January 31, 2017

Joe Crelier
Director of Risk Management
Portland Public Schools
501 N Dixon Street
Portland, Oregon 97227

Via email: jcrelier@pps.net

Regarding: Continuous Radon Monitor Measurement Report
Five Locations at Peninsula, Ockley Green, Jefferson, and Skyline
Portland, Oregon
PBS Project No. 06500.618, Phase 0002

Dear Mr. Crelier:

From January 10 to January 18, 2017, PBS Engineering and Environmental Inc. (PBS) conducted continuous radon monitor (CRM) measurements at four Portland Public Schools (PPS) sites in five unique locations. These measurements were performed in response to elevated radon levels identified during previous short term radon monitoring. Locations tested are identified in the following table:

| Site | Building | Room |
|---|---|---|
| Peninsula | Main | Boiler Room |
| Ockley Green | Main | ym |
| Jefferson | Main | A75 |
| Jefferson | Main | A36 South Office |
| Skyline | Main | 105A |

This testing was performed with Sun Nuclear Model 1027 continuous radon monitors, EPA- and industry-approved testing devices. CRM monitors were placed on desk or table tops in rooms identified for testing. Devices were placed on the morning of January 10, 2017, and collected January 18, 2017. The devices recorded radon levels and tilts (an anti-tampering indication) data for 90 hours. Closed building conditions were not verified during the course of this testing.

The following table summarizes radon data collected:

| Test Location | Start Time | Stop Time | Total Time* | Average Radon Concentration (pCi/L = picocuries per liter) |
|---|---|---|---|---|
| Peninsula – Boiler Room | 01/10/2017 10:00 AM | 01/18/2017 10:00 AM | 90 Hours | 8.0 pCi/l |
| Ockley Green – Gym | 01/10/2017 8:30 AM | 01/18/2017 11:00 AM | 90 Hours | 11.0 pCi/l |
| Jefferson – A36 South Office | 01/10/2017 9:05 AM | 01/18/2017 11:22 AM | 90 Hours | 10.7 pCi/l |
| Jefferson – A75 | 01/10/2017 9:15 AM | 01/18/2017 11:28 AM | 90 Hours | 7.9 pCi/l |
| Skyline – 105A | 01/10/2017 11:00 AM | 01/18/2017 1:16 PM | 90 Hours | 10.9 pCi/l |

* Units log data once per hour for a maximum of the first 90 hours. Data for all hours between start and stop times may not be logged.

For more detail, please see the Report Graphs with Detailed Hourly Data for each test location (attached).

Please feel free to contact me at 503.417.7694 or chris.boyce@pbsusa.com with any questions or comments.

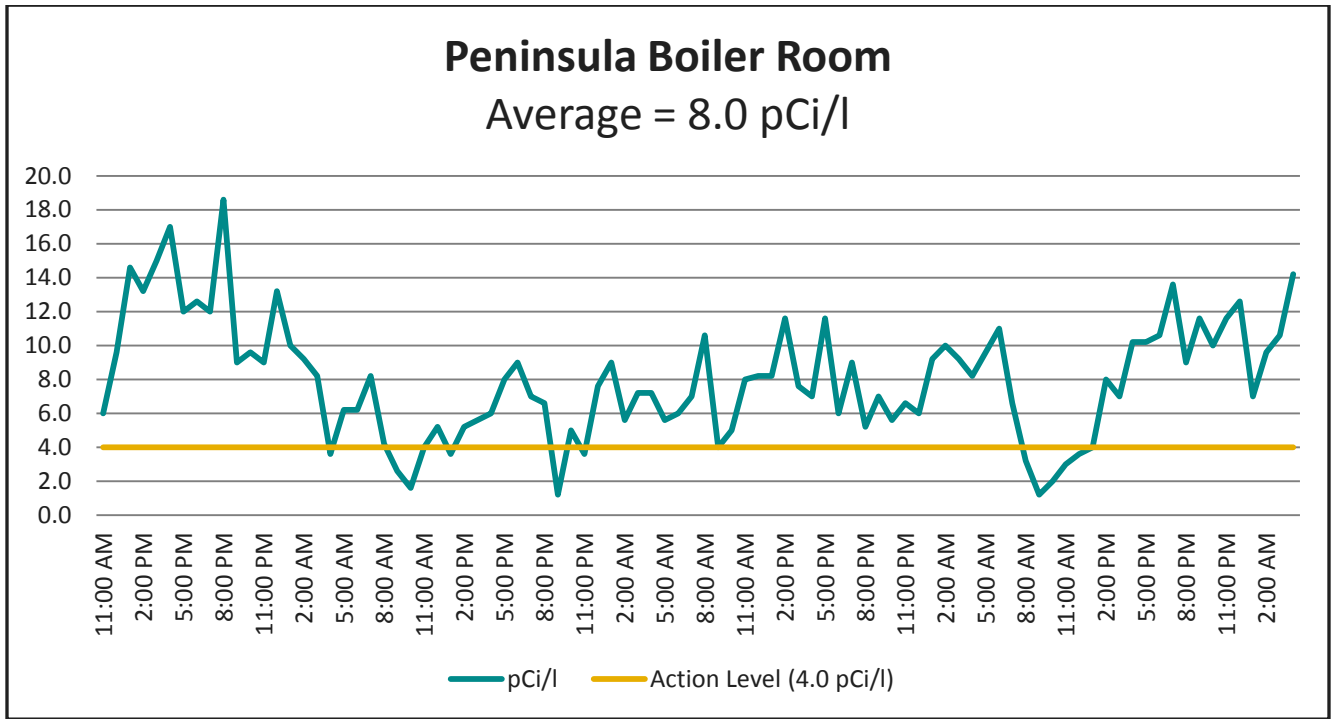
Sincerely,

Chris Boyce
Project Manager

Attachments: Report Graphs with Detailed Hourly Data (5)
CRM Statements of Calibration (Serial Numbers: 1407171, 1407175, 1407185, 1407187, 1407188)

CB::lkn

Unit Type: Sun Nuclear Model 1027
Serial Number: 1407185

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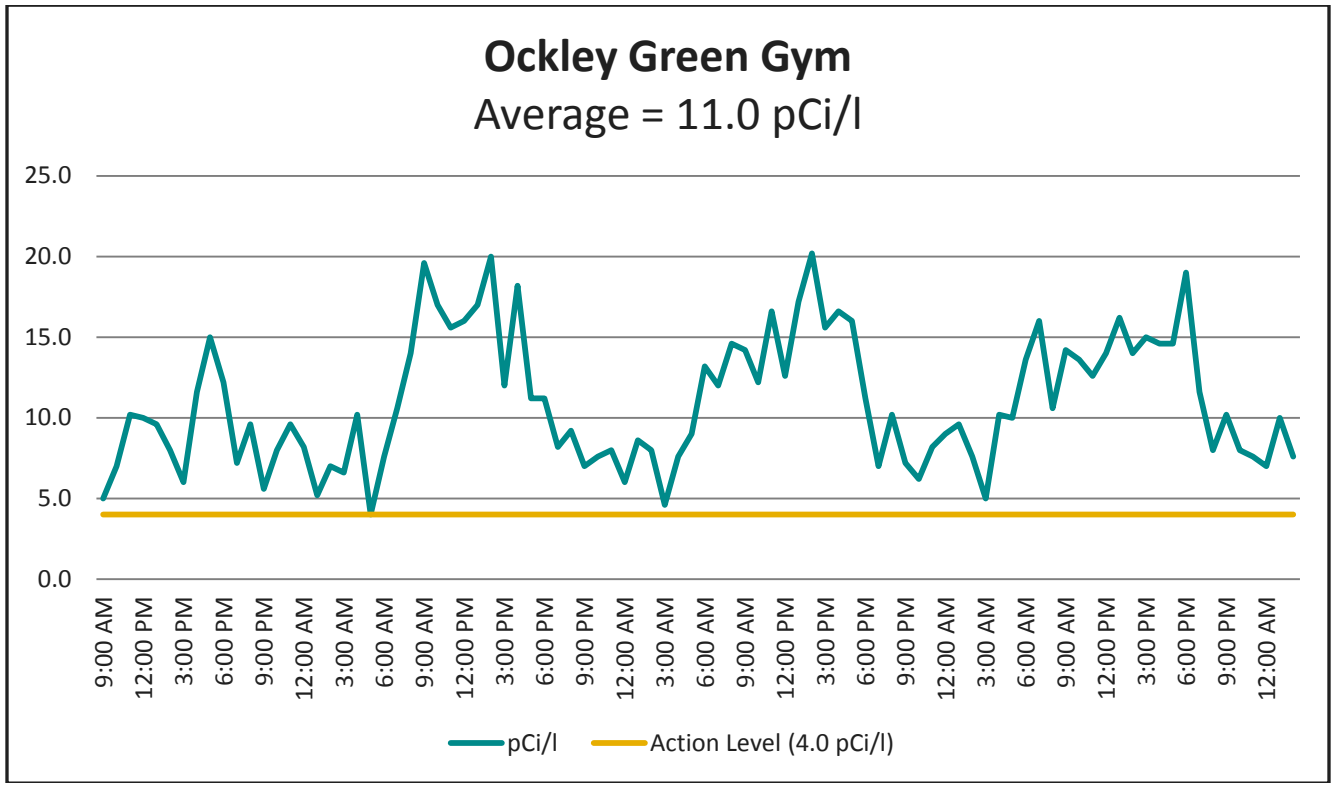
Unit Type: Sun Nuclear Model 1027
Serial Number: 1407188

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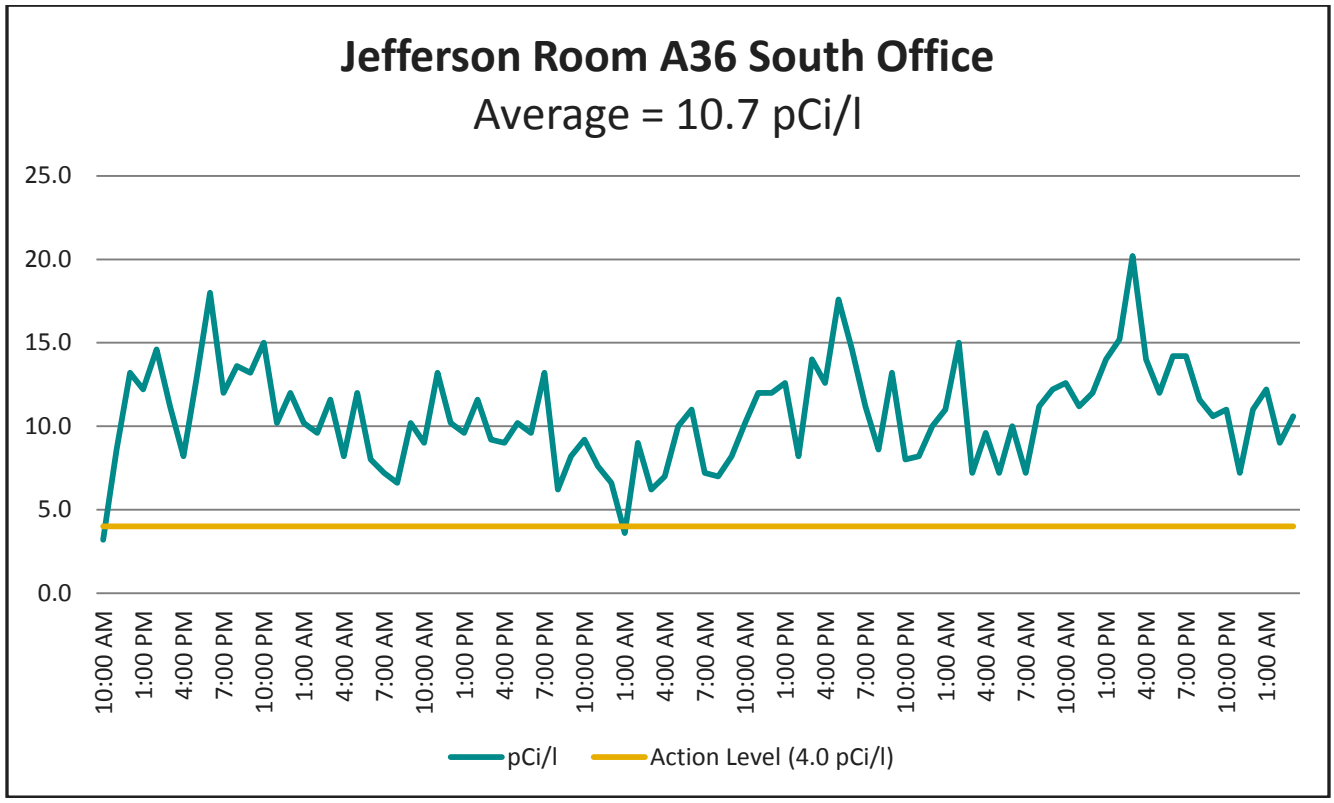
Unit Type: Sun Nuclear Model 1027
Serial Number: 1407187

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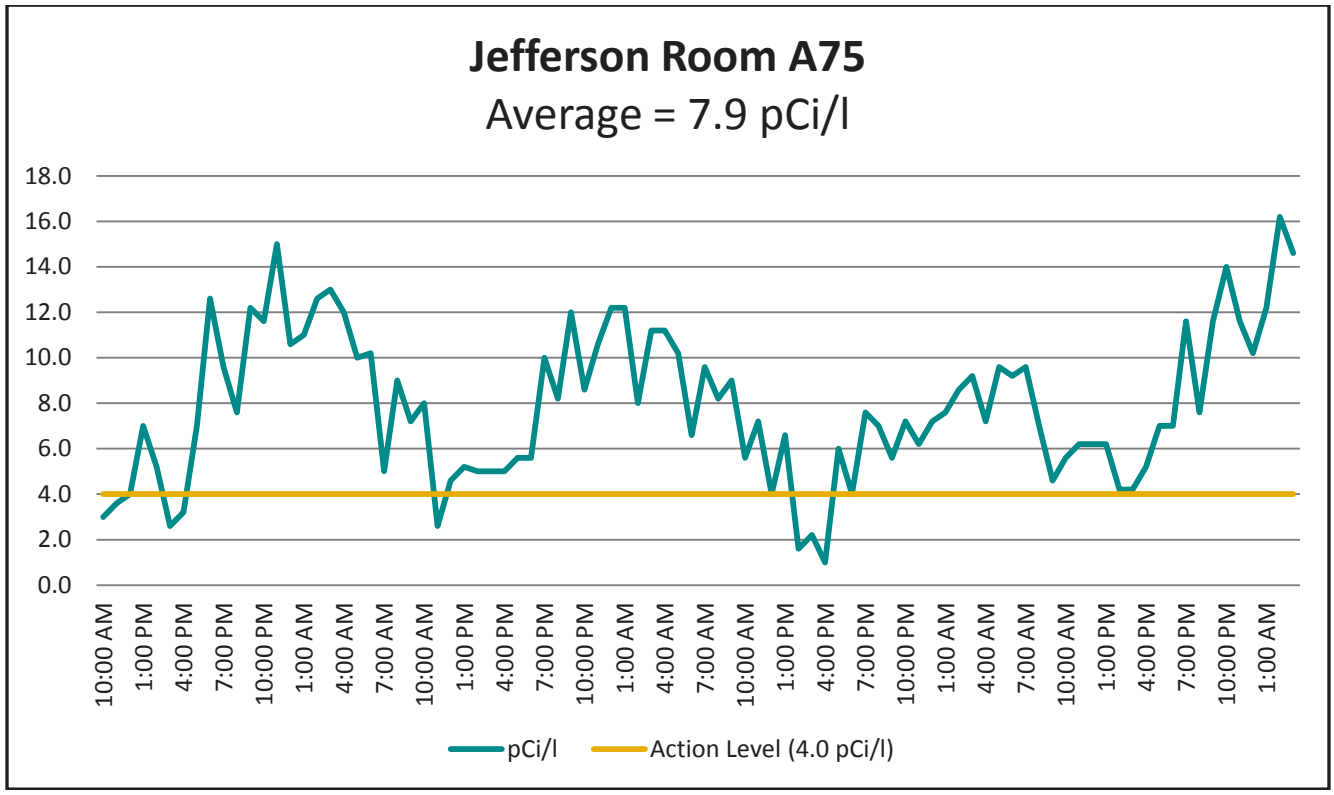
Unit Type: Sun Nuclear Model 1027
Serial Number: 1407171

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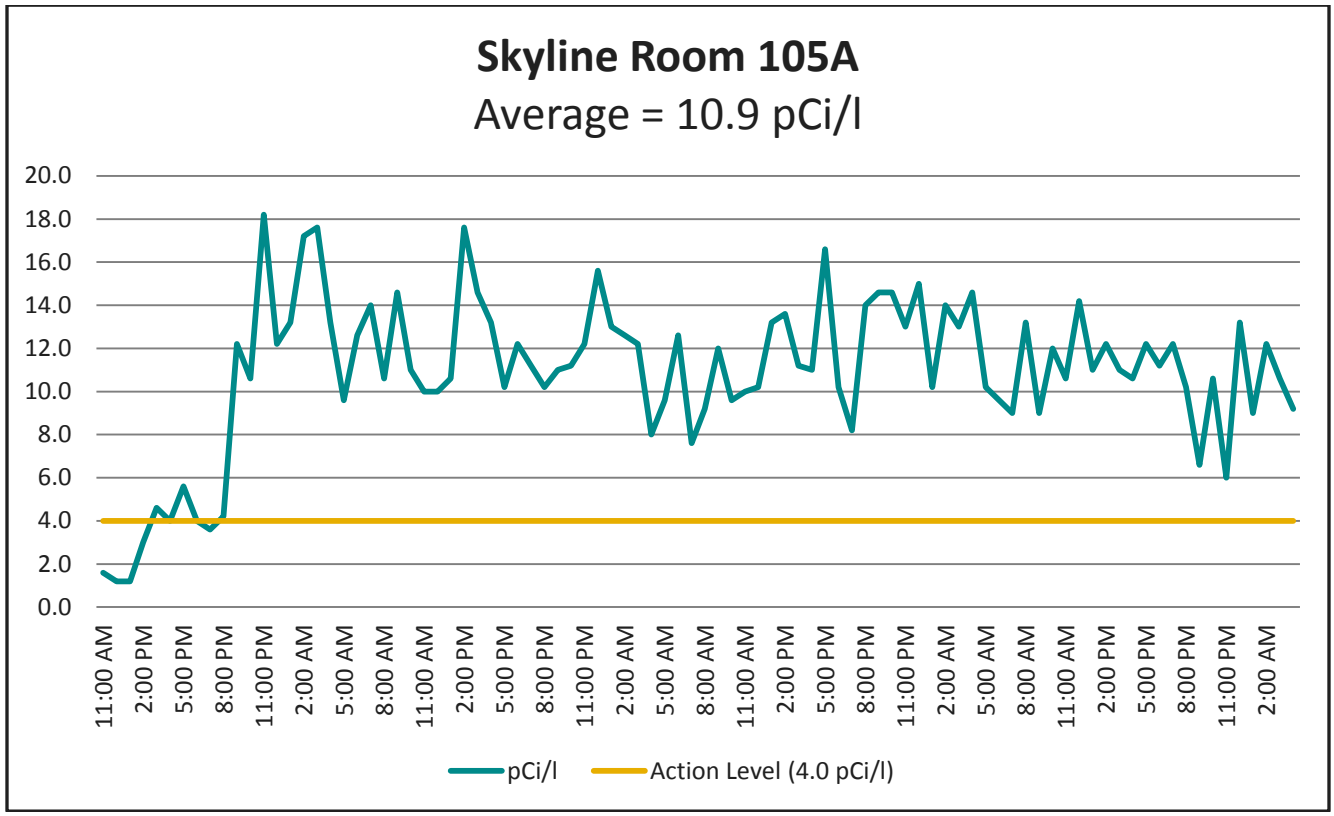
Unit Type: Sun Nuclear Model 1027
Serial Number: 1407175

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| January 10, 2017 | 9:00 PM | 12.2 |
| January 10, 2017 | 10:00 PM | 10.6 |
| January 10, 2017 | 11:00 PM | 18.2 |
| January 11, 2017 | 12:00 AM | 12.2 |

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| | | |
|---|---|---|
| January 11, 2017 | 1:00 AM | 13.2 |
| January 11, 2017 | 2:00 AM | 17.2 |
| January 11, 2017 | 3:00 AM | 17.6 |
| January 11, 2017 | 4:00 AM | 13.2 |
| January 11, 2017 | 5:00 AM | 9.6 |
| January 11, 2017 | 6:00 AM | 12.6 |
| January 11, 2017 | 7:00 AM | 14.0 |
| January 11, 2017 | 8:00 AM | 10.6 |
| January 11, 2017 | 9:00 AM | 14.6 |
| January 11, 2017 | 10:00 AM | 11.0 |
| January 11, 2017 | 11:00 AM | 10.0 |
| January 11, 2017 | 12:00 PM | 10.0 |
| January 11, 2017 | 1:00 PM | 10.6 |
| January 11, 2017 | 2:00 PM | 17.6 |
| January 11, 2017 | 3:00 PM | 14.6 |
| January 11, 2017 | 4:00 PM | 13.2 |
| January 11, 2017 | 5:00 PM | 10.2 |
| January 11, 2017 | 6:00 PM | 12.2 |
| January 11, 2017 | 7:00 PM | 11.2 |
| January 11, 2017 | 8:00 PM | 10.2 |
| January 11, 2017 | 9:00 PM | 11.0 |
| January 11, 2017 | 10:00 PM | 11.2 |
| January 11, 2017 | 11:00 PM | 12.2 |
| January 12, 2017 | 12:00 AM | 15.6 |
| January 12, 2017 | 1:00 AM | 13.0 |
| January 12, 2017 | 2:00 AM | 12.6 |
| January 12, 2017 | 3:00 AM | 12.2 |
| January 12, 2017 | 4:00 AM | 8.0 |
| January 12, 2017 | 5:00 AM | 9.6 |
| January 12, 2017 | 6:00 AM | 12.6 |
| January 12, 2017 | 7:00 AM | 7.6 |
| January 12, 2017 | 8:00 AM | 9.2 |
| January 12, 2017 | 9:00 AM | 12.0 |
| January 12, 2017 | 10:00 AM | 9.6 |
| January 12, 2017 | 11:00 AM | 10.0 |
| January 12, 2017 | 12:00 PM | 10.2 |
| January 12, 2017 | 1:00 PM | 13.2 |
| January 12, 2017 | 2:00 PM | 13.6 |
| January 12, 2017 | 3:00 PM | 11.2 |
| January 12, 2017 | 4:00 PM | 11.0 |
| January 12, 2017 | 5:00 PM | 16.6 |

| | | |
|---|---|---|
| January 12, 2017 | 6:00 PM | 10.2 |
| January 12, 2017 | 7:00 PM | 8.2 |
| January 12, 2017 | 8:00 PM | 14.0 |
| January 12, 2017 | 9:00 PM | 14.6 |
| January 12, 2017 | 10:00 PM | 14.6 |
| January 12, 2017 | 11:00 PM | 13.0 |
| January 13, 2017 | 12:00 AM | 15.0 |
| January 13, 2017 | 1:00 AM | 10.2 |
| January 13, 2017 | 2:00 AM | 14.0 |
| January 13, 2017 | 3:00 AM | 13.0 |
| January 13, 2017 | 4:00 AM | 14.6 |
| January 13, 2017 | 5:00 AM | 10.2 |
| January 13, 2017 | 6:00 AM | 9.6 |
| January 13, 2017 | 7:00 AM | 9.0 |
| January 13, 2017 | 8:00 AM | 13.2 |
| January 13, 2017 | 9:00 AM | 9.0 |
| January 13, 2017 | 10:00 AM | 12.0 |
| January 13, 2017 | 11:00 AM | 10.6 |
| January 13, 2017 | 12:00 PM | 14.2 |
| January 13, 2017 | 1:00 PM | 11.0 |
| January 13, 2017 | 2:00 PM | 12.2 |
| January 13, 2017 | 3:00 PM | 11.0 |
| January 13, 2017 | 4:00 PM | 10.6 |
| January 13, 2017 | 5:00 PM | 12.2 |
| January 13, 2017 | 6:00 PM | 11.2 |
| January 13, 2017 | 7:00 PM | 12.2 |
| January 13, 2017 | 8:00 PM | 10.2 |
| January 13, 2017 | 9:00 PM | 6.6 |
| January 13, 2017 | 10:00 PM | 10.6 |
| January 13, 2017 | 11:00 PM | 6.0 |
| January 14, 2017 | 12:00 AM | 13.2 |
| January 14, 2017 | 1:00 AM | 9.0 |
| January 14, 2017 | 2:00 AM | 12.2 |
| January 14, 2017 | 3:00 AM | 10.6 |
| January 14, 2017 | 4:00 AM | 9.2 |

# RADON REFERENCE LABORATORY

BOWSER MORNER®

## STATEMENT OF CALIBRATION

**Client Information:**
PBS Engineering & Environmental Inc.
4412 Southwest Corbett Avenue
Portland, Oregon 97239
Attn: Chris Boyce

**BMI Control Information:**
Statement No.: 17581709
Issue Date: July 25, 2016
Calibrated on: July 25, 2016
Calibrated by: JPN
Calibration site: BMI Dayton

**Description of Continuous Radon Monitor:**
**Manufacturer:** Sun Nuclear **Model:** 1027 **Serial No.:** 1407171

The monitor was found to be in good physical condition. No power adapter was received with the monitor. The calibration was conducted using an adapter belonging to Bowser-Morner.

**Initial Checks:**

| Visual Inspection | Batteries | Power Adapter | High Voltage | Software Version |
|---|---|---|---|---|
| Ok | Ok | See above | 1199 VDC (Ok) | N5A |

**Result of Background Exposure (16 hr):** 0.2 pCi/liter

**Radon Chamber Conditions:**

| Exposure Duration | Radon Concentration | Relative Humidity | Temperature |
|---|---|---|---|
| 48 hr | 25.8 ± 0.5 pCi/liter | 49.9 ± 0.5 % | 70.0 ± 0.1 °F |

The values listed above for the radon concentration, relative humidity and temperature are the means and standard deviations of the hourly average measurements of these parameters. The calibration of Bowser-Morner's Radon Monitoring System is maintained through comparisons with the USEPA radon laboratory in Las Vegas using a NIST traceable radium standard. The estimated total uncertainty of Bowser-Morner's average chamber concentration is ± 6.4% at the 95% confidence level.

**Results of Calibration:**

| Average Monitor Reading | Relative Error As Received | Relative Error After Change of Calibration Factor |
|---|---|---|
| 27.7 pCi/liter | 6.6% | -3.1% |

Based on the results of the calibration, the monitor's internal calibration factor was changed to the most accurate available setting. The background value listed above should be subtracted from the radon measurement and the result multiplied by the correction factor of 1.032.

The calibration was performed using BMI procedure number 42-001.

Authorized Signature Jill P. Newton, Manager Radon Reference Lab





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# RADON REFERENCE LABORATORY

BOWSER MORNER®

## STATEMENT OF CALIBRATION

**Client Information:**
PBS Engineering & Environmental Inc.
4412 Southwest Corbett Avenue
Portland, Oregon 97239
Attn: Chris Boyce

**BMI Control Information:**
Statement No.: 17581704
Issue Date: July 25, 2016
Calibrated on: July 25, 2016
Calibrated by: JPN
Calibration site: BMI Dayton

**Description of Continuous Radon Monitor:**
**Manufacturer:** Sun Nuclear **Model:** 1027 **Serial No.:** 1407175

The monitor was found to be in good physical condition.

**Initial Checks:**

| Visual Inspection | Batteries | Power Adapter | High Voltage | Software Version |
|---|---|---|---|---|
| Ok | Replaced | 11.1 VDC (Ok) | 1114 VDC (Ok) | N5A |

**Result of Background Exposure (16 hr):** 0.2 pCi/liter

**Radon Chamber Conditions:**

| Exposure Duration | Radon Concentration | Relative Humidity | Temperature |
|---|---|---|---|
| 48 hr | 25.8 ± 0.5 pCi/liter | 49.9 ± 0.5 % | 70.0 ± 0.1 °F |

The values listed above for the radon concentration, relative humidity and temperature are the means and standard deviations of the hourly average measurements of these parameters. The calibration of Bowser-Morner's Radon Monitoring System is maintained through comparisons with the USEPA radon laboratory in Las Vegas using a NIST traceable radium standard. The estimated total uncertainty of Bowser-Morner's average chamber concentration is ± 6.4% at the 95% confidence level.

**Results of Calibration:**

| Average Monitor Reading | Relative Error As Received | Relative Error After Change of Calibration Factor |
|---|---|---|
| 29.0 pCi/liter | 11.6% | 1.5% |

Based on the results of the calibration, the monitor's internal calibration factor was changed to the most accurate available setting. The background value listed above should be subtracted from the radon measurement and the result multiplied by the correction factor of 0.986.

The calibration was performed using BMI procedure number 42-001.

Authorized Signature Jill P. Newton, Manager Radon Reference Lab





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# RADON REFERENCE LABORATORY

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## STATEMENT OF CALIBRATION

**Client Information:**
PBS Engineering & Environmental Inc.
4412 Southwest Corbett Avenue
Portland, Oregon 97239
Attn: Chris Boyce

**BMI Control Information:**
Statement No.: 17581701
Issue Date: July 25, 2016
Calibrated on: July 25, 2016
Calibrated by: JPN
Calibration site: BMI Dayton

**Description of Continuous Radon Monitor:**
**Manufacturer:** Sun Nuclear **Model:** 1027 **Serial No.:** 1407185

The monitor was found to be in good physical condition. No power adapter was received with the monitor. The calibration was conducted using an adapter belonging to Bowser-Morner.

**Initial Checks:**

| Visual Inspection | Batteries | Power Adapter | High Voltage | Software Version |
|---|---|---|---|---|
| Ok | Ok | See above | 1118 VDC (Ok) | N5A |

**Result of Background Exposure (18 hr):** 0.1 pCi/liter

**Radon Chamber Conditions:**

| Exposure Duration | Radon Concentration | Relative Humidity | Temperature |
|---|---|---|---|
| 48 hr | 26.0 ± 0.3 pCi/liter | 48.9 ± 0.6 % | 70.0 ± 0.1 °F |

The values listed above for the radon concentration, relative humidity and temperature are the means and standard deviations of the hourly average measurements of these parameters. The calibration of Bowser-Morner's Radon Monitoring System is maintained through comparisons with the USEPA radon laboratory in Las Vegas using a NIST traceable radium standard. The estimated total uncertainty of Bowser-Morner's average chamber concentration is ± 6.4% at the 95% confidence level.

**Results of Calibration:**

| Average Monitor Reading | Relative Error As Received | Relative Error After Change of Calibration Factor |
|---|---|---|
| 29.7 pCi/liter | 13.8% | 3.5% |

Based on the results of the calibration, the monitor's internal calibration factor was changed to the most accurate available setting. The background value listed above should be subtracted from the radon measurement and the result multiplied by the correction factor of 0.966.

The calibration was performed using BMI procedure number 42-001.

Authorized Signature Jill P. Newton, Manager Radon Reference Lab





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# RADON REFERENCE LABORATORY

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## STATEMENT OF CALIBRATION

**Client Information:**
PBS Engineering & Environmental Inc.
4412 Southwest Corbett Avenue
Portland, Oregon 97239
Attn: Chris Boyce

**BMI Control Information:**
Statement No.: 17581707
Issue Date: July 25, 2016
Calibrated on: July 25, 2016
Calibrated by: JPN
Calibration site: BMI Dayton

**Description of Continuous Radon Monitor:**
**Manufacturer:** Sun Nuclear **Model:** 1027 **Serial No.:** 1407187

The monitor was found to be in good physical condition.

**Initial Checks:**

| Visual Inspection | Batteries | Power Adapter | High Voltage | Software Version |
|---|---|---|---|---|
| Ok | Replaced | 11.1 VDC (Ok) | 1130 VDC (Ok) | N5A |

**Result of Background Exposure (16 hr):** 0.0 pCi/liter

**Radon Chamber Conditions:**

| Exposure Duration | Radon Concentration | Relative Humidity | Temperature |
|---|---|---|---|
| 48 hr | 25.8 ± 0.5 pCi/liter | 49.9 ± 0.5 % | 70.0 ± 0.1 °F |

The values listed above for the radon concentration, relative humidity and temperature are the means and standard deviations of the hourly average measurements of these parameters. The calibration of Bowser-Morner's Radon Monitoring System is maintained through comparisons with the USEPA radon laboratory in Las Vegas using a NIST traceable radium standard. The estimated total uncertainty of Bowser-Morner's average chamber concentration is ± 6.4% at the 95% confidence level.

**Results of Calibration:**

| Average Monitor Reading | Relative Error As Received | Relative Error After Change of Calibration Factor |
|---|---|---|
| 28.6 pCi/liter | 10.9% | 0.8% |

Based on the results of the calibration, the monitor's internal calibration factor was changed to the most accurate available setting. The radon measurement should be multiplied by the correction factor of 0.992.

The calibration was performed using BMI procedure number 42-001.

Authorized Signature Jill P. Newton, Manager Radon Reference Lab





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# RADON REFERENCE LABORATORY

BOWSER MORNER®

## STATEMENT OF CALIBRATION

**Client Information:**
PBS Engineering & Environmental Inc.
4412 Southwest Corbett Avenue
Portland, Oregon 97239
Attn: Chris Boyce

**BMI Control Information:**
Statement No.: 17581703
Issue Date: July 25, 2016
Calibrated on: July 25, 2016
Calibrated by: JPN
Calibration site: BMI Dayton

**Description of Continuous Radon Monitor:**
**Manufacturer:** Sun Nuclear **Model:** 1027 **Serial No.:** 1407188

The monitor was found to be in good physical condition.

**Initial Checks:**

| Visual Inspection | Batteries | Power Adapter | High Voltage | Software Version |
|---|---|---|---|---|
| Ok | Replaced | 11.1 VDC (Ok) | 1103 VDC (Ok) | N5A |

**Result of Background Exposure (16 hr):** 0.1 pCi/liter

**Radon Chamber Conditions:**

| Exposure Duration | Radon Concentration | Relative Humidity | Temperature |
|---|---|---|---|
| 48 hr | 25.8 ± 0.5 pCi/liter | 49.9 ± 0.5 % | 70.0 ± 0.1 °F |

The values listed above for the radon concentration, relative humidity and temperature are the means and standard deviations of the hourly average measurements of these parameters. The calibration of Bowser-Morner's Radon Monitoring System is maintained through comparisons with the USEPA radon laboratory in Las Vegas using a NIST traceable radium standard. The estimated total uncertainty of Bowser-Morner's average chamber concentration is ± 6.4% at the 95% confidence level.

**Results of Calibration:**

| Average Monitor Reading | Relative Error As Received | Relative Error After Change of Calibration Factor |
|---|---|---|
| 27.9 pCi/liter | 7.8% | -2.1% |

Based on the results of the calibration, the monitor's internal calibration factor was changed to the most accurate available setting. The background value listed above should be subtracted from the radon measurement and the result multiplied by the correction factor of 1.021.

The calibration was performed using BMI procedure number 42-001.

Authorized Signature Jill P. Newton, Manager Radon Reference Lab





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