DAINIS AND COMPANY, INC.
PSYCHOMETRICS AND EVALUATION

AARST Radon Measurement Field Technician, Measurement Professional, Mitigation Installer and Mitigation Specialist: Job Task Analysis Report

Executive Summary

The Job Task Analysis (JTA) process for the four National Radon Proficiency Program (NRPP) exams took place over the span of six months, from August 2018 through February 2019. Overall, there were almost 400 Subject Matter Experts (SMEs) from across the United States involved in the process.

The main steps were as follows:

- JTA workshop in Indianapolis, Indiana(August 2018)
    - A two-day workshop involved 9 SMEs and the establishment of the Domains and Sub-domains of knowledge and tasks necessary to perform the job duties of Measurement Field Technician, Measurement Professional, Mitigation Installer and Mitigation Specialist.
- Validation Survey (December 2018 - January 2018)
    - A sample of 390 industry practitioners, representing all geographic and industry sectors, responded to the survey and rated sub-domains on frequency and importance.
- Finalization and Approval of Blueprints (February 2018)
    - This final step included approval of the final four blueprints by the committee members.

Appendices are included in this report containing the list of SMEs involved in the workshop and the detailed draft content outline.

Initial JTA Workshop

August, 2018
Indianapolis, Indiana

Following a general introductory session during which SMEs were led through the results of the high-level survey administered prior to the workshop, SMEs reviewed four new certification programs. Then they began in-depth discussions of each Domain. Using an iterative process, with a majority decision-rule, sub-areas of the Domains were created by the SMEs and detailed, with extensive discussion surrounding the relevance, importance, and overall impact of the knowledge and tasks on the success of the job role. Within each Sub-Domain, Knowledge / Task (KT) statements were created to cover the knowledge and tasks associated with that area of the job role.

Outcome

The group was able to revise the current Domain list, as well as detail Sub-Domains of tasks and knowledge areas required to be a minimally competent Measurement Field Technician, Measurement Professional, Mitigation Technician and Mitigation Specialist for AARST. Additionally, the group of nine SMEs were able to create a comprehensive list of knowledge and task statements (KT statements) to align with the revised Domains and Sub-Domains of the job role. The end result (attached to this summary in Appendix B) is a draft outline consisting of the following:

- Measurement Field Technician: 5 domains, 11 sub-domains
- Measurement Professional: 5 domains, 13 sub-domains
- Mitigation Installer: 6 domains, 20 sub-domains
- Mitigation Specialist: 8 domains, 24 sub-domains

Relevant Appendices:

A: List of SMEs

B: Resulting Content Outline

DAINIS AND COMPANY, INC.
PSYCHOMETRICS AND EVALUATION

JTA Validation Study

December 2018 – January 2019

Following the drafting of the Domains, Sub-Domains, and KT statements, validation surveys were administered to 390 industry practitioners. Respondents were asked to rate each sub-domain on both frequency and importance. The breakdown of years of experience for the sample is presented in the following table.

Measurement Field Technician: n=140

Years of Experience	Frequency (%)
Less than 2 years	25.0
3 to 5 years	19.3
6 to 10 years	17.1
11 to 15 years	11.4
Over 15 years	26.4

Measurement Professional: n=83

Years of Experience	Frequency (%)
Less than 2 years	20.5
3 to 5 years	20.5
6 to 10 years	14.5
11 to 15 years	9.6
Over 15 years	34.9

Mitigation Installer: n=94

Years of Experience	Frequency (%)
Less than 2 years	5.8
3 to 5 years	18.1
6 to 10 years	25.5
11 to 15 years	17.0
Over 15 years	27.7

Mitigation Specialist: n=73

Years of Experience	Frequency (%)
Less than 2 years	8.2
3 to 5 years	15.1
6 to 10 years	31.5
11 to 15 years	13.7
Over 15 years	31.5

All sub-domains were validated and kept for the final blueprint. The proportions of items to be mapped to each sub-domain were calculated by weighting the ratings, resulting in the final exam blueprint for all four (4) exams.

DAINIS AND COMPANY, INC.
PSYCHOMETRICS AND EVALUATION

Final Blueprint

February 2019

The draft blueprints were reviewed and approved by the committee on February 20, 2019.

The percentage next to the Domain title is the portion of the test content that will be mapped to the Domain. The number aligned with each Sub-Domain is the number of items on the exam that will cover that Sub-Domain.

Measurement Field Technician:

Domain 1: Communicate with the Client		16%
1.1	Communicate basic radon risks	6
1.2	Explain required test protocols	8

Domain 2: Evaluate the Test Site		24%
2.1	Determine appropriate test protocol	7
2.2	Recognize factors that could impact test results	7
2.3	Inspect existing mitigation system	6

Domain 3: Perform the Test		28%
3.1	Determine proper device placement location(s)	13
3.2	Execute field quality control measures	11

Domain 4: Keep Records		14%
4.1	Record radon test data	6
4.2	Record site data necessary for test interpretation	6

Domain 5: Operate in an Ethical/Professional Manner		18%
5.1	Comply with protocols and standards	8
5.2	Observe ethical work practices	7

Measurement Professional:

Domain 1: Communicate Basic Radon Science		18%
1.1	Communicate health risk	4
1.2	Communicate radon entry behavior	3
1.3	Recommend testing approach	5

Domain 2: Conduct and Validate Measurement Data		25%
2.1	Select appropriate test device(s)	5
2.2	Assess radon measurement data	6
2.3	Interpret site data	5

Domain 3: Report Findings and Make Recommendations		22%
3.1	Prepare a proper test report	5
3.2	Make follow-up recommendations	5
3.3	Report site factors affection radon results	4

Domain 4: Manage QA/QC Program		18%
4.1	Develop QA plan and SOPs	6
4.2	Execute QA plans	6

Domain 5: Oversee and Train Measurement Techs		17%
5.1	Determine work exposure	5
5.2	Provide tech oversight	6

Mitigation Installer:

Domain 1: Communicate with the Client		14%
1.1	Explain basic radon risk as per EPA pamphlets	5
1.2	Describe radon entry behavior	3
1.3	Describe work scope and potential hazards	4

Domain 2: Identify Radon Entry Points		17%
2.1	Identify and record construction characteristics	5
2.2	Identify radon pathways	5
2.3	Identify driving forces	4

Domain 3: Maintain Jobsite Safety		15%
3.1	Identify jobsite hazards	6
3.2	Implement jobsite safety measures	7

Domain 4: Implement Mitigation Installation Strategy		30%
4.1	Install sub-membrane system	3
4.2	Apply ASD to existing water drainage systems	3
4.3	Install sub-slab depressurization system	3
4.4	Install radon fan and vent piping	3
4.5	Seal foundation openings to improve ASB	4
4.6	Apply ASD to multiple foundations and types	3
4.7	Install ASD in new home construction	3
4.8	Labeling and documentation	4

Domain 5: Perform Post-Installation Tasks		17%
5.1	Characterize the system	7
5.2	Provide information to homeowner	7

Domain 6: Operate in an Ethical and Professional Manner		7%
6.1	Sustain ethical approach to clients	3
6.2	Sustain ethical approaches in business	3

Mitigation Specialist:

Domain 1: Communicate Basic Radon Science		9%
1.1	Communicate health risk (employee and client)	3
1.2	Communicate radon entry behavior	3

Domain 2: Evaluate Pre-Mitigation Measurement		8%
2.1	Evaluate pre-mitigation tests and perform diagnostics	5

Domain 3: Design Radon Mitigation System		25%
3.1	Design sub-slab depressurization system	3
3.2	Design sub-membrane depressurization system	2
3.3	Design crawlspace depressurization system	2
3.4	Design ASD connected to drainage system	2
3.5	Design fan and piping system	3
3.6	Design soil pressurization system	1
3.7	Design block wall depressurization systems	1
3.8	Design residential mitigation systems in new construction	2

Domain 4: Validate Post-Installation Data		12%
4.1	Ensure post-mitigation radon test is performed to verify effectiveness	3
4.2	Conduct PFE and airflow tests to verify performance	3
4.3	Construct OM&M plan	2

Domain 5: Troubleshooting System Problems / Implement Corrective Actions		17%
5.1	Identify airflow and PFE limitations	4
5.2	Review hourly radon data for failure caused by external conditions	3
5.3	Identify untreated foundation areas as contributing radon sources	4

Domain 6: Develop / Maintain Worker Health and Safety Plan		8%
6.1	Establish radon exposure plan	3
6.2	Develop and implement jobsite safety plan	2

Domain 7: Maintain Mitigation Quality Assurance Plan		12%
7.1	Maintain job installation records	3
7.2	Maintain employee records	2
7.3	Manage staff training	3

Domain 8: Operate in an Ethical/Professional Manner		9%
8.1	Sustain ethical approach to clients	3
8.2	Sustain ethical approaches in business	3

Appendix A: SMEs Involved in JTA Workshop

NAME	COMPANY	LOCATION
David Daniels	Radon Specialist of WI	Neenah, WI
Fred Ellrott	Radon Be Gone	Somis, CA
Gary Hodgden	Midwest Radon	Olathe, KS
Kyle Hoylman	Protect Environmental	Louisville, KY
Dave Kapturowski	RadonAway	Ward Hill, MA
Doug Kladder	Center for Environmental Research & Technology, Inc. (CERTI)	Colorado Springs, CO
Tony McDonald	A-Z Solutions	North Canton, OH
Calvin Murphy	Allied Radon	Mount Vernon, IL
Gil Ward	Advanced Home Solutions	Plainfield, IN

Appendix B: Content Outline including KT Statements

Measurement Field Technician:

	Domain and Sub-Domains	
1	**Communication with the Client**	
1.1	**Communicate Basic Radon Risk** (as per EPA Homeowner and Homebuyer publications)	
	1.1.1	Explain radon as a long-term cause of lung cancer
	1.1.2	Interpret EPA Radon Risk tables
	1.1.3	Explain where radon comes from
	1.1.4	Clarify underlying geology as primary source of radon
	1.1.5	Describe how radon enters a house/building
	1.1.6	Explain the basis of radon health risk
	1.1.7	Describe the abbreviated Radon Decay Series
	1.1.8	Explain homes are fixable by an NRPP certified contractor
	1.1.9	Describe the variability of radon levels from house-to-house
	1.1.10	Explain seasonal effects - different climates
	1.1.11	Describe how radon/RDPs enter the lungs
	1.1.12	Know the effect of alpha damage to lung cells -
	1.1.13	Know there is little impact on other organs such as skin, etc.
	1.1.14	Relay the Surgeon General's Recommendation
	1.1.15	Understand occupational exposure guidance
	1.1.16	Explain risk exists below 4 pCi/L (not a health-based action level)
	1.1.17	Describe method homes are typically fixed -ASD
1.2	**Explain Required Test Protocols**	
	1.2.1	Explain pretest requirements for ST tests
	1.2.2	Describe test set-up and required protocol for short-term test
	1.2.3	Describe protocols required for long-term test
	1.2.4	Provide anti-tampering advisement
	1.2.5	Provide written instructions and place notices
	1.2.6	Explain logic of test conditions and location (basement vs 1st floor)
	1.2.7	Define responsibilities of the occupant and/or agent
	1.2.8	Establish proper test durations and arrange retrieval times
	1.2.9	Provide non-interference agreement for signature
2	**Evaluate the Test Site**	
2.1	**Determine Appropriate Test Protocol**	

	2.1.1	Choose simultaneous short-term when appropriate
	2.1.2	Know EPA sequential ST option for homeowners
	2.1.3	Know when to collect data in hourly increments (CM)
	2.1.4	Understand the purpose of short-term measurements, i.e. potential
	2.1.5	Determine how to maintain closed-building conditions
	2.1.6	Ensure closed-building pre-test conditions (as per Table 5 of MAH)
	2.1.7	Execute minimum/maximum deployment duration for Short-Term tests
	2.1.8	Execute minimum/maximum deployment duration Long-term tests
	2.1.9	Distinguish between required building conditions for Long-term vs. Short-term tests
	2.1.10	Understand precedence of Long-term over Short-Term test results
	2.1.11	Know when and when not to test (e.g., not on weekends for schools. not unusual/severe weather
2.2	**Recognize Factors that Could Impact Test Results**	
	2.2.1	Identify when radon in water may be a concern
	2.2.2	Identify sumps and drainage systems and effect on entry
	2.2.3	Recognize mechanical system types and their effects on radon entry
	2.2.4	Identify buried ductwork and effect on radon results
2.3	**Inspect Existing Mitigation System**	
	2.4.1	Check for proper pipe installation (slope, pipe materials,supports)
	2.4.2	Check for proper fan location
	2.4.3	Inspect electrical connection and disconnects
	2.4.4	Verify proper discharge point
	2.4.5	Check for proper performance indicator
	2.4.6	Verify labeling and system documentation
3	**Perform the Test**	
3.1	**Determine Proper Device Placement Location(s)**	
	3.1.1	Decide to test over which foundation type(s) (over slab, over crawl, in basement)
	3.1.2	Choose appropriate floor to test (as per Section 4.0 MAH)
	3.1.3	Choose device location within a room (as per Table 4.3 MAH)
	3.1.4	Know what a testable room is (occupied vs. occupiable)
	3.1.5	Identify and manage factors that may interfere with test
	3.1.6	Maintain required distance from other objects or test devices
	3.1.7	Adhere to minimum sampling times (short-term and long-term)
	3.1.8	Choose additional test locations for large open areas (e.g. greater than 2,000 sq ft)

3.2	**Execute Field QC Measures**	
	3.2.1	Inspect passive devices for damage when unpacking
	3.2.2	Perform routine instrument checks with CRs
	3.2.3	Deploy duplicate or comparison devices at frequency required by protocol
	3.2.4	Perform semi-annual crosschecks with CRs
	3.2.5	Execute proper placement of duplicates (4 inches apart)
	3.2.6	Understand the purpose of blanks
	3.2.7	Deploy field blanks at frequency required by protocol
	3.2.8	Deploy office blanks as per QA plan
	3.2.9	Deploy tamper-detection methods
4	**Keep Records**	
4.1	**Record Radon Test Data**	
	4.1.1	Maintain chain of custody log
	4.1.2	Record Start/Stop dates and times
	4.1.3	Identify deviations/violations of standard(s) and communicate
	4.1.4	Record device ID numbers of devices (regular and QC devices)
	4.1.5	Record property identifier e.g., address, etc.
4.2	**Record Site Data Necessary for Test Interpretation**	
	4.2.1	Record building specific items identified during site evaluation
	4.2.2	Record Weather conditions during test
	4.2.3	Record tamper indications
5	**Operate in an Ethical and Professional Manner**	
5.1	**Comply with Protocols/Standards**	
	5.1.1	Know what protocols are applicable to test being conducted
	5.1.2	Never falsify data collected
	5.1.3	Know state requirements have precedence over NRPP requirements
	5.1.4	Report deviations and concerns to your Measurement Professional
5.2	**Observe Ethical Work Practices**	
	5.2.1	Work within limits certification limits – meaning tasks covered in other NRPP certifications
	5.2.2	Do not prepare or report final results (responsibility of Meas Pro)
	5.2.3	Only deploy devices you have been trained to use
	5.2.4	Do not delegate device deployment or retrieval to uncertified individuals/agents
	5.2.5	Refrain from speaking of other certified radon professionals in a manner that diminishes profession or service in eyes of the public
	5.2.6	Do not engage in conduct detrimental to the reputation or best interests of the NRPP

DAINIS AND COMPANY, INC.
PSYCHOMETRICS AND EVALUATION

Measurement Professional:

	Domain and Sub-Domain	
1	**Communicate Basic Radon Science**	
1.1	**Communicate Health Risk (to employees and client)**	
	1.1.1	Distinguish units of measure-Radon: Bq/m3 and pCi/L
	1.1.2	Explain the Linear No-Threshold Risk Model
	1.1.3	Distinguish radon exposure as a cumulative vs acute Risk
	1.1.4	Know the WHO Action Level of 100 Bq/m3 - relationship to 4 pCi/L (2.7)
	1.1.5	Review of other country's Action Levels (i.e. Canada at 200 Bq/m3)
	1.1.6	Understand radon as a Group A Carcinogen
	1.1.7	Convey an overview of Epidemiological Studies
	1.1.8	Understand alpha particle/decay basics
	1.1.9	Explain abbreviated U-238 decay series and types of radiation emitted
	1.1.10	Understand the decay of short-lived RDPs
	1.1.11	Distinguish relative penetrating power of ionizing radiation vs beta and gamma
	1.1.12	Know Half-Life of Radon
	1.1.13	Know how decay causes ionization
	1.1.14	Distinguish relative penetrating power of alpha, beta and gamma
1.2	**Communicate Radon Entry Behavior**	
	1.2.1	Know the influence of extreme weather conditions
	1.2.2	Know the influence of building and foundation types
	1.2.3	Interpret and explain limitations of the EPA Zone Map
	1.2.4	Know what common geological factors that affect radon source and entry
1.3	**Recommend Testing Approach**	
	1.3.1	Know when to recommend short-Term or long-Term
	1.3.2	Distinguish between real estate vs occupied testing situations
	1.3.3	Know when a home should be retested (additions, HVAC changes, etc.)
	1.3.4	Understand importance of new construction testing
	1.3.5	Know protocol for Post-Mitigation testing
	1.3.6	Explain lack of feasibility of soil tests for new homes
	1.3.7	Know when follow-up measurements are advised
2	**Conduct and Validate Measurement Data**	
2.1	**Select Appropriate Test Device(s)**	
	2.1.1	Distinguish Time Characteristics Integrating/Continuous
	2.1.2	Distinguish attributes of Active vs Passive Devices

	2.1.3	Distinguish attributes of Radon vs RDP Measurements
	2.1.4	Know benefits of Short-Term vs Long-Term
	2.1.5	Recognize the definition of an NRPP Approved Device
	2.1.6	Distinguish LLD and Minimum Detectable Concentration
	2.1.7	Understand concepts of sensitivity and counting efficiency
	2.1.8	Recognize number of devices needed in large areas (2,000 sq. ft. or larger)
2.2	**Assess Radon Measurement Data**	
	2.2.1	Recognize significance of standard deviation when interpreting results
	2.2.2	Know when to and not to average measurements
	2.2.3	Know when to throw out a collocated pair (2x rule when duplicate results straddle 4)
	2.2.4	Identify indications of possible device malfunction/electronic interference
2.3	**Interpret Site Data**	
	2.3.1	Recognize large subgrade pathways-Karst, air shafts, sink holes
	2.3.2	Correlate spike in radon to timing of an environmental or operational event
	2.3.3	Determine impact of leaky ductwork
	2.3.4	Identify signs of tampering
	2.3.5	Understand impact of stack effect changes on radon entry
	2.3.6	Identify significance of environmental factors (severe weather)
	2.3.7	Understand radon distribution within residences; Room-to Room and Floor-to-Floor
	2.3.8	Recognize when RN in water should be tested for (i.e., groundwater supply)
	2.3.9	Calculate assumed contribution of Rn from water in indoor radon measurements, 10:000 1 rule
	2.3.11	Distinguish between advective, diffusion, emanation, and Rn from H2O
	2.3.12	Recognize different foundations pathways
	2.3.13	Identify HVAC related trends from CRM data
	2.3.14	Identify non-compliance of radon mitigation system with standards and local codes
3	**Report Findings and Make Recommendations**	
3.1	**Prepare a Proper Test Report**	
	3.1.1	Include required elements of a Radon Report (MAH)
	3.1.2	Know who receives report (maintaining client confidentiality)
	3.1.3	Understand significant figures (i.e., 1 decimal point)
	3.1.4	Know when and how to average results

	3.1.5	Identify protocol deviations
	3.1.6	Note conditions that existed at the time of the test that may affect future test results
3.2	**Make follow-up Recommendations**	
	3.2.1	Recommend confirmatory testing when appropriate
	3.2.2	Make mitigation recommendation based upon EPA Cit Guide or Real estate Guide
	3.2.3	Recommend mitigation between 2 and 4 pCi/L as a precaution
	3.2.4	Retest at least every 5 years and after major modifications to home (additions, HVAC, etc.)
3.3	**Report Site Factors Affecting Radon Results**	
	3.3.1	Include presence and condition of radon mitigation system
	3.3.2	Include presence and condition of unique ventilation systems
	3.3.3	Advise future retesting after mitigation
4	**Manager QA/QC Program**	
4.1	**Develop QA Plan and SOPs**	
	4.1.1	Define terms: accuracy, precision, and bias
	4.1.2	Know purpose of Blank, Duplicates and Spikes
	4.1.3	Define background measurements
	4.1.4	Know when and where devices are calibrated
	4.1.5	Perform comparison checks as needed
	4.1.6	Specify numbers and frequency of QA devices
	4.1.7	Define pre-determined corrective actions
4.2	**Execute QA Plan**	
	4.2.1	Calculate RPD of duplicates
	4.2.2	Use and Interpret Duplicate Control Charts (which one to use)
	4.2.3	Distinguish when duplicates are out of control
	4.2.4	Apply side-by-side devices in real estate tests towards QC
	4.2.5	Use Control Charts for blanks
	4.2.6	Compare blank result to MDC
	4.2.7	Calculate RPE of spikes as compared to chamber value
	4.2.8	Use Spike Charts
	4.2.9	Recognize when accuracy (via spikes) is out of control
	4.2.10	Ensure calibrations are performed at required frequency at NRPP-Approved STAR
	4.2.11	Perform Device Performance Test(s)
	4.2.12	Maintain records the required number of years
5	Oversee and Train Measurement Techs	
5.1	Determine worker exposure	

	5.1.1	Recognize factors affecting Eq Factor
	5.1.2	Calculate exposure in WLM/year or pCi/L/days
	5.1.3	Convert radon measurement to WL (Equilibrium equation)
	5.1.4	Compare worker exposure to acceptable guidance
	5.1.5	Maintain records for worker exposure
5.2	Provide Tech Oversight	
	5.2.1	Be responsible for performance of calibrations, DPTs, blanks, spikes, duplicates and crosschecks
	5.2.2	Be responsible for ensuring each Field Technician completes device specific training
	5.2.3	Create and Review Monitor chain-of-custody logs

DAINIS AND COMPANY, INC.
PSYCHOMETRICS AND EVALUATION

Mitigation Installer:

	Domains and Sub-Domains	
1	**Communicate to the Client**	
1.1	**Explain Basic Radon Risk as per EPA Documents**	
	1.1.1	Explain how radon/RDPs enter the lungs
	1.1.2	Describe effect of alpha damage to lung cells
	1.1.3	Explain there is little impact on other organs such as skin, etc.
	1.1.4	Explain risks exists below 4 pCi/L (not a health based guidance)
	1.1.5	Interpret the EPA Risk Chart-Citizens Guide
	1.1.6	Relay Surgeon General's Recommendation of 4.0 pCi/L
	1.1.7	Understand alpha particle/Decay
	1.1.8	Describe impact of short-lived RDPs
1.2	**Describe Radon Entry Behavior**	
	1.2.1	Explain seasonal Effects-Different Climates
	1.2.2	Know influence of building and foundation types
	1.2.3	Describe underlying geology as primary source
	1.2.4	Explain house-to-house variations happen
1.3	**Describe Work Scope and Potential Hazards**	
	1.3.1	Explain concept of ASD
	1.3.2	Describe specific work plan
	1.3.3	Describe potential hazards and identify occupant sensitivities
	1.3.4	Explain the OM&M Plan
2	**Identify Radon Entry Points**	
2.1	**Identify and Record Construction Characteristics**	
	2.1.1	Recognize wood foundations and highly permeable capillary breaks
	2.1.2	Identify hidden foundation areas
	2.1.3	Identify chases/balloon walls
	2.1.4	Recognize different foundation types
2.2	**Identify Radon Pathways**	
	2.2.1	Identify water source as potential radon entry point
	2.2.2	Note foundation openings such as sumps, caissons, foundation drains
	2.2.3	Recognize passive solar construction and impact on radon entry
2.3	**Identify Driving Forces**	
	2.3.1	Recognize buried return ducts and openings under FAU
	2.3.2	Know impact of leaky ductwork
	2.3.3	Recognize effect of mechanical equipment (e.g. Evaporative Coolers and ERVs)
3	**Maintain Job Safety**	

3.1	**Identify Jobsite Hazards**	
	3.1.1	Identify suspected asbestos-containing materials, lead paint, etc.
	3.1.2	Identify potential hantavirus concerns
	3.1.3	Detect existing electrical hazards or limited circuits
	3.1.4	Identify confined spaces
	3.1.5	Note structural concerns
	3.1.6	Locate building water shut-off
	3.1.7	Identify potential of post-tension slabs
	3.1.8	Pinpoint underslab hazards such as piping, heating lines, etc.
	3.1.9	Detect evidence of varmints, rodents, spiders, snakes etc. in work area
3.2	**Implement Jobsite Safety Measures**	
	3.2.1	Safely use and secure ladders
	3.2.2	How to limit radon exposure
	3.2.3	How to ventilate the workspace
	3.2.4	Know what the Occupational Radon Exposure limits are
	3.2.5	Be familiar with emergency contacts
	3.2.6	Have and know how to use First Aid Kit onsite
	3.2.7	Know how to read Safety Data Sheets - provide when and to whom
	3.2.8	Use PPE-Safety glasses, clothing, hearing protection gloves dust masks
	3.2.9	Maintain integrity of electrical cords and grounding
4	**Implement Mitigation Installation Strategy (as per ANSI-AARST SMG-SF Standard)**	
4.1	**Install sub-membrane system**	
	4.1.1	Prepare the foundation walls
	4.1.2	Address drainage concerns (i.e. relief for plumbing leaks)
	4.1.3	Properly attach and seal to the wall
	4.1.4	Overlap seams and seal
	4.1.5	Understand degree of sealing needed
	4.1.6	Address passive sub-membrane ballooning
	4.1.7	Work with foundation wall insulation
	4.1.8	Deal with appliances in crawlspace
	4.1.9	Attach membrane to rough/stone foundation walls
4.2	**Apply ASD to Existing Water Drainage Systems**	
	4.2.1	Choose or design lid for sump depressurization
	4.2.2	Know the specs for homemade sump lids
	4.2.3	Allow for surface drainage (P-Traps)
	4.2.5	Know purpose of non-radon pipes running into sumps and how to deal with them
	4.2.6	Properly connect vent pipe to sump lid

	4.2.7	Deal with pedestal sump pumps
	4.2.8	Maintain sump's ability to function
	4.2.9	Address/utilize perimeter drains (interior and exterior)
	4.2.10	Understand drain boards; Channel and canal drains
	4.2.11	How to connect vent pipe to drain system without impeding water collection
	4.2.12	Know how to address daylight ends
	4.2.13	Deal with window well drains and area drains
	4.2.14	Maintain functionality of drain
4.3	**Install Sub-Slab System**	
	4.3.1	Understand SSD concepts
	4.3.2	Determine optimal suction point location
	4.3.3	Know how to make a proper suction pit and how its size affects performance
	4.3.4	Know vent pipe-to-slab connection options
	4.3.5	Address obstacles, such as grade beams and inconsistent fill
	4.3.6	Avoid sub slab hazards
	4.3.7	Know how to connect multiple suction points
	4.3.8	Know methods for extending PFE (additional Suction Points, gophering, etc.)
4.4	**Install Radon Fan and Vent Piping**	
	4.4.1	Properly locate termination point
	4.4.2	Prevent varmint entry
	4.4.3	Properly penetrate the roof
	4.4.4	Choose suitable location for performance indicators
	4.4.5	Properly install various U-tube Types - prevent condensation in tubing
	4.4.6	Instalation and interpretation of amperage style performance indicator
	4.4.7	Distinguish between pipe materials - (PVC/ABS)
	4.4.8	Effectively use and connect downspout material for exterior vents
	4.4.9	Safely and effectively use PVC primer and glue
	4.4.10	How to connect radon fan to radon vent pipe (i.e. type of connectors)
	4.4.11	Apply positive slope back to suction points
	4.4.12	Know protocol for pipe supports (vertical and horizontal)
	4.4.13	Properly locate fan (i.e. outside living space and distance from other hazards)
	4.4.14	Plan access to fans in attics (near access or catwalks)
	4.4.15	Avoid damaging structural members
	4.4.16	Know what constitutes a firewall and how a fire collar is installed
	4.4.17	Respect the need for Electrical Permit

	4.4.18	Know protocol for electrical disconnects
	4.4.19	Avoid routing radon vent pipe through rated air plenums
	4.4.20	Properly route electrical wiring (e.g., not inside pipe)
	4.4.21	Properly orient the fan
4.5	**Seal Foundation Openings to Improve ASD**	
	4.5.1	Use smoke to identify locations that need sealing
	4.5.2	Seal/gasket sump lids to allow future access
	4.5.3	Choose proper caulk to be used for slabs
	4.5.4	Use backer rod as needed when sealing slab openings
	4.5.5	Seal utility penetrations
	4.5.6	Seal daylight end of perimeter drain without compromising drainage
	4.5.7	Seal canal drains
	4.5.8	Seal floor to wall joints cold and expansion type
	4.5.9	Seal/foam wall entry penetrations
	4.5.10	Seal floor drains as needed and without interfering with drainage
	4.5.11	Use traps on sump lids for gravity or surface drainage or on condensate drains
	4.5.12	Seal plumbing block outs
	4.5.13	Seal block walls (sill plates, foams)
4.6	Apply ASD to Multiple Foundations and Types	
	4.6.1	Connect SMD with SSD
	4.6.2	Connect SSD with Drainage System
	4.6.3	Connect different slab elevations
	4.6.4	Understand the concept of Block wall Depressurization
	4.6.5	Know how to use jumpers and Interconnection to other walls when applying BWD
	4.6.6	Know the impact of bond beams in Block Wall Depressurization
4.7	**Install ASD in New Home Construction**	
	4.7.1	Understand approach of passive to active
	4.7.2	Apply interim labeling
	4.7.3	Apply special system label for passive systems
	4.7.4	Properly route vent pipe through interior
	4.7.5	Allow space for future fan installation (for passive-in only)
	4.7.6	Maintain drainage of sub-slab soil collectors when grade changes
4.8	**Labeling and Documentation**	
	4.8.1	Apply permanent system label - wording and location
	4.8.2	Label Power Panel
	4.8.3	Label the Sump
	4.8.4	Label the membrane at crawlspace access point

	4.8.5	Label vent pipe at protocol locations and frequency
	4.8.6	Label exterior systems
	4.8.7	Apply temporary label on stub-up riser in new home construction
	4.8.8	Annotate U-tube reading on label and documentation
5	**Perform Post-Installation Tasks**	
5.1	**Characterize the System**	
	5.1.1	Perform sub-slab pressure field measurements with micro manometer
	5.1.2	Read and record system performance indicator reading
	5.1.3	Measure airflow in vent system
	5.1.4	Record system description for O&M Plan
	5.1.5	Conduct backdraft test of combustion appliances
5.2	**Provide information to homeowner**	
	5.2.1	Include component warranties
	5.2.2	Advise client to ventilate area if caulk, glue vapors until they dissipate
	5.2.3	Include instructions for post-installation testing (as provided by Specialist)
6	**Operate in an Ethical and Professional Manner**	
6.1	**Sustain Ethical Approach to Clients**	
	6.1.1	Address client's concern for installation aesthetics
	6.1.3	Respect the homeowner's belongings
	6.1.4	Refrain from speaking of other certified radon professionals in a manner that diminishes the profession or service in the eyes of the public
6.2	**Sustain Ethical Approaches in Business**	
	6.1.2	Do not perform work such as electrical you are not certified or licensed to perform.
	6.1.5	Do not engage in conduct detrimental to the reputation or best interests of the NRPP

Mitigation Specialist:

	Domains and Sub-Domains	
1	**Communicate Basic Radon Science**	
1.1	**Communicate Health Risk (employee and client)**	
	1.1.1	Understand change in # Protons within nucleus
	1.1.2	Explain abbreviated U-238 decay series
	1.1.3	Explain Linear-no-Threshold Model as basis
	1.1.4	Distinguish radon as a cumulative vs acute risk
	1.1.5	Explain radon as a Group-A Carcinogen
	1.1.6	Describe variation of effect on different groups, i.e. smokers, children, women, etc.
	1.1.7	Distinguish the units of Rn measure: Bq/m3 and pCi/L
	1.1.8	Clarify WHO Action Level of 100 Bq/m3 and relationship to 4 pCi/L (2.7)
	1.1.9	Be able to convey other country's guidance levels (i.e. Canada at 200 Bq/m3)
	1.1.10	Explain alpha particle/decay
	1.1.11	Describe Half-Life of Radon
	1.1.12	Convey overview of epidemiological studies
	1.1.13	Distinguish the relative penetrating power of ionizing radiation vs beta, gamma
1.2	**Communicate Radon Entry Behavior**	
	1.2.1	Calculate assumed contribution of Rn from water in indoor radon measurements, 10:000 1 rule
	1.2.2	Identify when radon-in-water may be a concern
	1.2.3	Distinguish between advective, diffusion, emanation and Rn from H2O
	1.2.4	Describe radon distribution within residential buildings (Room-to-Room and Floor-to-Floor)
	1.2.5	Explain large subgrade pathways-Karst, air shafts, sink holes
	1.2.6	Correlate and explain spike in radon to timing of an environmental or operational event
	1.2.7	Understand and explain impact of stack effect changes on radon entry
	1.2.8	Detail effect of Environmental Factors (wind, etc.)
	1.2.9	Explain effect of mechanical ventilation
2	**Evaluate Pre-Mitigation Measurements**	
	2.2.1	Know protocols for simultaneous short-term test
	2.2.2	Know protocols for sequential Short-term test
	2.2.3	Recognize protocols for hourly increments with CR
	2.2.4	Determine if device was located in an appropriate room: occupiable/level/location within room
	2.2.5	Identify minimum/maximum test duration (short-term and long-term)

	2.2.6	Understand requirements for closed-building conditions
	2.2.7	Understand precedence of Long-term over Short-Term
	2.2.8	Distinguish time characteristics for grab samples/time-integrating devices/continuous monitors
	2.2.9	Determine if test was conducted by an NRPP certified/State licensed person
	2.2.10	Determine if measurement device was an NRPP approved device
	2.2.11	Recommend a retest if a non-NRPP certified device was utilized to determine the need for mitigation
3	**Design Radon Mitigation System**	
3.1	**Design Sub-Slab Depressurization System**	
	3.1.1	Calculate differential pressure needed to overcome stack and mechanical effects as a function of climate zone, building height, etc.
	3.1.2	Estimate airflow needs from vacuum cleaner test
	3.1.3	Identify need for multiple suction points
	3.1.4	Identify barriers to sub-slab communication
	3.1.5	Recognize sub-slab hazards (electrical, heat pipes) use of IR
3.2	**Design Sub-Membrane Depressurization System**	
	3.2.1	Select membrane type (Durability, flame spread, etc)
	3.2.2	Select soil gas collector type
	3.2.3	Design interconnections of vent piping for multiple crawlspaces
3.3	**Design Crawlspace Depressurization System**	
	3.3.1	Treat inaccessible crawlspaces and non-habitable, isolatable spaces
	3.3.2	Identify potential interaction with building appliances
	3.3.3	Determine fan location and vent discharge point
	3.3.4	Avoid negative impact on plumbing and HVAC ductwork
	3.3.5	Specify sealing of floor assemblies
	3.3.6	Specify balancing system to reduce air loss
	3.3.7	Stipulate placarding/labeling
	3.3.8	Recognize and design means to avoid long-term failure
	3.3.9	Avoid impact on occupied spaces (e.g., combustion appliance spillage)
	3.3.10	Design airflow-based performance indicator
3.4	**Design ASD Connected to Drainage System**	
	3.4.1	Understand impact of interceptors or connections to storm drains
	3.4.2	Address excess air leakage from downspouts, window well drains and area drains
3.5	**Design Fan and Piping System**	
	3.5.1	Estimate piping size from diagnostics
	3.5.2	Determine fan location when no attic exists
	3.5.3	Select proper fan from diagnostic data and fan curves
	3.5.4	Know when to specify low voltage Class-II wiring systems

	3.5.5	Know where appliance cords can/can't be used
	3.5.6	Estimate power consumption (amps to watts to annual cost)
	3.5.7	Specify need for electrical disconnects
	3.5.8	Determine fan distance from mechanical equipment (gas relief valves, etc.)
	3.5.9	Specify performance indicator -U-tube; pressure sensor; ammeter, electrical
	3.5.10	Select appropriate pipe routing and termination points
	3.5.11	Minimize system noise
	3.5.12	Select appropriate pipe material, schedule and size
	3.5.13	Minimize effects of freezing
	3.5.14	Control condensation on exterior surface of radon vent piping
3.6	**Design Soil Pressurization System**	
	3.6.1	Determine when and where applicable (permeable soils)
	3.6.2	Ensure air source comes from outdoors
	3.6.3	Know how and when to conduct appropriate post-mitigation test
	3.6.4	Detail failure mechanisms
3.7	**Design Block wall Depressurization Systems**	
	3.7.1	Conduct block wall vacuum cleaner tests to identify PFE
	3.7.2	Identify airflow connection between walls
	3.7.3	Select sealing method for open courses
	3.7.4	Specify how to bridge across pilasters, bond beams etc.
3.8	**Design Residential Mitigation Systems in New Construction**	
	3.8.1	Selection of sub-grade collection method (aggregate, vs perf pipe, vs soil gas mats)
	3.8.2	Estimate airflow requirements
	3.8.3	Select method for interconnecting multiple foundation areas
	3.8.4	Specify vapor barrier-where needed and where to seal
	3.8.5	Select between foundation drains or separate system as soil gas collector
	3.8.6	Specify where fire collars are needed
	3.8.7	Assure there is access to fans in attics (catwalks)
	3.8.8	Design sub-grade interconnections between grade beams
	3.8.9	Specify Method and timing for post-construction testing
4	**Validate Post-Installation Data**	
4.1	**Ensure Post-mitigation Radon Test is Performed to Verify Effectiveness**	
	4.1.1	Recommend independent post-mitigation radon test
	4.1.2	Specify timing for Post-Mitigation testing
	4.1.3	Evaluate post-mitigation test data when applicable
4.2	**Conduct PFE and Airflow Tests to Verify Performance**	
	4.2.1	Calculate air flows from velocity measurements
	4.2.2	Calibrate and interpret pressure field measurement devices

	4.2.3	Perform differential pressure measurements across slab
4.3	**Construct OM&M Plan**	
	4.3.1	Provide system description and diagram/photos
	4.3.2	Explain System Performance Indicator
	4.3.3	Provide advice for periodic retesting
	4.3.4	Include contact info for maintenance
	4.3.5	Clearly describe radon warranty
	4.3.6	Clearly describe mechanical warranties
	4.3.7	Clearly define post-installation service agreements
	4.3.8	Identify items that may adversely affect system effectiveness
	4.3.9	Identify other building equipment that may have benefitted radon reduction and should be maintained
	4.3.10	Include contact information for the state radon program
	4.3.11	Provide installer info, name, NRPP Certificate number
	4.3.12	Include copies of requisite building permits
5	**Troubleshoot System Problems / Implement Corrective Actions**	
5.1	**Identify Airflow and PFE Limitations**	
	5.1.1	Measure system airflows
	5.1.2	Determine air flow limitations (fan selection from curves, pipe size limitations)
	5.1.3	Correlate U-tube reading to fan curve
	5.1.4	Locate foundation openings or connections to other building systems that may be causing excess air flow
	5.1.5	Identify obstructions in ASD system
	5.1.6	Conduct pressure field measurements with micro manometer and smoke
	5.1.7	Identify non-soil radon sources (e.g. building materials)
5.2	**Review Hourly Radon Data for Failure Caused by External Conditions**	
	5.2.1	Correlate hourly radon measurements to weather conditions
	5.2.2	Correlate hourly radon measurements to occupant activities
	5.2.3	Identify intermittent power losses
	5.2.4	Identify intermittent airflow surges from wind, Karst and high geologic permeability situations
	5.2.5	Correlate hourly radon levels to operation of mechanical systems
5.3	**Identify Untreated Foundation Areas as Contributing Radon Source**	
	5.3.1	Determine if garages and adjacent porches/stoop are contributing radon and must be treated
	5.3.2	Determine if homes forced air system is importing radon via sub grade ductwork or FAU cabinet openings.
6	**Develop / Maintain Worker Health and Safety Plan**	
6.1	**Establish Radon Exposure Plan**	
	6.1.1	Know the definition of a Working Level

	6.1.2	Understand the Equilibrium Factor (ratio) and equation
	6.1.3	Recognize factors affecting Eq Factor
	6.1.4	Calculate WLM and worker exposure
	6.1.5	Understand occupational exposure limits (4 WLM/year and 1 WLM/year or 5700 pCi/L-Days)
	6.1.6	Specify protective measures when working in areas of elevated Rn concentrations
	6.1.7	Retain exposure records (20 Years unless required longer by other agencies)
6.2	**Develop and Implement Jobsite Safety Plan**	
	6.2.1	Provide Safety Data Sheets to employees & clients
	6.2.2	Review Safety Data Sheets and Safety Plan with installer(s) on annual basis
	6.2.3	Retain records (5 Years unless required longer by other agencies)
7	**Maintain Mitigation Quality Assurance Plan**	
7.1	**Maintain Job-Installation Records**	
	7.1.1	Maintain Copy of individual site O&M Plan
	7.1.2	Maintain all valid radon pre and post radon measurements
	7.1.3	Retain installation record for minimum of 5 years
7.2	**Maintain Employee Records**	
	7.2.1	Retain employee Radon Records for 20 years
	7.2.2	Retain employee job site incident reports for 20 years
	7.2.3	Maintain records of individuals receiving safety training
	7.2.4	Track employee training/certification requirements for each employee
	7.2.5	Ensure employees and subcontractors hold appropriate licenses and certifications for the work they perform
7.3	**Manage Staff Training**	
	7.3.1	Establish and conduct periodic reviews of procedures
	7.3.2	Conduct initial and regularly scheduled safety training sessions for employees and sub contractors
8	**Operate in an Ethical and Professional Manner**	
8.1	**Sustain Ethical Approach to Clients**	
	8.1.1	Recommend independent post-mitigation test
	8.1.2	Disclose potential conflict of interest if mitigating same house you tested
8.2	**Sustain Ethical Approaches in Business**	
	8.2.1	Ensure required permits are obtained prior to commencing work
	8.2.2	Do not exceed the capabilities of your certification