to consider further study because the potential for risk is already known for larger magnitude seismic events as described in FSAR Subsection 2.5.1.2.5.10.3.

Conclusion

The statements and conclusions of the WLA Data Report are generally in agreement with the findings and discussion points in the case study of recent Fort Worth Basin earthquakes occurring since the date of the WLA Data Report (December 2007). Both support the fact that induced seismicity can occur as a result of gas production or water injection; however, both also show that historical induced earthquakes in the Texas region have all been less than magnitude 4.6 and have not produced substantial damage. It is Luminant's position that the WLA Data Report recommendations are appropriate from a research standpoint but are not appropriate for the Comanche Peak site because the design already includes much larger input ground motion than that which could result from any seismic event resulting from gas production or fluid injection. The WLA Data Report states that the maximum likely earthquake magnitude from gas extraction would be smaller than the minimum magnitude of 5.0 considered in the PSHA. While further research may help to better understand micro-seismicity induced by gas production or other proposed subsurface injection activities, the WLA Data Report recommendations are not intended to satisfy any pending seismic response or performance issue related to Comanche Peak Units 1 through 4, do not consider cost to benefit, nor do they arise from any regulatory requirement. Inasmuch as additional information may be desirable to better understand the impact of gas production on seismicity, it should not be incumbent upon Luminant to provide as part of the COL Application for Comanche Peak Units 3 and 4.

References

(TLE 2010) The Leading Edge. Frohlich, Cliff, E. Potter, C. Hayward, and B. Stump. Dallas-Fort Worth earthquakes coincident with activity associated with natural gas production. March 2010.

(WLA 2007) William Lettis & Associates, Inc. Rathje, Ellen, and J. Olson. Technical Issues Related to Hydraulic Fracturing and Fluid Extraction/Injection near the Comanche Peak Nuclear Facility in Texas. WLA Project Number 1908. December 3, 2007.

Attachment 2

Supplemental Response to
Request for Additional Information No. 4841 (CP RAI #170)

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4841 (CP RAI #170)

SRP SECTION: 02.05.04 - Stability of Subsurface Materials and Foundations

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 7/8/2010

QUESTION NO.: 02.05.04-22

In the response to RAI Number 22 (2929) question 2.5.4-10, the applicant has not presented any information to meet the Acceptance Criteria in Subsection 2.5.4.5 "Excavation and Backfill" of NUREG-0800, 'Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,'. This subsection states "The extent (horizontally and vertically) of all Category I excavations, fills, and slopes are clearly shown on plot plans and profiles." Please provide the extent of fills and excavations as well as the requirements for engineered fill materials expected to be needed on the sides of the power block structures and under other safety class structures.

Luminant's Final Responses to Requests for Additional Information No. 2929; Log # TXNB-09059; dated October 28, 2009; ML093080116.

ANSWER:

This response supplements the response to Question 02.05.04-22 (letter TXNB-10062 dated September 10, 2010) with additional figures that provide supplemental information regarding excavations, fills and slopes for Category I structures. The original figures were revised to reference new excavation section profiles and for minor editorial adjustments. The original and additional figures have been added to the FSAR.

The NRC determined that the figures provided with the original response contained security-related information (SRI) and withheld the figures from public dissemination. All figures provided with this response contain SRI as well and should be withheld from public dissemination.

Impact on R-COLA

See attached marked-up FSAR Revision 1 page 2.5-190 (attached) and new Figures 2.5.4-246, 2.5.4-247, 2.5.4-248, 2.5.4-249, 2.5.4-250, 2.5.4-251, 2.5.4-252, 2.5.4-253, 2.5.4-254, 2.5.4-255, 2.5.4-256, 2.5.4-257, 2.5.4-258, 2.5.4-259, 2.5.4-260 and 2.5.4-261 (Security-Related Information in Attachment 3 to this letter).

Impact on DCD

None.

The shallow and deep profiles, as described above, were combined by coupling the Strawn Group using the Mineral Wells Formation, which is the deepest stratigraphic layer encountered in the geotechnical exploration for Units 3 and 4 and the shallowest layer characterized for the deep profile.

2.5.4.5 Excavations and Backfill

CP COL 2.5(1) Replace the content of DCD Subsection 2.5.4.5 with the following.

This subsection discusses site preparation, excavation, backfill, and earthwork requirements for CPNPP Units 3 and 4 site. The following items are addressed in this section:

- Horizontal and vertical limits of excavation, exposed subgrade preparation, fills, and slopes
- Construction excavation, temporary cut slopes, and dewatering
- Backfill material types, sources, specifications, and quality control observation and testing
- Foundation excavation, subgrade, and slope geologic monitoring during construction

Figures 2.5.4-209, 2.5.4-210, 2.5.4-211, and 2.5.4-217 illustrate the general layout and general excavation requirements for the main plant structures. Figures 2.5.4-246 and 2.5.4-247 provide preliminary excavation plans for CPNPP Units 3 and 4, respectively. Preliminary excavation section profiles along three north-south and four east-west directions are shown on Figures 2.5.4-248 through 2.5.4-254 for Unit 3, and on Figures 2.5.4-255 through 2.5.4-261 for Unit 4. For general grading and site preparation to plant yard grade elevation of 822 ft (Figure 2.5.5-204), excavation cuts of up to about 45 ft are required within the CPNPP Units 3 and 4 site. The general excavation cuts completely strip all surficial soils and the upper weathered zones of the Glen Rose Formation engineering Layer A. For foundation installations of the structures within the power block and UHS areas, additional temporary excavations are required to depths of approximately 40 ft to 45 ft below the yard grade elevation of 822 ft. As shown on Figure 2.5.4-217, Glen Rose Formation Layer B, which consists of shale beds, daylights into the temporary excavation sidecuts near the bottom of the excavation, creating. potential low strength beds and interfaces. The shale strata are generally horizontal, a geometry that is favorable for stability. However, shale strata are considerably weaker materials than limestone strata, and may undergo significant softening and pose potential sliding surfaces that undermine the rock masses within the excavation banks. Although the construction experience from CPNPP Units 1 and 2 suggests that vertical cuts are viable, construction precautionary and preventing methods (e.g. rock anchors or angle cut) that are typical procedures in bedded rock formations with potential weak zones provide an acceptable level of construction stability and ensure the safety of personnel and

RCOL2_02.05.04-22 S01

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4841 (CP RAI #170)

SRP SECTION: 02.05.04 - Stability of Subsurface Materials and Foundations

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

DATE OF RAI ISSUE: 7/8/2010

QUESTION NO.: 02.05.04-23

In the response to RAI Number 22 (2929) question 2.5.4-13, the applicant has indicated that some seismic category I structures are supported on fill concrete placed over engineering Layer C limestone, and seismic category I duct banks are supported on backfill materials. 10 CFR 100.23 (d) (4) requires that "Each applicant shall evaluate all siting factors and potential causes of failure, such as the physical properties of the materials underlying the site ...." Regulatory Guide 1.206 Section C.I.2.5.4.5, "Excavations and Backfill" states that the applicant should discuss "sources and quantities of backfill and borrow, including a description of exploration and laboratory studies and the static and dynamic engineering properties of these materials." In your response, please

1. Address the dynamic properties of fill concrete such as shear wave velocity and concrete modulus to ensure these properties equal or exceed the in-situ limestone properties.

2. Indicate if any backfill under Seismic Category I facilities will follow Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) procedures to ensure that selected backfill properties meet the requirements of the US-APWR DCD with respect to the minimum shear wave velocity and compaction. Further, for any fill materials with dynamic properties not verified by testing results submitted for review, please indicate how the fill ultimately selected will be verified to equal or exceed the values used in stability analyses such as the bearing capacity, settlement, slope stability and lateral earth pressure.

Luminant's Final Responses to Requests for Additional Information No. 2929; Log # TXNB-09042; dated September 10, 2009; ML092820486.

ANSWER:

During a public conference call on September 23, 2010, the NRC Staff requested additional clarification from Luminant on the use of seismic category I shallow-embedded duct banks resting on backfill.

As stated in FSAR Subsection 3.8.4, the only seismic Category I structures at CPNPP Unit 3 and 4 are the R/B Complex, PS/Bs, ESWPT, UHSRS, and PSFSVs. There are no other seismic Category I structures (e.g., shallow-embedded duct banks or pipe chases). As stated in FSAR Subsections 3.7.2.4.1 and 3.8.5.5, all seismic Category I structures rest on fill concrete placed over engineering Layer C limestone or directly on Layer C limestone and there are no seismic Category I facilities that rest on backfill at CPNPP Units 3 and 4. Subsections 2.5.4.3, 3.7.1.1, 3.7.2.3.1, 3.7.2.4.1, and 3.8.4.1.3.4 have been revised to that effect.

The response to RAI No. 2819 (CP RAI #66) Question 03.03.02-4 submitted November 5, 2009 and RAI No. 2818 (CP RAI #54) Question 03.03.01-1 submitted October 26, 2009 will be revised to reflect that there are no other seismic Category I structures (i.e., shallow-embedded duct banks or pipe chases). Subsections 3.3.1.2, 3.3.2.2.2 and 3.3.2.2.4 will be revised to that effect.

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.5-179, 3.7-3, 3.7-7, 3.7-8, 3.7-9, and 3.8-7

Impact on DCD

None.

2.5.4.2.3.4.4 Organic Content

Organic contents were measured in two samples of fine-grained residual soils. Results indicate an organic content of 1.9 percent for a sample of sandy clay and 2.6 percent for a sample of silty clay.

2.5.4.3 Foundation Interfaces

CP COL 2.5(1) Replace the content of DCD Subsection 2.5.4.3 with the following.

The following subsections describe the subsurface conditions determined from the extensive investigation and resulting data. The boring data, including detailed core descriptions, geophysical logs and surveys and laboratory test results, are used to divide the vertical section into layers that are distinguished by different physical characteristics. These engineering layers were applied to develop a representative static and dynamic profile for engineering analysis as well as development of the seismic ground motion for the site, as described in Subsection 2.5.2. Significant discussion is focused on a prominent and thick limestone layer (referred to as engineering Layer C), the top of which is present at about 40 ft below the yard grade (elevation 822 ft). This limestone layer is the foundation bearing layer for all seismic category I structures~~, with the exception of shallow-embedded electrical duct banks~~. There are no site-specific seismic category I structures resting on backfill. ~~It~~Layer C has a uniform thickness of about 60 ft and a consistent S-wave velocity of about 6300 fpc. Subsurface conditions to a depth of about 550 ft are described in the following subsections. RCOL2_03.08.04-63 RCOL2_02.05.04-23 S01

2.5.4.3.1 Engineering Stratigraphy

The subsurface conditions and engineering stratigraphy for the site area are based on the integrated data acquired from the geotechnical exploration program described in Subsection 2.5.4.2 and shown on Figure 2.5.4-202. Figures 2.5.4-206, 2.5.4-207, and 2.5.4-208 are examples of boring in situ test summary logs from key boreholes that integrate geologic and geophysical data to help define and correlate engineering layers through the site.

Site bedrock materials are divided into discrete engineering layers for evaluation of foundation and seismic site response characteristics. The bedrock formations extending from the ground surface to a depth of about 550 ft (approximately elevation 294 ft) are divided into 13 stratigraphic-engineering (engineering) rock layers (Figures 2.5.4-204 and 2.5.4-205), and a thin cover of surface residual soils and localized undocumented fill. Engineering rock layers are correlated with the regional geologic stratigraphy described in Subsection 2.5.1, and rock strata defined for the CPNPP Units 1 and 2 FSAR that include the Glen Rose Formation, Twin Mountain Formation, and Mineral Wells Formation. Figure 2.5.4-205 shows the correlation between the site engineering layers and those defined for CPNPP Units 1 and 2. Each engineering layer is a unique stratigraphic layer differentiated on the basis of lithology (e.g., shale or limestone), rock mass property (e.g., degree of fracturing or cementation), geotechnical index properties (e.g., FIRS4 = nominal response spectrum corresponding to typical plant grade elevation 822' for shallow-embedment structures founded on engineered and compacted structural backfill that extends down to top of limestone at nominal elevation 782'. FIRS4 is computed using both a 30 percent and a 50 percent coefficient of variation for the engineered fill properties to account for a wide range of potential backfill materials. ~~FIRS4 applies to seismic category I duct banks and chases used for routing yard piping and conduits.~~ RCOL2_02.05.04-23 S01

The 5 percent damping site-specific horizontal response spectra accelerations for all frequencies, at all FIRS locations, are less than those of the 5 percent damping minimum response spectra tied to the shape of the CSDRS and anchored at 0.1 g, as demonstrated in Figure 3.7-201. Similarly, the 5 percent damping site-specific vertical response spectra, which are developed from the horizontal response spectra using vertical/horizontal response spectral ratios appropriate for the site, are less than the 5 percent damping minimum vertical response spectra tied to the shape of the CSDRS and anchored at 0.1g. The nominal site-specific response spectra described above are less than the minimum required response spectra, and are therefore not used for site-specific design. Instead, the site-specific SSE and FIRS are defined as the shape of the CSDRS anchored at 0.1g, in order to comply with the intent of Appendix S (IV)(a)(1)(i) of 10 CFR 50 (Reference 3.7-7). The site-specific SSE, defined at ground surface (plant grade elevation 822 ft), consistent with the requirements of Appendix S, is the same as the FIRS used as input for site-specific seismic design. By definition, the site-specific SSE and FIRS are automatically enveloped by the CSDRS given in DCD Figures 3.7.1-1 and 3.7.1-2 for standard plant seismic category I structures. The site-specific FIRS (CSDRS anchored at 0.1 g) are used for the design of seismic category I and II SSCs that are not part of the US-APWR standard plant. RCOL2_03.08.04-64 RCOL2_03.08.04-64

The site-specific SSE and FIRS are presented in Figures 3.7-202 and 3.7-203 for the horizontal and vertical ~~FIRS~~directions, respectively. Tabulated values of the corresponding spectral accelerations for each of the spectral control points are presented in Tables 3.7-201 and 3.7-202 for the horizontal and vertical ~~FIRS~~directions, respectively. RCOL2_03.08.04-64 RCOL2_03.08.04-64

CP COL 3.7(2) Replace the seventeenth paragraph in DCD Subsection 3.7.1.1 with the following.

The site-specific verification analysis of US-APWR standard plant seismic category I structures has been performed considering SSI effects and using the site-specific FIRS as described in Subsection 3.7.2.4.1.

CP COL 3.7(13) Replace the first and second sentences of the nineteenth paragraph in DCD Subsection 3.7.1.1 with the following.

For CPNPP Units 3 and 4, the value of the operating-basis earthquake (OBE) ground motion that serves as the basis for defining the criteria for shutdown of the

3.7.2.1 Seismic Analysis Methods

CP COL 3.7(29) Replace the second sentence of the first paragraph in DCD Subsection 3.7.2.1 with the following.

Table 3.7.2-1R presents a summary of dynamic analysis and combination techniques including types of models and computer programs used, seismic analysis methods, and method of combination for the three directional components for the seismic analysis of the US-APWR standard and site-specific seismic category I buildings and structures.

3.7.2.3.1 General Discussion of Analytical Models

CP COL 3.7(3) Replace the sixth paragraph (including bullets) in DCD Subsection 3.7.2.3.1 with the following.

Analytical models used for the seismic analyses of buildings and structures are developed on a site-specific basis as follows:

- PSFSVs (seismic category I). A three-dimensional site-specific SASSI (Reference 3.7-17) finite element (FE) model is used for seismic analysis. The PSFSV analytical model is discussed in Appendix 3MM.
- ESWPT (seismic category I). Three-dimensional site-specific SASSI (Reference 3.7-17) FE models are used for seismic analysis. The ESWPT analytical models are discussed in Appendix 3LL.
- UHSRS (seismic category I). Three-dimensional site-specific SASSI (Reference 3.7-17) FE models are used for seismic analysis. The UHSRS analytical model is discussed in Appendix 3KK.
- ~~To account for seismic response of site-specific seismic category I yard piping and conduits routed within reinforced concrete duct banks (solid) or reinforced concrete chases (hollow), a nominal FIRS (FIRS4) was developed considering a wide range of potential variation of the site-specific backfill properties. The FIRS4 was compared to and found to be enveloped by the minimum required design response spectrum. The artificial time histories corresponding to the minimum response spectra are developed in compliance with SRP 3.7.1 (Reference 3.7-10), Option 1, Approach 2, and independently from (not scaled from) the CSDRS time histories. This forms a basis for seismic design of these items which~~ RCOL2_02.05.04-23 S01

~~therefore accounts for the site-specific soil media (backfill) characteristics and the site-specific earthquake.~~ RCOL2_02.05.04-23 S01

3.7.2.4.1 Requirements for Site-Specific SSI Analysis of US-APWR Standard Plant

---

CP COL 3.7(25) Replace the first and second paragraph in DCD Subsection 3.7.2.4.1 with the following.

The site-specific SSI analysis for the R/B-PCCV-containment internal structure is performed utilizing the program ACS-SASSI Version 2.2 (Reference 3.7-17). The analysis confirms that site-specific effects are enveloped by the standard design. The site-specific SSI analysis of the R/B-PCCV-containment internal structure is addressed in Appendix 3NN.

CP COL 3.7(26) Replace the third paragraph in DCD Subsection 3.7.2.4.1 with the following.

The site-specific SSI analyses of the UHSRS, ESWPT, and PSFSVs are performed using the computer program ACS-SASSI (Reference 3.7-17). The SASSI analyses for these structures are performed using the same methodology as the site-specific SASSI analysis of the R/B-PCCV-containment internal structure. The SASSI analyses and results for the UHSRS, ESWPT, and PSFSVs are addressed in further detail in Appendices 3KK, 3LL, and 3MM, respectively.

The SSI analyses of the A/B and T/B are performed based on lumped parameter SSI analyses which consider a range of subgrade conditions that envelope the site-specific subgrade conditions, including site-specific effects due to soil layering and location of the water table. The SSI damping values used do not exceed the values specified by ASCE 4-98 (Reference 3.7-9).

CP COL 3.7(8) Replace the sixth, seventh, and eighth paragraphs with the following.

The SSI analysis uses stiffness and damping properties of the subgrade materials that are compatible with the strains generated by the site-specific design earthquake.

All standard plant and site-specific seismic category I and II buildings and major structures are founded directly on a limestone stratum approximately 65 ft. thick, with a layer of fill concrete (not backfill) installed underneath the entire basemat where required to fill the volume between the basemat bottom and the top of limestone. The dynamic properties of the rock subgrade at CPNPP Units 3 and 4 are considered to be strain-independent. The mean shear wave velocity of the top

400 ft. of subgrade below seismic category I and II buildings and structures is 3,830 ft/s. This is above the limit of 3,500 ft/s (corresponding to subgrade material defined as rock with strain-independent dynamic properties) typically used as the cut-off point, below which dynamic testing of the subgrade material would be implemented. At depths below the 400 ft. range discussed above, the shear wave velocity of the rock is higher than 5,500 ft/s. Due to the low site seismicity, the anticipated strains in the rock subgrade due to the site-specific earthquake are very low, less than 0.01 percent. As previously mentioned in Subsection 3.7.2.4, the seismic design of the R/B-PCCV-containment internal structure does not rely on the backfill present on the sides of the building to derive lateral or structural support. Furthermore, the seismic designs of all other seismic category I and II buildings and structures, including the PS/Bs, A/B, T/B, UHSRS, ESWPT, and PSFSVs, also do not rely on backfill for lateral or structural support. The designs of the exterior walls of the building basements consider the earth pressures generated by the design earthquake.

~~Seismic category I shallow-embedded duct banks and chases are installed in and rest on compacted engineered structural backfill at the site. These structures consist of ruggedly designed reinforced concrete and are equipped with expansion joints that accommodate potentially large strains in the surrounding backfill.~~ RCOL2_03.08.04-63 RCOL2_02.05.04-23 S01

Based on these site conditions, in which the basemats of all seismic category I and II buildings rest directly on limestone or fill concrete, dynamic testing is not required to evaluate the strain-dependent properties of the rock subgrade and compacted backfill at CPNPP Units 3 and 4.

The water table at the site is located below the basemat bottom elevations and is taken as no higher than elevation 780 ft. for purposes of seismic analysis. The P-wave velocities of the saturated rock layers exceed the P-wave velocity of the water (5,000 ft/s). Therefore, the water table elevation does not affect the P-wave velocities of the submerged subgrade materials. Significant variations in the water table elevation and significant variations of the subgrade properties in the horizontal direction are addressed by using additional sets of site profiles.

In order to accurately capture effects of basemat embedment and flexibility, a 3-D finite element model is used to represent the stiffness and mass inertia of the basement in the SASSI model developed for the site-specific SSI verification analysis. To assure proper comparability with the US-APWR standard plant design, the above-ground portion of the R/B-PCCV-containment internal structure is modeled using lumped mass stick models with properties identical to those of the verified and validated lumped mass stick models of the building superstructure used in the US-APWR standard design.

The properties of the SASSI (Reference 3.7-17) seismic model are verified by an SSI analysis of the building resting on the surface of a hard rock subgrade that simulates fixed base conditions. The results of the SASSI analysis are prevent full penetration or structural failure by the spectrum of tornado missiles identified in Subsection 3.5.1.4. RCOL2_09.02.05-3

For details see Figures 3.8-207 through 3.8-211 for the UHS basin, UHS ESW pump house and cooling tower enclosures. Details of the UHSRS seismic analysis are provided in Appendix 3KK. RCOL2_03.08.04-12

3.8.4.1.3.3 PSFSVs

The PSFSVs are underground reinforced concrete structures required to house the safety-related and non safety-related fuel oil tanks. There is one vault for each PS/B. The vault contains two safety-related and one non safety-related oil tanks. Each tank is contained in a separate compartment. Compartments are separated by reinforced concrete walls. A common mat supports the tanks and the rest of the vault. The PSFSV roof slab is sloped to facilitate drainage. The highest point of the roof slab is slightly above grade. Bollards and a concrete curb are provided to prevent vehicular traffic on the roof.

Access to each vault is provided by a reinforced concrete tunnel from the applicable PS/B. Each tank compartment has a separate pipe/access tunnel, which is an integral part of the ESWPT.

For vault details see Figures 3.8-212 through 3.8-214. Details of the PSFSV seismic analysis are provided in Appendix 3MM. RCOL2_03.08.04-4

3.8.4.1.3.4 Other Site-Specific Structures

There are no additional site-specific seismic category I structures other than ESWPT, UHSRS and PSFSVs. ~~Site-specific seismic category I yard piping and conduits are routed within reinforced concrete duct banks (solid) or reinforced concrete chases (hollow). The duct banks and chases have shallow embedments and are buried partially or wholly below grade within structurally engineered and compacted backfill that extends down to top of limestone at nominal elevation 782 ft. The duct banks and pipe chases are constructed in segments, which are separated from each other and other structures by expansion joints.~~ RCOL2_03.08.04-63 RCOL2_02.05.04-23 S01 RCOL2_03.08.04-5 RCOL2_03.08.04-5

~~The expansion joints accommodate all anticipated differential settlement and movement (due to seismic and other loading) at support points, penetrations, and entry points into other structures.~~ RCOL2_03.08.04-5

3.8.4.3 Loads and Load Combinations

CP COL 3.8(20) Replace the second paragraph in DCD Subsection 3.8.4.3 with the following.

Externally generated loads from the following postulated site-specific sources are evaluated in the following subsections:

- Subsection 2.4.2.3 concludes no loads induced by floods are applicable.