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**BEFORE THE AIR QUALITY CONTROL COMMISSION, STATE OF COLORADO**

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In the Matter of Proposed Revisions to Ambient Air Quality Standards Regulation, Regulation Numbers 3, 7, and 11 for the Denver Metropolitan & North Front Range Ozone Action Plan

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**REBUTTAL TESTIMONY OF BRUCE C. MACDONALD, Ph.D.—WITNESS FOR ANADARKO PETROLEUM CORPORATION, NOBLE ENERGY, INC. and WILLIAMS PRODUCTION RMT COMPANY**

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I, Bruce C. Macdonald, depose and state as follows:

I am an Air Quality Consultant and Regional Vice President for the Air Quality Practice Area for AECOM Environment (a subsidiary of AECOM, Inc., formerly ENSR, Inc.) in Fort Collins, Colorado, and have over 30 years experience in atmospheric dispersion modeling, air quality monitoring, risk assessments, and control technology and emission assessment. I live at 4125 Sunstone Drive, Ft. Collins, Colorado. My education and professional background are summarized in the attached curriculum vitae.

I have been asked provide rebuttal testimony in the captioned proceeding concerning certain aspects of the separate analysis of control strategies that more carefully evaluate proposed emission control options. the Air Pollution Control Division's ("Division") photochemical dispersion modeling and use of modeling results in support of the proposed regulatory changes, including modeling assumptions, modeling results, sensitivity analyses, source apportionment, the Division's use of air mass modeling to perform "back-trajectory analyses" and weight of evidence ("WOE") analyses. I have the requisite educational training in atmospheric science and the professional experience and personal knowledge of dispersion modeling techniques, including modeling impacts of major stationary sources, evaluating control technology decisions and assessing emission rates to demonstrate compliance with environmental laws and regulations. My experience is further summarized in my written testimony attached to the Well Operators' Final Statement, and my bio attached thereto.

**I. Analysis of Environ International Corporation and Alpine Geophysics, LLC Supplemental Control Strategy Modeling**

The Well Operators have commissioned a separate analysis of control strategies that further evaluates the various control options. The reproduced summary table (Table ES-2, below) from the Executive Summary of the *Draft Final Report 2010 OZONE ATTAINMENT DEMONSTRATION MODELING FOR THE DENVER 8-HOUR OZONE STATE IMPLEMENTATION PLAN CONTROL STRATEGY* lists the control strategies that were evaluated for the Attainment Demonstration. It is clear from that table that Control Strategy 2 (Cntl2) includes at least two control options that are not implemented in 2010. These are the

Inspection and Maintenance Control Program for the Northern Front Range and the increase in condensate tank controls at oil and gas operations proposed for 2011 and 2012.

**Table ES-2.** Summary of control measures in the 2010 Control 1 and Control 2 emission scenarios.

| <b>Strategies Under Development for 2008 Proposed Ozone Action Plan</b><br>(All strategies apply to the entire Denver/North Front Range nonattainment area (NAA) unless otherwise noted) |  |   |  |                  |   |
|--|--|---|--|------------------|---|
| <b>Control 1</b>   |  | <i>Potential Emission Reduction</i>       | <b>Control 2</b>   |                  | <i>Potential Emission Reduction</i>                                 |
| Recommended Measures for Federally-Enforceable State Implementation Plan (SIP)   |  |   | Recommend Measures Adopted and Enforced as State-only Measures   |                  |   |
| ➤ More stringent Reg. 11 I/M cutpoints (Denver area) – adopted, effective May 1, 2008  |  | ~ 1 tpd VOC,<br>~3 tpd NOx,<br>~13 tpd CO | ➤ Inspection/maintenance program in North Front Range (structure to be determined)   |                  | ~ 1 tpd VOC,<br>~1 tpd NOx,<br>~17 tpd CO                           |
| ➤ 7.8 RVP gasoline regulatory requirement in North Front Range (consistent with Denver area)   |  | ~ 3 tpd VOC                               | ➤ Mandatory high-emitter <u>pilot</u> program (Denver area) – began January 1, 2008  |                  | <i>unknown at this time</i>   |
|  |  |   | ➤ Tighten up collector plate requirements for older vehicles (statewide)   |                  | < 1 tpd VOC<br>~ 7 tpd CO   |
| ➤ Increase condensate tank control (95%)<br>▪ for all new/modified tanks >2 tpy (2009)<br>▪ for all existing tanks >10 tpy (2010)  |  | VOC<br>~ 6-9 tpd<br>~19-30 tpd            | ➤ Increase condensate tank control (95%)<br>▪ for all existing tanks >5 tpy (2011)<br>▪ for all existing tanks >2 tpy (2012) |                  | VOC<br>~ 30-35 tpd<br>~9-12 tpd                                     |
| ➤ Pneumatic valves controls - require low/no bleed valves on all new and existing valves by 2009   |  | ~ 23 tpd VOC                              | ➤ Statewide Oil & Gas regulations -- Controls on existing reciprocating internal combustion engines                          |                  | <i>unknown at this time</i>   |
| ➤ Expand Reg. 7 (VOC control requirements) to entire NAA   |  | <i>unknown at this time</i>               |  |                  |   |
| ➤ Remove current exemptions in Reg. 3 for selected small sources required to file air pollution emission notices and obtain permits  |  | <i>unknown at this time</i>               |  |                  |   |
| ➤ Require Reasonably Available Control Technology (RACT) for minor sources in NAA (Reg. 3)   |  | <i>unknown at this time</i>               |  |                  |   |
| <b>TOTAL EMISSION REDUCTIONS</b>   |  | VOC<br>NOx<br>CO                          |  | VOC<br>NOx<br>CO | ~52-66 tpd<br>~ 3 tpd<br>~13 tpd<br><br>~41-49 tpd<br>NA<br>>24 tpd |

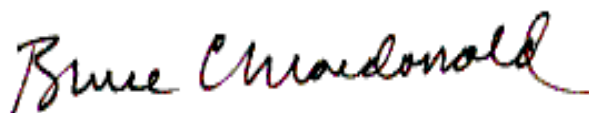
To better evaluate the modeled benefits of the state-wide RICE controls in the 2010 attainment demonstration year, a separate control analysis (Cntl2b) was conducted in order to determine the effectiveness of Control Strategy 2 for the year 2010, which would leave out the indicated inspection and maintenance program and the additional condensate tank controls. The results of that modeling effort are depicted in the table below at the ozone monitoring stations for each of the control strategies. This table essentially reproduces the results provided in the Draft Final Report cited above, but adds a column for the results for Cntl2b. The results clearly indicate that there is no improvement in the design values at monitors that show high ozone levels, specifically Fort Collins West and Rocky Flats North, as well as many of the other monitors that have reported high ozone design values.

Only four sites show an improvement, and that improvement in ozone design values is only 0.1 ppb at all four sites. These include the Carriage, Fort Collins (downtown), and the Greely Weld Tower. South Boulder Creek also shows the same marginal improvement. Ozone also is projected at higher levels in Gunnison.

| ID       | Site                 | County    | DVC  | Base | Cntl1 | Cntl2b | Cntl2 |
|----------|----------------------|-----------|------|------|-------|--------|-------|
| 80013001 | Welby                | Adams     | 70.0 | 70.2 | 70.2  | 70.2   | 70.2  |
| 80050002 | Highland             | Arapahoe  | 78.0 | 77.3 | 77.2  | 77.2   | 77.1  |
| 80130011 | S. Boulder Creek     | Boulder   | 81.0 | 80.8 | 80.7  | 80.6   | 80.6  |
| 80310002 | Denver - CAMP        | Denver    | 56.0 | 56.0 | 56.0  | 56.0   | 55.9  |
| 80310014 | Carriage             | Denver    | 74.0 | 74.1 | 74.1  | 74.0   | 74.0  |
| 80350004 | Chatfield State Park | Douglas   | 84.0 | 83.4 | 83.3  | 83.3   | 83.3  |
| 80410013 | USAF Academy         | El Paso   | 73.0 | 72.0 | 71.9  | 71.9   | 71.9  |
| 80410016 | Manitou Springs      | El Paso   | 74.0 | 73.7 | 73.7  | 73.7   | 73.7  |
| 80590002 | Arvada               | Jefferson | 79.0 | 79.2 | 79.1  | 79.1   | 79.1  |
| 80590005 | Welch                | Jefferson | 75.0 | 75.0 | 75.0  | 75.0   | 74.9  |
| 80590006 | Rocky Flats North    | Jefferson | 85.0 | 84.9 | 84.8  | 84.8   | 84.7  |
| 80590011 | NREL                 | Jefferson | 82.0 | 82.3 | 82.2  | 82.2   | 82.1  |
| 80690011 | Fort Collins - West  | Larimer   | 86.0 | 84.9 | 84.7  | 84.7   | 84.5  |
| 80691004 | Fort Collins         | Larimer   | 74.0 | 73.0 | 72.9  | 72.8   | 72.7  |
| 81230009 | Greeley - WeldTow    | Weld      | 78.0 | 77.7 | 77.4  | 77.3   | 77.0  |
| GTH161   | Gunnison             | Gunnison  | 68.0 | 67.8 | 67.8  | 67.9   | 67.9  |
| ROM206   | Larimer              | Larimer   | 76.0 | 75.2 | 75.1  | 75.1   | 75.1  |
| ROM406   | Larimer              | Larimer   | 76.0 | 75.2 | 75.1  | 75.1   | 75.1  |

This analysis demonstrates that with the addition of Cntl2b state-only measures there is essentially no improvement in the design values for ozone at the critical sites for 2010 over the basic Control- (Cntl1) SIP measures. Therefore the implementation of that additional control strategy (state-wide RICE controls under Cntl2b) does not appear likely to result in improved critical ozone levels in the 2010 time frame.

Dated this 25<sup>th</sup> day of November, 2008.




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Bruce C. Macdonald, Ph.D.