Thursday, 02 August 2018

Re: DSTL/AGR/00520/01 Task 15 (UH-C004240.01.15)

Ozone Measurement

Dear Ian Hill,

We are pleased to provide the following response to your task approval form for DSTL/AGR/00520/01 Task 15 Ozone Measurement from worn bio ESP collection units.

UH will perform experimental tests to assess the levels/concentration of ozone produced from a worn-bio detector which uses an Electro Static Precipitation mechanism for bioaerosol collection. The purpose of this test is to measure the output and compare it to safe exposure/concentration levels.

For full costing and schedule please refer to the attached Task Approval form. A detailed test plan is also attached.

Yours sincerely,

Dr Daniel McCluskey
Director – Centre for Research in Biodetection Technologies
School of Engineering & Technology
University of Hertfordshire, Hatfield. Herts. AL10 9AB, U.K.
Tel: +44 (0)1707 284147   email: d.mccluskey@herts.ac.uk
ANNEX D – TASK APPROVAL FORM

<table>
<thead>
<tr>
<th>Purchase Order Number</th>
<th>Task No.: 15</th>
<th>Issue No.: 0.1</th>
<th>Date: 28/06/2018</th>
</tr>
</thead>
</table>

**Part 1:** Proposal to be completed by the Dstl Demand Owner

1.1. **Task Title:** Ozone Measurement

1.2. **Task Objective and Description** (including Specification, Acceptance Criteria/ Testing, Documentation required, & Quality Standard):

Using a corona to charge particles in an electrostatic precipitator (ESP) will generate ozone. It has been suggested that the ozone concentration produced from a worn-bio detector which uses an ESP may be above safe levels. The purpose of this test is to measure the output and compare it to safe exposure/concentration levels.

- Measure the amount of ozone which is output from the ESP.
  - Test both the WBD Phase 1 standalone ESP (as produced for testing at HSL) and the Phase 2 combined ESP-EWOD-LFA system.
  - Use standard methodology where applicable.
- Compare the results to suitable safe exposure/concentration levels.
Deliverables Required:

- A detailed test plan to be emailed to the Authority. It will then be reviewed and approved/rejected by the Authority. Due 15th July 2018

- Presentation of results of the test. To be given at the Contractor’s site. Due by task end date.

- Write up of results to be included in final report (item D11.3) from the previous WP11 (DSTL/AGR/00520/01, Task No. 6, part 4). To include processed and raw data from all testing, description of test methodologies, conclusions on the success of testing. Due by task end date.

<table>
<thead>
<tr>
<th>Timescale of Task - Start:</th>
<th>16th July 2018</th>
<th>End:</th>
<th>31st Jan 2019</th>
</tr>
</thead>
</table>

Additional Special terms and conditions


### Part 2: Price for Proposed Task

The Task at 'Part 1' is accepted at a Firm Price of £3,579.06 broken down as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of Days</th>
<th>Rate/Day</th>
<th>Sub-Total</th>
<th>Travel &amp; Subsistence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Daniel McCluskey</td>
<td>1.5</td>
<td>£679.08</td>
<td>£1,018.62</td>
<td>-</td>
</tr>
<tr>
<td>Mr Richard Kaye</td>
<td>2</td>
<td>£562.75</td>
<td>£1,125.50</td>
<td>-</td>
</tr>
<tr>
<td>Mr Matthew Lodge</td>
<td>2</td>
<td>£392.47</td>
<td>£784.94</td>
<td>-</td>
</tr>
<tr>
<td>Materials inc Ozone Sensing</td>
<td></td>
<td></td>
<td>£650</td>
<td>-</td>
</tr>
</tbody>
</table>

**RELEVANT IPR PROVISION:**
- DEFCON 703
- DEFCON 705
- DEFCON 91

Other (to be specified):

<table>
<thead>
<tr>
<th>Our detailed proposal ref:</th>
<th>NA</th>
<th>dated:</th>
<th>NA</th>
</tr>
</thead>
</table>

| Date: 1st August 2018 | Proposal submitted by: | Daniel McCluskey |

**Part 3: Approval to be completed by the DSTL Demand Owner**

Approval is hereby given to place the Task

**Signed** [Signature]

**Dated** 17/8/18

Upon completion of Part 3 the DSTL Demand Owner shall create/update the iCAS requisition, then attach this form and submit to DSTL Commercial Services for action.
Ozone Measurement of the UH design ESP

The following test plan will be used to assess the level of ozone generated via the UH designed electrostatic collection unit of the worn Biodetector project. The ESP unit uses a corona to charge particles prior to collection/capture onto a surface. This mechanism is known to generate ozone during operation. This experimental test is designed to record the ozone concentration produced from a wom-bio detector in two operating modes – open air and confined space. In both scenarios the level of ozone will be recorded to determine whether this is above recognised safe levels. The purpose of this test is to measure the output and compare it to safe exposure/concentration levels. For this test, UH will refer to the UK Health and Safety Executive guidelines ‘Ozone: Health hazards and control measures’ (Guidance Note EH38), when assessing the output of the ESP.

The respective guidelines for ozone exposure are as follows:

HSE - The current HSE workplace exposure limit (WEL) for ozone is 0.2 ppm in air averaged over a 15-minute reference period.

Ozone measurements will be conducted with a Honeywell GasAlert Extreme single gas detector. This unit has a sensor specification for O₃ as follows:

<table>
<thead>
<tr>
<th>Measuring range (PPM)</th>
<th>0-1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-4 to +122°F/-20 to +50°C</td>
</tr>
<tr>
<td>Relative Humidity (non-condensing)</td>
<td>15% - 90%</td>
</tr>
</tbody>
</table>

Methodology

The experimental test setup will consist of both open and confined operation of the ESP. All tests will take place within a Bassaire IS Clean Air fume hood to ensure no external sources of contamination. All tests will be run for 2 hrs and repeated in triplicate.

**Test 1** will consist of direct monitoring of the output gas from the ESP with a custom mount manufactured to enable the ozone monitor to be mounted directly to the exhaust of the ESP unit. This will measure the highest concentration of ozone generated by the ESP.

**Test 2** will consist see the ozone monitor placed 250mm away from the ESP exhaust (representing the approximate distance from the exhaust of a lapel mounted ESP to the wearers mouth/nose). This will measure the likely human inhalation exposure of ozone generated by the ESP.

**Test 3** will consist of both ESP and ozone monitor being placed in a sealed custom enclosure (250 x 250 250mm). This will measure the ozone concentration that builds up in confined space where external dissipation is not possible.

In all tests the maximum ozone concentration recorded will be reported. Where the threshold limit has been met the time to reach this threshold will be reported.