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Job Task Analysis
Blast Protection Professional

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Job Task Analysis

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Executive Summary

This report describes the process for and results of a comprehensive job task analysis (JTA) for Blast Protection Professionals (BPPs). This study was performed by Professional Testing, Inc. on behalf of Karagozian and Case, Inc. and the National Institute of Building Sciences under contract to the Department of Defense Combating Terrorism Technical Support Office. The Developing a Curriculum (DACUM) chart, which identifies the competencies (i.e., domains, tasks, and associated knowledge, skills and abilities) required to perform the job, was initially developed by a representative panel of practitioners (i.e., collectively referred to as the Commerical Workforce Credentialing Council (CWCC) BPP JTA Committee) during a meeting held on April 18 – 20, 2017, in Washington, DC. After the job tasks and associated knowledge were identified, a validation survey was conducted of the JTA findings and the results of the validation study were reviewed by the JTA Committee during a series of three webinars. The JTA Committee finalized the JTA and recommended content weightings that form the examination blueprint for the BPP based on the survey results.

Once the JTA was finalized by the JTA Committee, it was reviewed and used by the CWCC BPP Certification Scheme Committee to develop the BPP Certification Scheme.

Upon completion of the BPP Certification Scheme, the CWCC Blast Protection Board of Advisors reviewed the BPP JTA and recommended several minor changes to task and sub-task (i.e., step) wording that were subsequently reviewed and approved by the JTA Committee. The CWCC Board of Direction then approved the final BPP JTA for release. With that approval, the BPP JTA is available to the public from the CWCC web site at www.nibs.org/cwcc.

Acronyms

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing and Materials
BPBOA	Blast Protection Board of Advisors
BPP	Blast Protection Professional
CTTSO	Combating Terrorism Technical Support Office
CWCC	Commercial Workforce Credentialing Council
DACUM	Developing a Curriculum
DHS S&T	Department of Homeland Security Science & Technology Directorate
JTA	Job Task Analysis
K&C	Karagozian & Case, Inc.
NIBS	National Institute of Building Sciences
PTI	Professional Testing, Inc.
SME	Subject Matter Expert
TSA	Transportation Security Administration

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1 Introduction

Job task analysis (JTA) is the process by which the tasks performed by individuals in a particular job are identified, and the importance of those tasks is determined. Additionally, JTA helps to establish the knowledge, skills, abilities, and other characteristics necessary for the effective performance of a job incumbent. Specifically, JTA can be defined as any systematic procedure for collecting and analyzing job-related information to meet a particular purpose.

The important tasks and critical competencies identified in a JTA should be validated by a representative, large-scale group of job incumbents. A well-conducted validation study is a foundational requirement of any valid credentialing program, and helps to identify the core knowledge areas, critical work functions, and skills which are common across a representative sampling of current practitioners or job incumbents. Empirical results which validate the JTA provide examinees and the public with a fair, reliable, and realistic assessment that reflects the knowledge, skills, and abilities required for competent job performance. A large-scale validation effort allows the results of a job task analysis to be quantified, and the validation inventories can reach a large, diversified sample within a short period of time.

The services of Professional Testing, Inc. (PTI) were secured by Karagozian and Case, Inc. (K&C) through a grant from the Department of Defense Combating Terrorism Technical Support Office (CTTSO) to assist with the development and administration of a validation survey for Blast Protection Professionals (BPPs).

PTI would like to thank the sponsors and consulting team members that participated in the planning and/or observed the JTA Committee Meeting: Alec Williamson, Alexander Arbizo, and James Mead from CTTSO, Amber Kasbeer from the Transportation Security Administration (TSA), Elizabeth Obregon and Douglas Cash from the Department of Homeland Security Science & Technology Directorate (DHS S&T), Mark Weaver from K&C, and Roger Grant from the National Institute of Building Sciences (NIBS).

2 DACUM Chart for Blast Protection Professional

2.1 Job Title & Description

A Blast Protection Professional (BPP) characterizes hazardous explosion effects and designs solutions to mitigate the resulting consequences to specified assets.

Definitions

- *Characterize*: To define in quantitative terms.
- *Hazardous Explosion Effect*: Airblast, gas pressure, fragments (primary and secondary), non-structural component debris, thermal effects, and ground shock deriving from military, commercial, or improvised explosives or combustible fuel/air mixtures.
- *Solution*: Structural / non-structural components and systems used to mitigate hazardous explosion effects and/or delay/prevent hazardous explosion effects propagation; includes site layout, utility, and architectural detailing considerations. Implemented on new and existing (via retrofit) structures.
- *Mitigate*: Limit consequences in conformance with specified performance requirements.
- *Consequence*: Lethality (human) or loss of intended purpose (equipment and structure).
- *Asset*: Humans, equipment, structure.

Exclusions (i.e., items not included in BPP scope)

- Design Basis Threat / Source
- Electronic Security Systems
- Chemical, Biological, Radiological and Nuclear (CBRN) Defense
- Design to Resist Vehicle Impact
- Access Control Systems
- Explosives & Weapons Search Detection
- Forced Entry Protection
- Design to Protect Against Ballistic Threats
- Disproportionate Collapse Design Procedures
- Computational Mechanics Methods

2.2 Job Task Analysis DACUM Chart

This section records the final Developing a Curriculum (DACUM) chart generated during the JTA for the BPP. Table 1 lists the final duties and tasks for the BPP and the recommended content weightings for the means of assessment based on the results of the JTA validation survey. These content weightings were derived using the results of the validation survey. In addition, a series of tables is included to further break down the information included in the final DACUM chart:

- Table 2 lists all of the special knowledge needed by the BPP as indicated by the JTA Committee.

- Table 3 lists how the JTA Committee rated (on average) the importance of general knowledge items for a BPP on a scale of 1 to 3.

- Table 4 lists how the JTA Committee rated (on average) the importance of attitude items for a BPP on a scale of 1 to 3.

- Table 5 lists how the JTA Committee rated (on average) the importance of physical condition items for a BPP on a scale of 1 to 3.

- Table 6 lists all of the tools, equipment, and resources needed by the BPP as indicated by the JTA Committee.

- Table 7 through Table 10 includes the final full DACUM chart by duty for the four duties identied by the JTA Committee.

Table 1. Duties and Tasks of Blast Protection Professional

	Duties and Tasks	Recommended Content Weighting
A	**Establishing project requirements**	**17%**
1	Establish a Basis of Design (BOD)	12%
2	Provide testing support	5%
B	**Determining loading**	**39%**
1	Calculate airblast environment for high explosives	13%
2	Calculate airblast environment for a fuel-air mixture	5%
3	Calculate ground shock, crater and ejecta	7%
4	Calculate primary and secondary fragment load	6%
5	Evaluate internal hazards due to internal explosions	1%
6	Calculate design and analysis loads	7%
C	**Performing analysis and design**	**28%**
1	Evaluate materials	7%
2	Perform dynamic analysis	14%
3	Evaluate test reports	4%
4	Analyze internal hazards due to external loads	3%
D	**Completing blast-resistant design**	**16%**
1	Incorporate analysis results into design	5%
2	Develop blast performance specifications for blast-resistant components	5%
3	Develop or review blast reports	6%

Table 2. Special Knowledge for Blast Protection Professional

Special Knowledge	
Allowable stress design	Analytic techniques
Angle of incidence	Assets
B and D regions	Balanced design
Basic geotechnical engineering	Benchmark data
Blast parameter terminology	Boundary conditions
Building structures	Burn rates
Casings	Casing effects
Clearing effects	Closed-form solutions for dynamic analysis
Compliance requirements	Configurations
Confinement	Connection design
Conservation of energy and momentum	Constitutive models
Construction drawings	Continuum mechanics
Data collection methods	Deflagration
Depth of burial	Detailing
Detonation	Detonation physics
Differential equations	Drag effects
Ductile vs. brittle behavior	Dynamic pressure
Dynamic reactions	Equivalent damping
Equivalent load	Equivalent mass
Equivalent stiffness	Explosive effects
Explosive types	Fast running models
Fragility curves	Fragmentation
Free field modification method	Geologic conditions
Hazard consequences	High fidelity analyses
Impact load calculations	Incident pressure
Leakage pressure	Lethality curves
Limitations of air blast modeling approaches	Limitations of ground shock load application methods
Limitations of shielding	Limitations of TNT equivalency
Load path	Load resistance design
Material alternatives	Material response test methods
Materials properties	Mechanics
Mechanics of materials	Minimum material requirements
Multiple blast sources	Nominal and expected values
Nomographs	Non-structural debris hazards
Numerical methods	Other disciplines
Past events	P-I curves and associated limitations
Plasticity	Primary fragments
Propellants	Protective design
Reflective pressure	Scaled distance
Scaling	Single-degree-of-freedom
Secondary fragments	Shock isolation
Shock isolation designs	Shock spectra
Shock wave attenuation	Shock waves

Special Knowledge	
Specification reading	Static and dynamic reactions
Strain rate	Structural dynamics
Structural mechanics	Structure-medium interaction (SMI) method
Support conditions	Test data
Test fixture design	Thermal load
Thermo-chemical properties	Time step convergence
Trajectory	Triaxial test methods
Wave propagation	Wave propagation through solids

Table 3. General Knowledge for Blast Protection Professional

General Knowledge	Average Scores
Calculations	
Perform simple math operations of addition	3.00
Perform simple math operations of subtraction	3.00
Perform simple math operations of multiplication	3.00
Perform simple math operations of division	3.00
Use a calculator	3.00
Compare numbers	3.00
Transfer number sequences from a source into a column	3.00
Perform mathematical operations with fractions	3.00
Perform mathematical operations with decimals	3.00
Solve ratio problems	3.00
Solve percent problems	3.00
Perform math operations using signed (positive and negative) numbers	3.00
Perform math operations using single and multiple digit numbers	3.00
Multiply and factor algebraic expressions	3.00
Solve formula calculations with one unknown	3.00
Solve formula calculations with more than one unknown	3.00
Perform math operations using exponential numbers	3.00
Solve problems with graphs	3.00
Measure angles	3.00
Perform angular calculations	3.00
Change numbers from fractions into decimals and back	3.00
Make rough estimates	3.00
Collect information to solve a problem	3.00
Figure averages	2.92
Solve right triangle problems using Pythagorean theorem	2.92
Solve angle-circle problems	2.92
Solve triangle-circle problems	2.92
Solve right triangle trigonometry problems	2.92
Solve compound angle problems	2.92
Change numbers from percentages into decimals and back	2.92
Solve oblique triangle problems	2.75
Solve oblique triangle trigonometry problems	2.75
Basic Measurement	
Estimate and approximate measurements	3.00
Convert measurements from one unit to another (English to Metric, etc.)	3.00
Read, interpret, and use size-scale relationships	3.00
Record measurements, using appropriate unit notations (feet, yards, etc.)	3.00
Read and apply coefficient measurements indicated in a table or chart	3.00
Read and use the scale of a drawing	3.00
Find the dimensions of an object from a scale drawing	3.00

General Knowledge	Average Scores
Find distances and directions on land maps	2.92
Make simple scale drawings	2.92
Read measurements taken with common measuring tools	2.92
Use tools to measure quantities and solve problems involving measurements	2.92
Calculate the perimeter and areas of common figures	2.92
Measure linear distances (length, width, etc.)	2.75
Measure area (square inches, square centimeters, etc.)	2.75
Measure volume (cubic inches, liters, etc.)	2.75
Measure temperature to within 1 degree Fahrenheit	2.75
Measure length to 1/4 of an inch	2.58
Measure weights using devices calibrated in pounds	2.58
Measure weights using devices calibrated in ounces	2.50
Measure length to 1/8 of an inch	2.42
Measure length to 1/16 of an inch	2.33
Measure length to 1/32 of an inch	2.17
Measure accurately to 0.01 inches	2.17
Measure accurately to 0.001 inches	2.08
Measure accurately to 0.03 millimeters	2.00
Measure accurately to 0.003 millimeters	2.00
Measure board feet	1.83
Measure accurately to 0.0001 inches	1.83
Communications	
Ask questions	3.00
Evaluate solutions	3.00
Explain procedures	3.00
Communicate using the vocabulary/terminology of a related trade	2.92
Communicate with co-workers and/or business people verbally (face-to-face)	2.92
Communicate with co-workers and/or business people verbally (telephone, radio)	2.92
Communicate with co-workers and/or business people in writing (letters, memos)	2.92
Listen	2.92
Read and follow directions found in equipment manuals and code books	2.92
Read information from tables and graphs (bar, circle, etc.)	2.92
Research information	2.92
Evaluate options/alternatives	2.83
Follow verbal job instructions	2.83
Present to others	2.83
Read drawings and specifications sheets	2.83
Write words and numbers legibly	2.83
Write reports	2.83
Find information in references (Machinery handbook, tap/drill charts, etc.)	2.75
Participate in brainstorming	2.75
Read and follow a map, chart, plan, etc.	2.75

General Knowledge	Average Scores
Apply assertiveness	2.67
Find information in catalogs	2.67
Read and interpret directions found on labels, packages, or instruction sheets	2.67
Read codes (building codes, electrical codes, standards, etc.)	2.67
Read flowcharts	2.67
Read statistical data	2.67
Summarize information	2.67
Speak to large groups	2.42
Compare names	1.92
Read binary code	1.42

Table 4. Attitudes for Blast Protection Professional

Attitudes	Average Scores
Accurate/Precise	2.92
Analytic	2.92
Common sense	2.83
Detail-oriented	2.83
Work in teams	2.83
Adaptable/Flexible	2.75
Team player	2.75
Critical thinker	2.67
Creative	2.67
Dependable	2.67
Eager to learn new things	2.67
Ethical	2.67
Good listener	2.67
Safety conscious	2.67
Trustworthy	2.67
Conscientious	2.58
Cooperative	2.58
Focused	2.58
Honest	2.58
Meticulous	2.58
Professional	2.58
Quality focused	2.58
Confident	2.50
Goal-oriented	2.50
Integrity	2.50
Punctual	2.50
Responsible/accountable	2.50
Work efficiently (time)	2.50
Work efficiently (resources)	2.50
Free of substance abuse	2.42
Industrious	2.42
Manage stress/pressure	2.42
Multi-tasker	2.42
Open-minded to change	2.42
Organized	2.42
Persistent	2.42
Self-motivated	2.42
Good time manager	2.33
Initiative	2.33
Lack of prejudice (bias)	2.33
Respectful	2.33

Attitudes	Average Scores
Customer-oriented	2.25
Pride in job	2.25
Self-control	2.25
Self-discipline	2.25
Tactful	2.25
Tolerant	2.25
Helpful	2.17
Patience	2.17
Self-esteem	2.17
Non-aggressive	2.08
Neat	1.92
Positive attitude	1.92
Social skills	1.92
Sensitive to thoughts of others	1.92
Courteous	1.83
Enthusiasm	1.83
Leader	1.83
Sense of humor	1.67
Physical stamina	1.58
Empathetic	1.50
Friendly	1.50
Personal hygiene	1.50
Caring	1.42
Compassionate	1.42
Appropriate dresser	1.00

Table 5. Physical Conditions for Blast Protection Professional

Physical Conditions	Average Scores
Position - It is important that one can. . .	
Stand part of the time	1.58
Sit part of the time	1.58
Stoop kneel or crouch	1.33
Sit all of the time	1.25
Bend forward frequently	1.25
Stand at all (could the work be performed from a sitting position?)	1.18
Stand all of the time	1.08
Work in a squatting position for more than five (5) minutes per hour	1.00
Lay on back	0.92
Mobility - It is important that one can. . .	
Walk	1.58
Crawl or creep	1.50
Climb ladders, stairs, poles, etc. using legs and/or arms	1.50
Run	0.75
Lifting - It is important that one can. . .	
Lift 50 lbs. maximum	0.67
Lift objects from ground to waist level	0.67
Carry Objects of up to 50 lbs.	0.58
Lift objects from waist to overhead level	0.58
Carry objects of up to 25 lbs.	0.55
Lift objects from ground to overhead level	0.50
Carry heavy objects while climbing (ladders, scaffolding, etc.)	0.33
Lift 100 lbs. maximum	0.27
Lift objects heavier than 100 lbs.	0.27
Carry objects heavier than 50 lbs.	0.27
Arm/Hand Use - It is important that one can. . .	
Write or type at a fast speed	1.50
Reach with arms and hands in any direction	1.00
Feel size, shape and temperature or texture of objects with the hands	0.67
Hold or move objects using the hands but not the fingers	0.67
Hold or move objects using the fingers	0.67
Push objects with arms or hands	0.67
Pull objects with arms or hands	0.67
Work with hands and arms over head level	0.50
Use digging or chopping motion while working	0.42
Senses - It is important that one can. . .	
Talk	2.25
Hear speech	2.08
See clearly at 20 inches or less (with/without optical assistance)	1.25
See clearly at 20 feet or more (with/without optical assistance)	1.25

Physical Conditions	Average Scores
Judge depth (the position and distance of objects) with the eyes	1.17
Detect abnormal noises	1.00
See and discriminate colors	0.83
Working Conditions – It is important that one can. . .	
Work inside	2.27
Work outside	1.36
Work in one place (no change of work location)	1.18
Work while wearing protective equipment (respirators, hoods, etc.)	1.09
Work in changing temperatures (in and out of buildings repeatedly)	1.09
Work in confined spaces	1.00
Work while standing on scaffolding	0.91
Work at heights of 1 to 25 feel above ground or floor level	0.91
Work in high temperatures (85 to 130 degrees F)	0.91
Work in low temperatures (0 to 45 degrees F)	0.91
Work in dry places (lacking any natural moisture or humidity)	0.91
Work in dust, oils, fumes, or smells	0.91
Work in noisy places (85 DB or higher with ear protection)	0.90
Work while standing on portable ladders	0.82
Work while sitting or standing on high roofs, overhangs, or I-beams	0.82
Work at heights of 26 to 75 feel above ground or floor level	0.82
Work at heights of 76 feet or higher above ground or floor level	0.82
Work in damp places (high humidity, some standing water)	0.82
Work with or near fiberglass or asbestos materials	0.73
Work with or near plastic resins	0.64
Work on slippery surfaces	0.55
Work around or near high voltage power sources or equipment	0.55
Handle toxic materials	0.55
Work in sub-zero temperatures (0 and lower)	0.55
Work around or near magnetic equipment or materials	0.45
Handle hot or cold objects	0.45
Work in stale air (with some oxygen depletion)	0.45

Table 6. Tools, Equipment and Resources for Blast Protection Professional

Tools, Equipment, and Resources	
Analytical software	Codes
Explosive effects manuals	Gurney equation
Historical data	Impact load calculations
Industry standard software	Materials standards (e.g. ACI, ASTM, AISC)
Modeling software	Mott distribution
Regulations	Standards
Test data	Test reports
Thor equations	

Table 7. Duties, Tasks, Steps, Special Knowledge, Skills, Abilities,Tools, Equipment, and Resources for "Establishing Project Requirements"

Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A. Establishing Project Requirements			
1. Establish a Basis of Design			
Collect project background information	• Building structures • Structural mechanics • Materials properties • Analytic techniques • Past events • Test data • Explosive types • Assets • Hazard consequences • Explosive effects • Other disciplines	• Coordination	• Codes • Standards • Regulations
Define project standards and criteria			
State design basis threats			
Define assets			
Select analysis methods and tools			
Select assessment methods and tools			
Identify project constraints			
Define performance requirements			
Establish quality assurance QA) criteria			
Confirm Basis of Design matches project objectives			
Assess feasibility of project objectives and criteria supplied by client and associated facility implications			
2. Provide testing support			
Define project standards and criteria	• Explosive effects • Configurations • Building structures • Structural mechanics • Materials properties • Analytic techniques • Past events • Test data • Explosive types • Assets • Hazard consequences • Other disciplines • Test fixture design	• Coordination	• Codes • Standards • Regulations
Provide preliminary assessment of predicted test article performance			
Determine the process for validation			
Determine the process for verification			
Develop test plan			

Table 8. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment and Resources for "Determining Loading"

Duties, Tasks and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment and Resources
B. Determining Loading			
1. Calculate airblast environment for high explosives			
Determine explosive sources (e.g., weight, explosive type, detonation mechanism, ideal/non-ideal)	• Blast parameter terminology • Limitations of TNT equivalency • Limitations of air blast modeling approaches • Casings • Confinement • Scaled distance • Shock waves • Drag effects • Clearing effects • Reflective pressure • Incident pressure • Depth of burial • Dynamic pressure • Limitations of shielding • Thermo-chemical properties • Detonation physics • Thermal load • Propellants • Burn rates • Casings effects	• Analytical skills • Advanced math skills	• Modeling software • Explosive effects manuals • Test data • Historical data • Analytical software • Gurney equation • Mott distribution
Determine location of explosive sources			
Determine TNT equivalency			
Assess effects of site conditions (e.g., topography, adjacent structures)			
Assess effects of environment (e.g., altitude, temperature, humidity)			
Assess effects of charge shape			
Assess effects of confinement (e.g., frangible surfaces, venting, gas pressure, thermal effects)			
Assess effects of casing			
Assess effects of depth of burial			
Calculate scaled distance (e.g., near field, far field)			
Characterize shock waves (e.g., positive and negative phase parameters, triple point)			
Assess effects of dynamic pressure			
Assess effects of shielding (e.g., barrier walls, barricades, earthen structures)			
2. Calculate airblast environment for a fuel-air mixture			
Determine fuel release sources (e.g., release source type, fuel type, level of reactivity, flammable volume)	• Blast parameter terminology • Limitations of TNT equivalency • Limitations of air blast modeling approaches • Casings • Confinement • Scaled distance • Shock waves	• Analytical skills • Advanced math skills	• Modeling software • Explosive effects manuals • Test data • Historical data • Analytical software
Assess effects of environment (e.g., wind, dispersion models)			
Assess dispersion or assume volume			
Identify ignition source			
Differentiate between deflagration and detonation			

Duties, Tasks and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment and Resources
Consult and assess validity of blast curves provided by the process safety consultant to determine pressures and impulses	• Drag effects • Clearing effects • Reflective pressure • Incident pressure • Deflagration • Detonation • Depth of burial • Dynamic pressure • Limitations of shielding • Thermo-chemical properties • Detonation physics		
3. Calculate ground shock, crater, and ejecta			
Assess applicability of ground shock load calculation Determine TNT equivalency Assess effects of site conditions (e.g., geology, water table, underground utilities) Assess ground shock regions Characterize ground shock waves (e.g., attenuation, dispersion, transmission, reflection) Assess effects of depth of burial (e.g., ground shock coupling) Assess effects of shielding Calculate crater and ejecta properties Assess one dimensional linear elastic wave propagation	• Wave propagation • Blast parameter terminology • Limitations of TNT equivalency • Limitations of air blast modeling approaches • Basic geotechnical engineering • Confinement • Scaled distance • Shock waves • Shock wave attenuation • Geologic conditions • Reflective pressure • Incident pressure • Depth of burial • Dynamic pressure • Limitations of shielding • Thermo-chemical properties • Detonation physics	• Advanced math skills • Analytical skills	• Analytical software • Modeling software • Explosive effects manuals • Test data • Historical data
4. Calculate primary and secondary fragment load			
Characterize cased explosive device Calculate initial fragment velocity Select fragment mass distribution Assess variation of fragment velocity and distribution with distance	• Blast parameter terminology • Limitations of TNT equivalency • Limitations of air blast modeling approaches	• Analytical skills • Advanced math skills • Statistical skills	• Modeling software • Explosive effects manuals • Test data • Historical data

Duties, Tasks and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment and Resources
Identify primary fragments (e.g., shape, caliber density, impact angle) Calculate of velocity of secondary fragments (e.g., constrained, unconstrained) Calculate fragment penetration and perforation	• Casings • Confinement • Scaled distance • Shock waves • Drag effects • Clearing effects • Reflective pressure • Incident pressure • Depth of burial • Dynamic pressure • Limitations of shielding • Thermo-chemical properties • Detonation physics • Primary fragments • Secondary fragments • Fragmentation • Trajectory • Impact load calculations		• Analytical software • Gurney equation
5. Evaluate internal hazards due to internal explosions			
Assess propagation of leakage pressure Assess internal thermal environment	• Leakage pressure • Non-structural debris hazards		
6. Calculate design and analysis loads			
Apply airblast loads to the blast-exposed components Assess effects of clearing and drag Apply ground shock loads to buried surfaces Apply point impact loads to structures (e.g., soft target, hard target, hard impactor) Apply distributed impact loads to blast-exposed components (e.g., fragments) Combine gravity and shock load effects Combine gravity, shock, and impact load effects	• Angle of incidence • Free field modification method • Structure-medium interaction (SMI) method • Limitations of ground shock load application methods • Wave propagation through solids • Conservation of energy and momentum • Shock isolation • Multiple blast sources		• Thor equations

Table 9. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment and Resources for "Performing Analysis and Design"

Duties, Tasks and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment and Resources
C. Performing Analysis and Design			
1. Evaluate Materials			
Determine expected properties Identify the need for material testing (e.g., standard, non-standard) Select material tests Quantify strain rate effects on material properties Define limit states based on analysis methods used (e.g., stress vs. strain, strain at failure) Identify material alternatives Select a constitutive model	• Nominal and expected values • Material response test methods • Strain rate • Minimum material requirements • Ductile vs. brittle behavior • Material alternatives • Constitutive models • Triaxial test methods • Mechanics of materials		• Materials standards (e.g. ACI, ASTM, AISC) • Test reports
2. Perform dynamic analysis			
Determine load path Identify preliminary dynamic analysis methods (from least to most complex) Identify limitations of preliminary dynamic analysis method Idealize boundary conditions Calculate input parameters (e.g., equivalent mass, stiffness, damping, load, natural period) Perform preliminary dynamic analysis (e.g., SDOF, breach curves, nomographs) Compare results with specified performance requirements Determine if higher fidelity analysis approach is warranted Determine if structural stability analysis is warranted (e.g., disproportionate collapse) Finalize dynamic analysis	• Closed-form solutions for dynamic analysis • Nomographs • SDOF • Load path • Equivalent mass • Equivalent stiffness • Equivalent load • Equivalent damping • Boundary conditions • High fidelity analyses • Structural dynamics • Plasticity • Structural mechanics • Continuum mechanics • Differential equations • Balanced design • P-I curves and associated limitations • Numerical methods	• Analytical skills • Advanced math skills	• Industry standard software

Duties, Tasks and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment and Resources
Relate dynamic analysis to the three domains in the P-I curve	• Time step convergence • Dynamic reactions • Fast running models		
3. Evaluate test reports			
Assess applicability of test reports (e.g., scaling, standards, data collection methods, support conditions)	• Scaling • Benchmark data • Data collection methods • Support conditions • Past events	• Post-event damage assessment	• Standards
Validate test data against benchmark data			
Evaluate recommendations and conclusions			
Verify accuracy and completeness of test and test report			
4. Analyze internal hazards due to external loads			
Evaluate potential debris	• Shock spectra • Fragility curves • Lethality curves • Shock isolation designs • Non-structural debris hazards		
Develop shock spectra			
Establish lethality and fragility curves (e.g., human, equipment)			
Assess need for shock isolation designs			

Table 10. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment and Resources for "Completing Blast-Resistant Design"

Duties, Tasks, and Steps	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
D. Completing Blast-Resistant Design			
1. Incorporate analysis results into design			
Extract design information from analysis Design connections and detailing to ensure they conform with assumptions made during analysis (e.g., boundary conditions, deformations) Coordinate with other disciplines to ensure compatibility with design and operational security measures Validate correct implementation Apply balanced design	• Detailing • Connection design • Plasticity • Structural dynamics • Mechanics • Static and dynamic reactions • B and D regions • Load resistance design • Allowable stress design • Balanced design	• Coordination • Visual communication (e.g., sketch, renderings)	
2. Develop blast performance specifications for blast-resistant components			
Define systems that require blast performance specifications Translate project performance requirements into specification language Coordinate blast performance specifications with other disciplines Incorporate demonstration of compliance requirements	• Construction drawing • Specification reading • Compliance requirements	• Specification writing • Visual communication (e.g., sketch, renderings)	
3. Develop or review blast reports			
Demonstrate blast-resistant design meets blast performance requirements Review blast-resistant design against overall building paradigm Document baseline assumptions and sources Summarize findings and recommendations Provide information on procedures and methodologies used	• Protective design • Blast performance requirements • Other disciplines	• Verbal communication • Technical writing • Prioritization • Coordination • Presentation	

3 JTA Committee Meeting

Based on recommendations provided by the Blast Protection Board of Advisors (BPBOA), which was formed under NIBS Commercial Workforce Credentialing Council (CWCC), and project participants knowledge of the blast protection industry, a selection process was conducted to identify a representative group consisting of twelve Subject Matter Experts (SMEs) to conduct a JTA for the BPP using the DACUM methodology. The twelve SMEs included on the JTA Committee are listed in Table 11.

Table 11. Blast Protection Professional JTA Committee Members

Name	Organization
Craig Ackerman	Department of State, Bureau of Diplomatic Security
Juan Archilla	Department of Veterans Affairs
Dr. Raymond Bennett	Baker Engineering and Risk Consultants, Inc.
James Brokaw	Applied Research Associates, Inc.
Dr. Jay Ehrgott	U.S. Army Engineer Research and Development Center
John Geringer	U.S. Army Corps of Engineers Protective Design Center
Jessica Godinho	KPFF Consulting Engineers
Dr. Theodor Krauthammer	University of Florida
Dr. Shalva Marjanishvilli	Hinman Consulting Engineers
Dr. Michael Oesterle	Naval Facilities Engineering and Expeditionary Warfare Center
Hollice Stone	Stone Security Engineering, P.C.
Martin Wingert	NYC Police Department, Counterterrorism Division

The DACUM JTA meeting was facilitated by Dr. Reed Castle, psychometrician, and Mr. Dustin Shullick, psychometrician and project manager, of PTI. The three-day meeting developed a list of four domains or duties, fifteen tasks, and ninety-four steps that constitute the BPP job.

3.1 Survey Development

The duty, task, and step list was used to build a survey that was delivered using an online mechanism. The survey consisted of two major sections: (1) demographic information collection and (2) BPP step validation. A draft survey was shared with CTTSO, TSA, DHS S&T, K&C, NIBS, and the JTA Committee for initial review prior to NIBS releasing the survey to the broader blast protection professional community. Appendix A includes a copy of the survey sent out by NIBS.

3.2 Survey Dissemination

NIBS sent the survey to 284 practicing blast protection professionals. The survey was open for twenty-three days in the summer of 2017 for data collection, during which time email reminders were sent. The final dataset included 129 respondents.

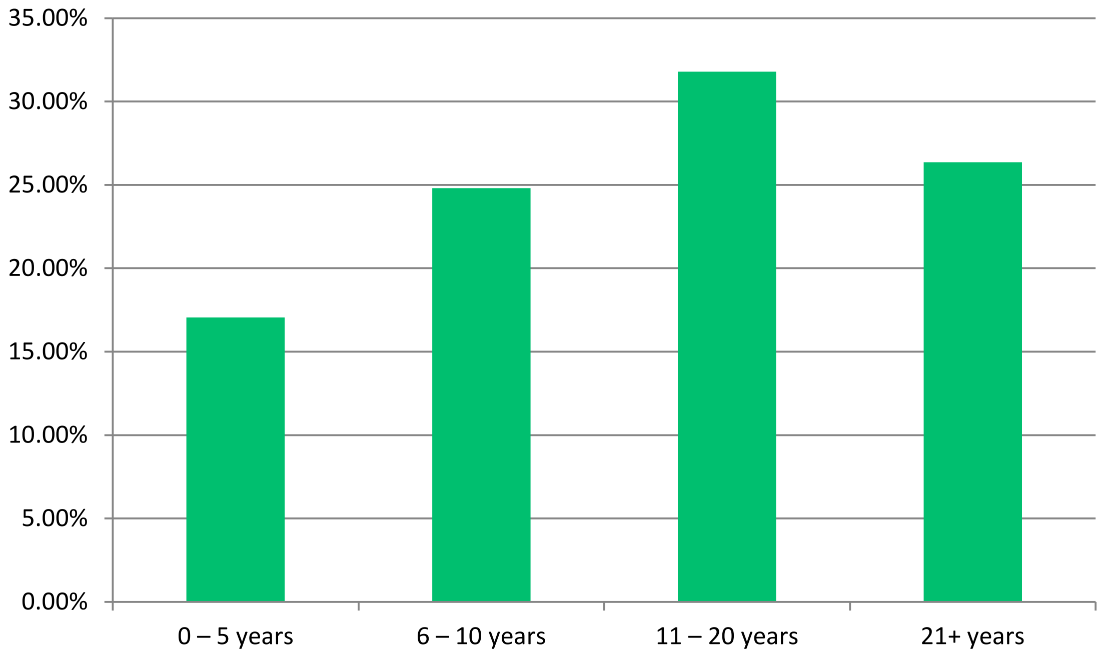
4 Survey Results

All data were included in the analyses, as people who skipped a question or task rating may have done so either accidentally or because they felt that the item was not applicable to their position. The sample size is large enough to allow reasonable confidence in the results of the survey. Results from the demographics questions are presented first.

4.1 Response Rate and Representativeness of Online Validation Survey

A total of 129 survey respondents were included in this analysis. The background and demographic portions of the survey assist with determining how representative the survey respondents are of the population of interest. The survey respondents were asked to report the number of years of experience that they have had as a Blast Protection Professional. Although the distribution of years of experience was varied, the greatest number of survey respondents (41 or 31.8%) reported 11 to 20 years, as illustrated in Table 12.

Table 12: Years of Experience as a Blast Protection Professional (as reported by survey respondents)



When asked "What type of experience have you had as a Blast Protection Professional?", the greatest number of respondents (102 or 79.7%) reported blast vulnerability assessment, as illustrated in Table 13. Participants specifying a job title category that was not listed chose "Other" and specified their job title category. A list of these responses can be found Table 14.

Table 13: Type of Experience as a Blast Protection Professional (as reported by survey respondents)

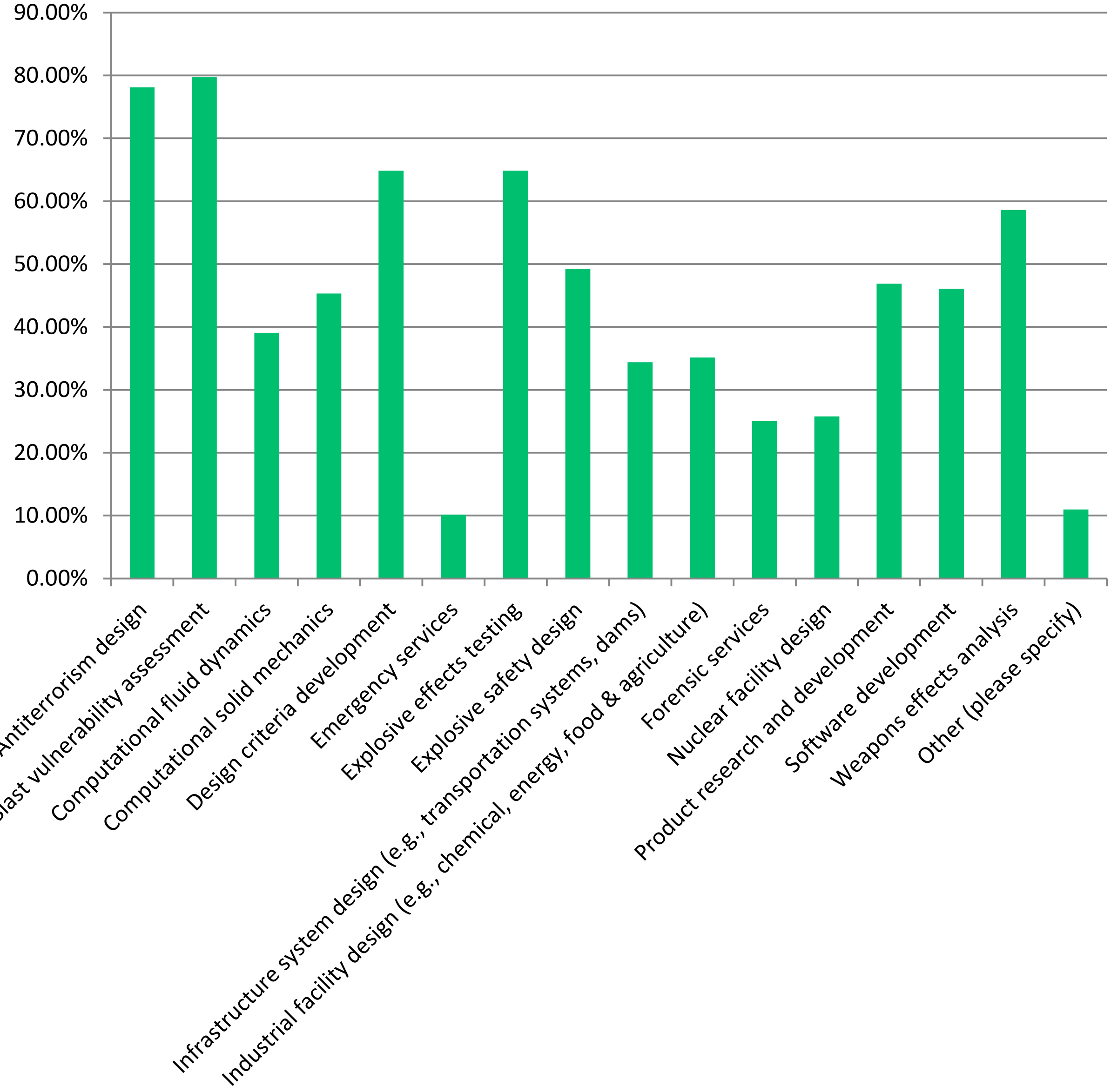


***Table* 14: Type of "Other" Experience as a Blast Protection Professional (as reported by survey respondents)**

Anti-Ram Design
Anti-ram perimeter layout/design
finite element analysis
High pressure testing hazards
High pressure testing hazards analysis/design
Internally loaded structures, explosives containment, Explosives safety and quantity distance, probable maximum loss studies (PML)
Mitigation performance evaluation and testing protocols
Project Manager
Research & Development
Structural Design and Overall Project Design Review, Ensure US Government Requirements and Design Standards are applied, Development of Non-Standard Project Design Requirements
Test design and planning
Threat Assessment; Human Fragility; Training Dev.; QC; V&V
Threat Vulnerability Risk Assessment, Physical Security design
Weapons effects and structural dynamics R&D

* *Responses in this table are listed exactly as they were provided by survey respondents. Any spelling and grammatical errors made by survey respondents were not corrected.*

When asked "In what type of organization have you been employed as a Blast Protection Professional?", the greatest number of respondents (90 or 70.3%) reported Consultancy, as illustrated in Table 15. Participants specifying a type of organization was not listed chose "Other" and specified their job title category. A list of these responses can be found Table 16.

Table 15: Types of Organizations that have Employed Survey Respondents

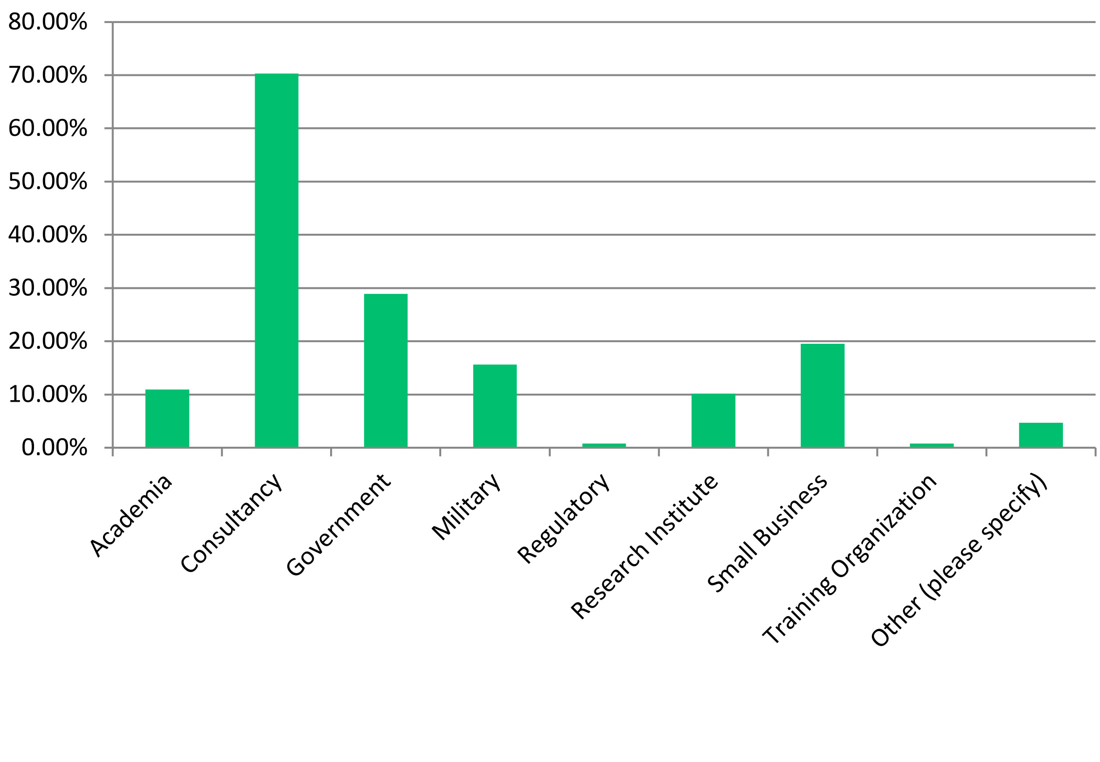


Table 16: Types of "Other" Organizations that have Employed Survey Respondents

Commercial and Goverment Building Design and Cosntruction
Engineering Firm
Engineerng & Construction firm
Manufacturer's Engineer
Private sector
Product Manufacturing (Precast)
Commercial and Goverment Building Design and Cosntruction
Project Manager

* *Responses in this table are listed exactly as they were provided by survey respondents. Any spelling and grammatical errors made by survey respondents were not corrected.*

When asked to report their highest level of education, the greatest number of respondents (70 or 54.7%) reported obtaining "Master's degree", as illustrated in Table 17. Participants specifying that their highest level of education was not listed chose "Other" and specified their job title category. A list of these responses can be found Table 18.

Table 17: Highest Level of Education of Survey Respondents

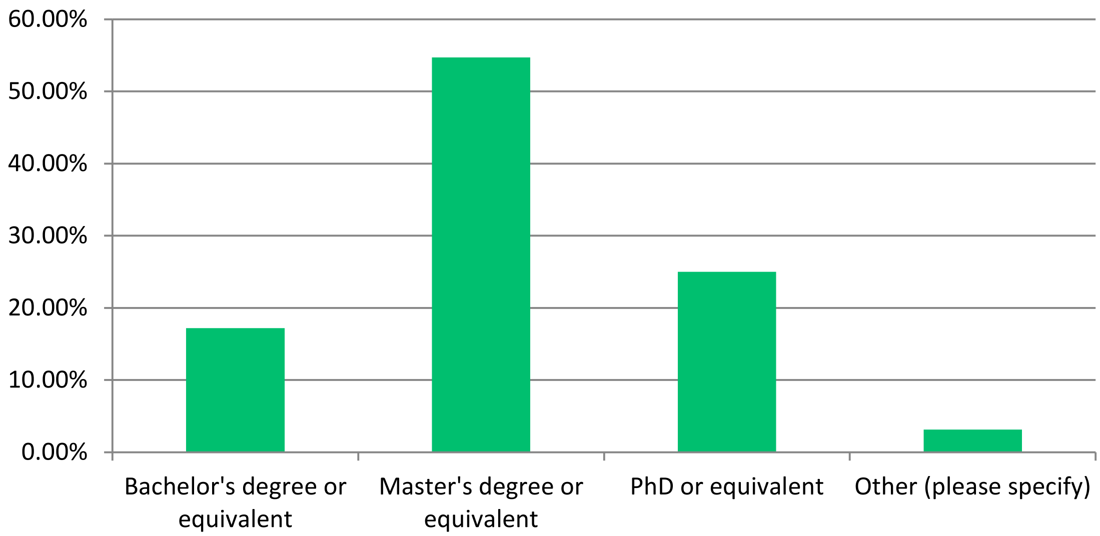


Table 18: "Other" Highest Level of Education of Survey Respondents

graduate studies beyond master's degree
member of the Register of security engineers and specialists
Prof. Dr.
UNIVERSITY PROFESSOR
graduate studies beyond master's degree

* *Responses in this table are listed exactly as they were provided by survey respondents. Any spelling and grammatical errors made by survey respondents were not corrected.*

When asked "What credentials/licenses do you currently hold?", the greatest number of respondents (83 or 75.5%) reported Professional Engineer (Civil), as illustrated in Table 19. Participants specifying credentials/licenses that were not listed chose "Other" and specified their job title category. A list of these responses can be found Table 20.

Table 19: Credentials / Licenses Held by Survey Respondents

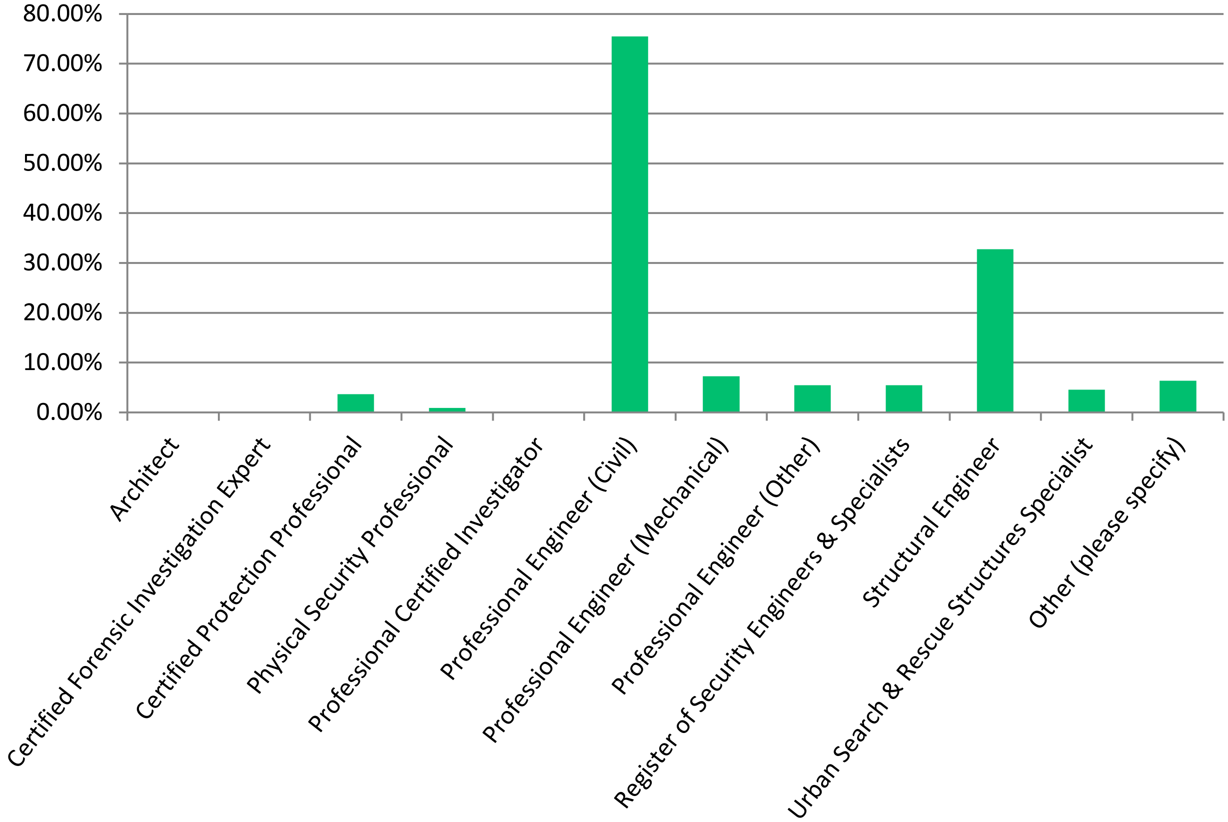


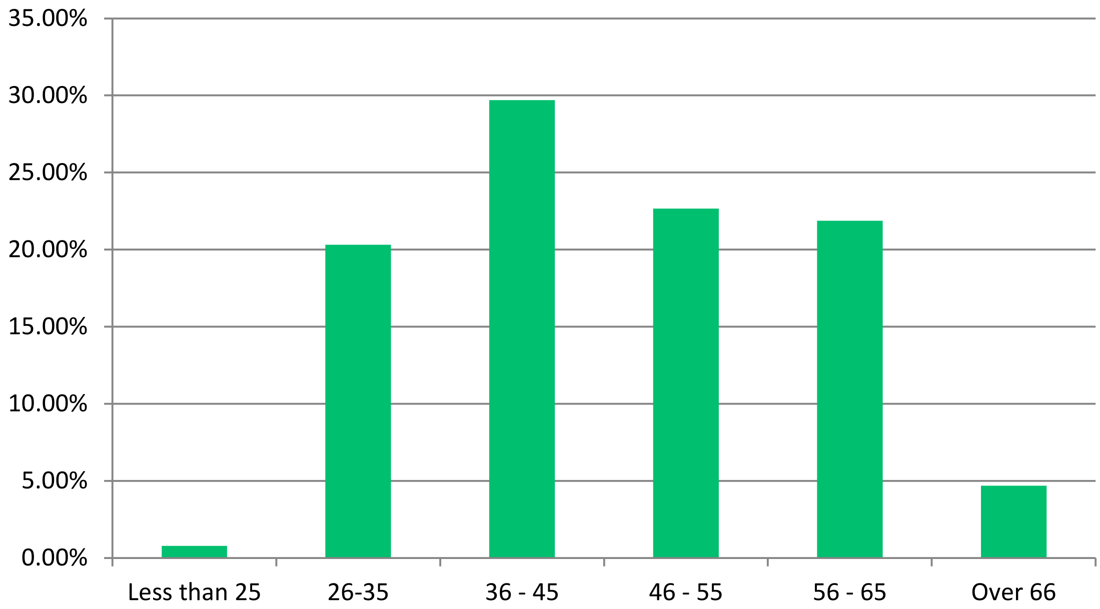
Table 20: "Other" Credentials / Licenses Held by Survey Respondents

Certified Bomb Technician
Chartered Civil Engineer, Canadian Risk Management
Chartered Engineer (UK), FICE, Professional Simulation Engineer
Chartered Engineer and Chartered Physicist
EIT
Project Management Professional (PMP)
Structural Engineering Certification Board

* *Responses in this table are listed exactly as they were provided by survey respondents. Any spelling and grammatical errors made by survey respondents were not corrected.*

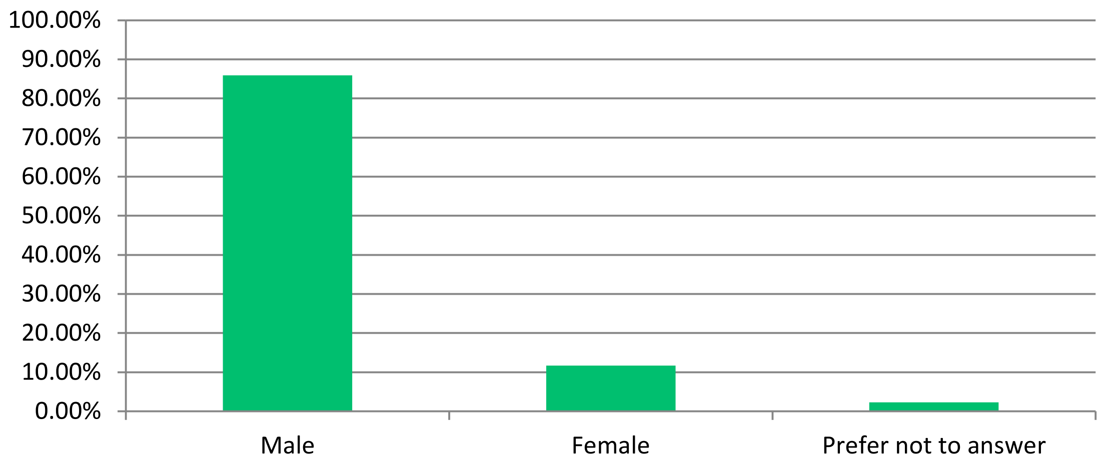
Next, survey respondents were asked about their age. The greatest number of respondents (38 or 29.7%) reported "36-45", as illustrated in Table 21.

Table 21: Years of Age of Survey Respondents



Survey respondents were asked about their gender. The greatest number of respondents (110 or 86.0%) reported being male, as illustrated in Table 22.

Table 22: Gender of Survey Respondents



4.2 Overview of Survey Respondents Ratings for Step Statements

Survey respondents were asked to rate step frequency and importance. The mean ratings for step frequency ranged from 2.11 to 4.63, with an average standard deviation of 1.08. The mean importance ratings ranged from 1.10 to 2.73, with an average standard deviation of 0.73 indicating that there was not a lot of variability in the ratings. The mean frequency rating across the ninety-four job steps was 3.40 on a 6-pt (0-5) scale. The mean importance rating across all tasks was 2.02 on a 4-pt (0-3) scale.

Criticality was calculated as a combination of frequency and importance ratings, with importance receiving twice the weight as shown in the formula below:

Overall = 2*Importance + Frequency

Criticality values ranged from 4.34 to 10.03, with a mean of 7.44. Eleven steps with a criticality value below 5.50 have been flagged in the table below. These steps were reviewed by the JTA Committee to determine whether or not they should be kept in the weightings for the final exam blueprint. Table 23 records the frequency, importance, and resulting criticality values based on the responses to the validation survey.

Table 23: Mean, Standard Deviation, and Criticality Ratings of Frequency and Importance for Each Step

Content Areas	Frequency Mean	Frequency SD	Importance Mean	Importance SD	Criticality
Establishing Project Requirements					
Establish a Basis of Design (BOD)					
Collect project background information	3.95	0.94	2.11	0.73	8.17
Define project standards and criteria	3.91	0.86	2.55	0.57	9.02
Define design basis threats	3.65	1.10	2.44	0.71	8.54
Define assets	3.10	1.21	1.82	0.85	6.73
Select analysis methods and tools	4.40	0.70	2.49	0.63	9.39
Select assessment methods and tools	4.06	0.99	2.36	0.66	8.78
Identify project constraints	3.86	0.89	2.19	0.65	8.24
Define performance requirements	3.77	0.95	2.43	0.64	8.63
Establish quality assurance (QA) criteria	2.80	1.20	1.70	0.80	6.19
Confirm Basis of Design (BOD) matches project objectives	3.81	1.06	2.20	0.75	8.21
Assess feasibility of project objectives and criteria supplied by client and associated facility implications	3.69	0.97	2.15	0.72	8.00
Provide testing support					
Define project standards and criteria	3.53	0.98	2.25	0.67	8.02
Provide preliminary assessment of predicted test article performance	3.68	1.04	2.12	0.77	7.92
Determine the process for certification	2.75	1.15	1.60	0.75	5.95
Determine the process for verification	3.17	1.09	1.86	0.68	6.89
Develop testing plan	3.83	1.29	2.38	0.77	8.58
Determining Loading					
Calculate airblast environment for high explosives					
Determine explosive sources (e.g., explosive type, detonation mechanism, ideal/non-ideal, weight)	3.52	1.24	2.12	0.83	7.76
Determine location of explosive sources	4.03	1.05	2.47	0.74	8.97
Determine TNT equivalency	3.82	1.23	2.31	0.75	8.43

Content Areas	Frequency Mean	Frequency SD	Importance Mean	Importance SD	Criticality
Evaluate effect of site conditions (e.g., shielding, topography, adjacent structures)	3.31	1.08	1.92	0.77	7.15
Evaluate effect of environment (e.g., altitude, temperature, humidity)	2.14	1.31	1.10	0.84	4.35
Identify charge shape dependence	2.55	1.19	1.47	0.85	5.48
Identify effects of confinement (e.g., frangible surfaces, venting, gas pressure, thermal effects)	3.59	1.14	2.27	0.78	8.12
Identify effects of casing	2.65	1.24	1.59	0.88	5.83
Determine effects of depth of burial	2.43	1.23	1.65	0.87	5.72
Calculate scaled distance (e.g., near field, far field)	4.08	0.96	2.32	0.69	8.72
Characterize shock waves (e.g., positive and negative phase parameters, triple point)	4.00	0.99	2.37	0.70	8.74
Calculate dynamic pressure	3.80	1.22	2.10	0.86	8.00
Evaluate shielding effects (e.g., barrier walls, barricades, earthen structures)	3.27	1.00	2.00	0.68	7.27
Calculate airblast environment for a fuel-air mixture					
Determine fuel release sources (e.g., release source type, fuel type, level of reactivity, flammable volume)	2.75	1.46	1.81	0.91	6.37
Determine effects of environment (e.g., wind, dispersion models)	2.39	1.44	1.53	0.89	5.44
Determine dispersion or assume volume	2.55	1.45	1.57	0.89	5.69
Assess ignition source	2.31	1.44	1.40	0.92	5.11
Differentiate between deflagration and detonation	3.00	1.31	2.03	0.86	7.07
Consult blast curves to determine pressures/impulses	3.34	1.43	2.03	0.82	7.41
Calculate ground shock, crater and ejecta					
Assess applicability of ground shock load calculation	2.88	1.22	1.67	0.78	6.22
Determine TNT equivalency (e.g., effects of coupling)	3.01	1.36	1.76	0.81	6.53
Evaluate effect of site conditions (e.g., geology, water table, underground utilities)	2.41	1.33	1.52	0.84	5.44
Assess ground shock regions	2.22	1.26	1.32	0.80	4.87
Characterize ground shock waves (e.g., attenuation, dispersion, transmission, reflection)	2.57	1.26	1.50	0.77	5.57
Determine effects of depth of burial (e.g., ground shock coupling)	2.65	1.30	1.61	0.85	5.87
Evaluate shielding effects	2.51	1.20	1.36	0.77	5.23
Calculate crater and ejecta properties	2.61	1.27	1.49	0.74	5.59
Calculate primary and secondary fragment load					
Characterize cased explosive device	2.83	1.39	1.72	0.90	6.26

Content Areas	Frequency Mean	Frequency SD	Importance Mean	Importance SD	Criticality
Calculate initial fragment velocity	3.02	1.33	1.79	0.78	6.60
Select fragment mass distribution	2.82	1.31	1.72	0.85	6.25
Review variation of fragment velocity with distance	2.58	1.20	1.42	0.75	5.43
Identify primary fragments (e.g., shape, caliber density, impact angle)	2.75	1.21	1.56	0.80	5.87
Calculate of velocity of secondary fragments (e.g., constrained, unconstrained)	2.61	1.27	1.52	0.76	5.65
Evaluate internal hazards due to external loads					
Determine propagation of leakage pressure	2.82	1.22	1.55	0.82	5.93
Assess internal thermal environment	2.11	1.32	1.12	0.84	4.34
Calculate design and analysis loads					
Apply airblast loads to the blast-exposed components	4.63	0.68	2.70	0.52	10.02
Identify effects of clearing and drag	3.61	0.99	1.99	0.75	7.59
Apply ground shock loads to buried surfaces	2.59	1.12	1.65	0.82	5.89
Apply point impact loads to structures (e.g., soft target, hard target, hard impactor)	2.87	1.34	1.69	0.79	6.26
Apply distributed impact loads to blast-exposed components (e.g., fragments)	2.99	1.22	1.75	0.85	6.48
Combine gravity and shock load effects	2.95	1.30	1.79	.86	6.53
Combine gravity, shock, and impact load effects	2.82	1.26	1.63	0.89	6.07
Performing Analysis and Design					
Evaluate materials					
Determine expected properties	4.00	1.10	2.41	0.73	8.82
Identify the need for material testing (e.g., standard, non-standard)	3.08	1.04	1.85	0.75	6.78
Select material tests	2.85	1.07	1.66	0.85	6.18
Quantify strain rate effects on material properties	3.63	1.24	2.08	0.82	7.79
Define limit states based on analysis methods used (e.g., stress vs. strain, strain at failure)	3.72	1.16	2.19	0.79	8.09
Identify material alternatives	3.32	0.99	1.82	0.75	6.96
Select a constitutive model	3.35	1.26	2.04	0.81	7.44
Perform dynamic analysis					
Determine load path	4.43	0.75	2.67	0.53	9.77
Identify preliminary dynamic analysis methods (from least to most complex)	4.31	0.87	2.49	0.54	9.29
Identify limitations of preliminary dynamic analysis method	4.20	0.90	2.54	0.52	9.29
Idealize boundary conditions	4.49	0.70	2.55	0.56	9.58

Content Areas	Frequency Mean	Frequency SD	Importance Mean	Importance SD	Criticality
Calculate input parameters (e.g., equivalent mass, stiffness, damping, load, natural period)	4.41	0.81	2.58	0.61	9.58
Perform preliminary dynamic analysis (e.g., SDOF, breach curves, nomographs)	4.49	0.80	2.65	0.54	9.78
Compare results with specified performance requirements	4.57	0.63	2.73	0.49	10.03
Determine if higher fidelity analysis approach is warranted	4.04	0.87	2.39	0.62	8.81
Finalize dynamic analysis	4.39	0.72	2.52	0.54	9.44
Evaluate test reports					
Determine applicability of test reports (e.g., scaling, standards, data collection methods, support conditions)	3.50	1.01	2.19	0.66	7.88
Validate test data against benchmark data	3.38	1.08	2.18	0.72	7.74
Evaluate recommendations and conclusions	3.76	0.94	2.33	0.61	8.42
Verify accuracy and completeness of test and test report	3.53	0.92	2.30	0.69	8.12
Analyze internal hazards due to external loads					
Evaluate potential debris	3.17	1.13	1.98	0.78	7.13
Develop shock spectra	2.12	1.10	1.31	0.77	4.74
Establish lethality and fragility curves (e.g., human, equipment)	2.68	1.12	1.74	0.73	6.17
Assess need for shock isolation designs	2.18	1.19	1.41	0.78	5.00
Completing Blast-Resistant Design					
Incorporate analysis results into design					
Extract design information from analysis	4.45	0.65	2.61	0.55	9.66
Design connections and detailing to ensure they conform with assumptions made during analysis (e.g., boundary conditions, deformations)	4.29	0.76	2.64	0.60	9.57
Coordinate with other disciplines to ensure compatibility with design	4.08	0.79	2.49	0.58	9.07
Validate correct implementation	3.88	0.91	2.45	0.62	8.77
Apply balanced design	3.81	0.80	2.18	0.72	8.18
Develop blast performance specifications for blast-resistant components					
Define systems that require blast performance specifications	3.89	0.94	2.28	0.75	8.46
Translate project performance requirements into specification language	3.62	1.04	2.18	0.77	7.98
Coordinate blast performance specifications with other disciplines	3.63	0.95	2.09	0.74	7.82

Content Areas	Frequency Mean	Frequency SD	Importance Mean	Importance SD	Criticality
Incorporate demonstration of compliance requirements	3.50	1.11	1.95	0.74	7.39
Develop or review blast reports					
Demonstrate blast-resistant design meets blast performance requirements	4.22	0.81	2.56	0.58	9.35
Review blast-resistant design against overall building paradigm	3.68	0.93	2.09	0.72	7.87
Document baseline assumptions and sources	4.15	0.78	2.41	0.59	8.96
Summarize findings and recommendations	4.39	0.72	2.52	0.56	9.44
Provide information on procedures and methodologies used	4.12	0.87	2.34	0.68	8.80

* *Note: Areas in red font were reviewed by the JTA Committee due to having low frequency and/or importance ratings.*

4.3 Tasks or Knowledge Missing

Survey respondents were asked if they felt any tasks or knowledge were missing from the JTA. Appendix B lists all write-in responses to this question. The JTA Committee reviewed all the comments and determined that additional content should be added to the JTA. Changes and additional content added to the JTA are identified in the following section.

5 Post-Survey Conference Call / Webinar

5.1 Final BPP Content Outline Approved by the JTA Committee

After the survey was administered, the JTA Committee met via a series of three webinars to discuss the survey results and review the survey participants' comments. The SMEs reviewed the steps rated with low criticality. After discussing each step, The SMEs indicated that all flagged steps should remain on the final outline. Then the committee members reviewed all comments given by survey participants. The committee decided to edit three steps and add five steps. These changed steps are followed by an "*" in Table 24 below. Upon review of the proposed JTA from the JTA Committee, the BPBOA recommended selected minor edits to wording and one step deletion. All proposed changes were accepted by the JTA Committee. These changed steps are followed by an "**" in Table 24 below. It should be noted that one of the steps added by the JTA Committee following the validation survey was subsequently removed based on the BPBOA recommended edits.

After the Content Outline was finalized by the JTA Committee, content weightings were calculated for each duty and task. The weightings were dictated by each step's criticality rating from the validation survey. The five steps that were added post-survey were given the average criticality rating from the validation survey.

Table 24: Final BPP Content Outline Approved by the JTA Committee

	Duties, Tasks, and Steps	Recommended Content Weighting
A	**Establishing project requirements**	17%
1	Establish a Basis of Design (BOD)	12%
a	Collect project background information	1%
b	Define project standards and criteria	1%
c	State design basis threats**	1%
d	Define assets	1%
e	Select analysis methods and tools	2%
f	Select assessment methods and tools	1%
g	Identify project constraints	1%
h	Define performance requirements	1%
i	Establish quality assurance (QA) criteria	1%
j	Confirm Basis of Design (BOD) matches project objectives	1%
k	Assess feasibility of project objectives and criteria supplied by client and associated facility implications	1%
2	Provide testing support	5%
a	Define project standards and criteria	1%
b	Provide preliminary assessment of predicted test article performance	1%
c	Determine the process for validation**	1%
d	Determine the process for verification	1%
e	Develop testing plan	1%

	Duties, Tasks, and Steps	Recommended Content Weighting
B	**Determining loading**	39%
1	Calculate airblast environment for high explosives	13%
a	Determine explosive sources (e.g., explosive type, detonation mechanism, ideal/non-ideal, weight)	1%
b	Determine location of explosive sources	1%
c	Determine TNT equivalency	1%
d	Assess effects of site conditions (e.g., topography, adjacent structures)**	1%
e	Assess effects of environment (e.g., altitude, temperature, humidity)**	1%
f	Assess effects of charge shape **	1%
g	Assess effects of confinement (e.g., frangible surfaces, venting, gas pressure, thermal effects)**	1%
h	Assess effects of casing**	1%
i	Assess effects of depth of burial**	1%
j	Calculate scaled distance (e.g., near field, far field)	1%
k	Characterize shock waves (e.g., positive and negative phase parameters, triple point)	1%
l	Assess effects of dynamic pressure**	1%
m	Assess effects of shielding (e.g., barrier walls, barricades, earthen structures)**	1%
2	Calculate airblast environment for a fuel-air mixture	5%
a	Determine fuel release sources (e.g., release source type, fuel type, level of reactivity, flammable volume)	1%
b	Assess effects of environment (e.g., wind, dispersion models)**	0-1%
c	Assess dispersion or assume volume**	1%
d	Identify ignition source**	0-1%
e	Differentiate between deflagration and detonation	1%
f	Consult and assess validity of blast curves provided by the process safety consultant to determine pressures and impulses*	1%
3	Calculate ground shock, crater and ejecta	7%
a	Assess applicability of ground shock load calculation**	1%
b	Determine TNT equivalency	1%
c	Assess effects of site conditions (e.g., geology, water table, underground utilities)**	1%
d	Assess ground shock regions	0-1%
e	Characterize ground shock waves (e.g., attenuation, dispersion, transmission, reflection)	0-1%
f	Assess effects of depth of burial (e.g., ground shock coupling)**	1%
g	Assess effects of shielding**	0-1%
h	Calculate crater and ejecta properties	1%
i	Assess one dimensional linear elastic wave propagation*	1%
4	Calculate primary and secondary fragment load	6%
a	Characterize cased explosive device	1%
b	Calculate initial fragment velocity	1%
c	Select fragment mass distribution	1%
d	Assess variation of fragment velocity and distribution with distance*	0-1%
e	Identify primary fragments (e.g., shape, caliber density, impact angle)	1%
f	Calculate of velocity of secondary fragments (e.g., constrained, unconstrained)	0-1%

	Duties, Tasks, and Steps	Recommended Content Weighting
g	Calculate fragment penetration and perforation*	1%
5	Evaluate internal hazards due to internal explosions**	1%
a	Assess propagation of leakage pressure**	0-1%
b	Assess internal thermal environment	0-1%
6	Calculate design and analysis loads	7%
a	Apply air blast loads to the blast-exposed components	1%
b	Assess effects of clearing and drag**	1%
c	Apply ground shock loads to buried surfaces	1%
d	Apply point impact loads to structures (e.g., soft target, hard target, hard impactor)	1%
e	Apply distributed impact loads to blast-exposed components (e.g., fragments)	1%
f	Combine gravity and shock load effects	1%
g	Combine gravity, shock, and impact load effects	1%
C	**Performing analysis and design**	28%
1	Evaluate materials	7%
a	Determine expected properties	1%
b	Identify the need for material testing (e.g., standard, non-standard)	1%
c	Select material tests	1%
d	Quantify strain rate effects on material properties	1%
e	Define limit states based on analysis methods used (e.g., stress vs. strain, strain at failure)	1%
f	Identify material alternatives	1%
g	Select a constitutive model	1%
2	Perform dynamic analysis	14%
a	Determine load path	1%
b	Identify preliminary dynamic analysis methods (from least to most complex)	1%
c	Identify limitations of preliminary dynamic analysis method	1%
d	Idealize boundary conditions	2%
e	Calculate input parameters (e.g., equivalent mass, stiffness, damping, load, natural period)	2%
f	Perform preliminary dynamic analysis (e.g., SDOF, breach curves, nomographs)	1%
g	Compare results with specified performance requirements	2%
h	Determine if higher fidelity analysis approach is warranted	1%
i	Determine if structural stability analysis is warranted (e.g., disproportionate collapse)*	1%
j	Finalize dynamic analysis	1%
k	Relate dynamic analysis to the three domains in a pressure-impulse curve*	1%
3	Evaluate test reports	4%
a	Assess applicability of test reports (e.g., scaling, standards, data collection methods, support conditions)**	1%
b	Validate test data against benchmark data	1%
c	Evaluate recommendations and conclusions	1%
d	Verify accuracy and completeness of test and test report	1%
4	Analyze internal hazards due to external loads	3%
a	Evaluate potential debris	1%

	Duties, Tasks, and Steps	Recommended Content Weighting
b	Develop shock spectra	0-1%
c	Establish lethality and fragility curves (e.g., human, equipment)	1%
d	Assess need for shock isolation designs**	0-1%
D	**Completing blast-resistant design**	16%
1	Incorporate analysis results into design	5%
a	Extract design information from analysis	1%
b	Design connections and detailing to ensure they conform with assumptions made during analysis (e.g., boundary conditions, deformations)	1%
c	Coordinate with other disciplines to ensure compatibility with design and operational security measures*	1%
d	Validate correct implementation	1%
e	Apply balanced design	1%
2	Develop blast performance specifications for blast-resistant components	5%
a	Define systems that require blast performance specifications	1%
b	Translate project performance requirements into specification language	1%
c	Coordinate blast performance specifications with other disciplines	1%
d	Incorporate demonstration of compliance requirements	1%
3	Develop or review blast reports	6%
a	Demonstrate blast-resistant design meets blast performance requirements	1%
b	Review blast-resistant design against overall building paradigm	1%
c	Document baseline assumptions and sources	1%
d	Summarize findings and recommendations	2%
e	Provide information on procedures and methodologies used	1%

* *Denotes steps that were edited or added by the JTA Committee following the validation survey.*

** *Denotes tasks or steps for which editorial changes were made based on recommendations from the BPBOA following the validation survey.*

6 Final Blast Protection Professional JTA

After all reviews were completed, the DACUM JTA chart was updated to reflect the final BPP Task list and knowledge as determined by the validation study. The final DACUM JTA chart was provided at the beginning of this Report.

7 Conclusions and Next Steps

The JTA is the first step in the test development process, serving as the primary source of evidence for validity of the examination. The final DACUM JTA (see Table 1) is now validated and may be used by training organizations to develop training programs and by a certification body or scheme committee to develop a certification scheme. The final duties, tasks, and steps for the Blast Protection Professional job appears in Table 24.

APPENDIX A : Validation Survey

Survey begins on the following page.

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Welcome!

The Combating Terrorism Technical Support Office has conducted a Job/Task Analysis (JTA) to validate the duties, tasks and steps associated with the role of Blast Protection Professional (BPP). The Combating Terrorism Technical Support Office is interested in validating this list through a survey of experts like you. We would appreciate it if you would respond to this survey to help us determine if the tasks for a Blast Protection Professional, identified during the JTA, are correct.

The survey includes a list of steps that are identified as steps that a Blast Protection Professional would perform. You will be asked to rate the frequency and importance of these work tasks.

The survey shouldn't take more than 30 minutes to complete.

If you have any difficulty responding to this survey, please contact rgrant@nibs.org.

We appreciate your assistance!

The survey will close on June 30th, 2017, so please complete your responses prior to that date.

CERTIFIED BLAST PROTECTION PROFESSIONAL
RECOGNIZED PROGRAM
U.S. Department of Defense
U.S. Department of Homeland Security

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Please answer the following background questions. Your responses will be kept confidential and this information will only be used for statistical purposes.

How many years of experience do you have as a Blast Protection Professional?

- ◯ 0 – 5 years
- ◯ 6 – 10 years
- ◯ 11 – 20 years
- ◯ 21+ years

What type of experience have you had as a Blast Protection Professional? (Select all that apply.)

- [ ] Antiterrorism design
- [ ] Blast vulnerability assessment
- [ ] Computational fluid dynamics
- [ ] Computational solid mechanics
- [ ] Design criteria development
- [ ] Emergency services
- [ ] Explosive effects testing
- [ ] Explosive safety design
- [ ] Infrastructure system design (e.g., Transportation Systems, Dams)
- [ ] Industrial facility design (e.g., Chemical, Energy, Food & Agriculture)
- [ ] Forensic services
- [ ] Nuclear facility design
- [ ] Product research and development
- [ ] Software development
- [ ] Weapons effects analysis
- [ ] Other (please specify)

In what type of organization have you been employed as a Blast Protection Professional? (Select all that apply.)

- [ ] Academia
- [ ] Consultancy
- [ ] Government
- [ ] Military
- [ ] Regulatory
- [ ] Research Institute
- [ ] Small Business
- [ ] Training Organization
- [ ] Other (please specify)

What is your highest level of education?

- ◯ Bachelor's degree or equivalent
- ◯ Master's degree or equivalent
- ◯ PhD or equivalent
- ◯ Other (please specify)

What credentials/licenses do you currently hold?

- ☐ Architect
- ☐ Certified Forensic Investigation Expert
- ☐ Certified Protection Professional
- ☐ Physical Security Professional
- ☐ Professional Certified Investigator
- ☐ Professional Engineer (Civil)
- ☐ Professional Engineer (Mechanical)
- ☐ Professional Engineer (Other)
- ☐ Register of Security Engineers & Specialists
- ☐ Structural Engineer
- ☐ Urban Search & Rescue Structures Specialist
- ☐ Other (please specify)

How old are you?

- ◯ Less than 25
- ◯ 26-35
- ◯ 36 - 45
- ◯ 46 - 55
- ◯ 56 - 65
- ◯ Over 66

Please indicate your gender:

- ◯ Male
- ◯ Female
- ◯ Prefer not to answer

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Instruction Page

In the following pages, you will be asked to look at each step that a Blast Protection Professional performs and indicate how frequently a typical Blast Protection Professional would perform each step and how important each step is to a Blast Protection Professional's competent performance on the job. To respond, click the drop down menu and select your response.

Following the job task questions, you will be asked to identify any gaps in the steps and weigh typical time requirements for each step.

Your participation will help us develop an accurate picture of the Blast Protection Professional.

The Blast Protection Professional job was broken down into the following categories:

- Establishing project requirements
- Determining loading
- Performing analysis and design
- Completing blast-resistant design

On the following pages you will find tasks and steps in each of the above categories for you to rate in relation to a Blast Protection Professional.

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Establishing Project Requirements - Establish a Basis of Design (BOD)

As part of *Establish a Basis of Design (BOD)*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Collect project background information		
Define project standards and criteria		
Define design basis threats		
Define assets		
Select analysis methods and tools		
Select assessment methods and tools		
Identify project constraints		
Define performance requirements		
Establish quality assurance (QA) criteria		
Confirm Basis of Design (BOD) matches project objectives		
Assess feasibility of project objectives and criteria supplied by client and associated facility implications		

Establishing Project Requirements - Provide Testing Support

As part of *Provide Testing Support*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Define project standards and criteria		
Provide preliminary assessment of predicted test article performance		
Determine the process for certification		
Determine the process for verification		
Develop testing plan		

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Determining Loading - Calculate Air Blast Environment for High Explosives

As part of *Calculate Air Blast Environment for High Explosives*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine explosive sources (e.g., explosive type, detonation mechanism, ideal/non-ideal, weight)		
Determine location of explosive sources		
Determine TNT equivalency		
Evaluate effect of site conditions (e.g., shielding, topography, adjacent structures)		
Evaluate effect of environment (e.g., altitude, temperature, humidity)		
Identify charge shape dependence		
Identify effects of confinement (e.g., frangible surfaces, venting, gas pressure, thermal effects)		
Identify effects of casing		
Determine effects of depth of burial		
Calculate scaled distance (e.g., near field, far field)		
Characterize shock waves (e.g., positive and negative phase parameters, triple point)		
Calculate dynamic pressure		
Evaluate shielding effects (e.g., barrier walls, barricades, earthen structures)		

Determining Loading - Calculate Air Blast Environment for a Fuel-Air Mixture

As part of *Calculate Air Blast Environment for a Fuel-Air Mixture*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine fuel release sources (e.g., release source type, fuel type, level of reactivity, flammable volume)		
Determine effects of environment (e.g., wind, dispersion models)		
Determine dispersion or assume volume		
Assess ignition source		
Differentiate between deflagration and detonation		
Consult blast curves to determine pressures/impulses		

Determining Loading - Calculate Ground Shock, Crater and Ejecta

As part of *Calculate Ground Shock, Crater and Ejecta*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine applicability of ground shock load calculation		
Determine TNT equivalency (e.g., effects of coupling)		
Evaluate effect of site conditions (e.g., geology, water table, underground utilities)		
Assess ground shock regions		
Characterize ground shock waves (e.g., attenuation, dispersion, transmission, reflection)		
Determine effects of depth of burial (e.g., ground shock coupling)		
Evaluate shielding effects		
Calculate crater and ejecta properties		

Determining Loading - Calculate Primary and Secondary Fragment Load

As part of *Calculate Primary and Secondary Fragment Load*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Characterize cased explosive device		
Calculate initial fragment velocity		
Select fragment mass distribution		
Review variation of fragment velocity with distance		
Identify primary fragments (e.g., shape, caliber density, impact angle)		
Calculate velocity of secondary fragments (e.g., constrained, unconstrained)		

Determining Loading - Evaluate Internal Hazards Due to External Loads

As part of *Evaluate Internal Hazards Due to External Loads*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine propagation of leakage pressure		
Assess internal thermal environment		

Determining Loading - Calculate Design and Analysis Loads

As part of *Calculate Design and Analysis Loads*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Apply air blast loads to the blast-exposed components		
Identify effects of clearing and drag		
Apply ground shock loads to buried surfaces		
Apply point impact loads to structures (e.g., soft target, hard target, hard impactor)		
Apply distributed impact loads to blast-exposed components (e.g., fragments)		
Combine gravity and shock load effects		
Combine gravity, shock, and impact load effects		

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Performing Analysis and Design - Evaluate Materials

As part of *Evaluate Materials*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine expected properties		
Identify the need for material testing (e.g., standard, non-standard)		
Select material tests		
Quantify strain rate effects on material properties		
Define limit states based on analysis methods used (e.g., stress vs. strain, strain at failure)		
Identify material alternatives		
Select a constitutive model		

Performing Analysis and Design - Perform Dynamic Analysis

As part of *Perform Dynamic Analysis*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine load path		
Identify preliminary dynamic analysis methods (from least to most complex)		
Identify limitations of preliminary dynamic analysis method		
Idealize boundary conditions		
Calculate input parameters (e.g., equivalent mass, stiffness, damping, load, natural period)		
Perform preliminary dynamic analysis (e.g., SDOF, breach curves, nomographs)		
Compare results with specified performance requirements		
Determine if higher fidelity analysis approach is warranted		
Finalize dynamic analysis		

Performing Analysis and Design - Evaluate Test Reports

As part of *Evaluate Test Reports*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Determine applicability of test reports (e.g., scaling, standards, data collection methods, support conditions)		
Validate test data against benchmark data		
Evaluate recommendations and conclusions		
Verify accuracy and completeness of test and test report		

Performing Analysis and Design - Analyze Internal Hazards Due to External Loads

As part of *Analyze Internal Hazards Due to External Loads*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Evaluate potential debris		
Develop shock spectra		
Establish lethality and fragility curves (e.g., human, equipment)		
Determine need for shock isolation designs		

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Completing Blast-Resistant Design - Incorporate Analysis Results into Design

As part of *Incorporate Analysis Results into Design*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Extract design information from analysis		
Design connections and detailing to ensure they conform with assumptions made during analysis (e.g., boundary conditions, deformations)		
Coordinate with other disciplines to ensure compatibility with design		
Validate correct implementation		
Apply balanced design		

Completing Blast-Resistant Design - Develop Blast Performance Specifications for Blast-Resistant Components

As part of *Develop Blast Performance Specifications for Blast-Resistant Components*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Define systems that require blast performance specifications		
Translate project performance requirements into specification language		
Coordinate blast performance specifications with other disciplines		
Incorporate demonstration of compliance requirements		

Completing Blast-Resistant Design - Develop or Review Blast Reports

As part of *Develop or Review Blast Reports*, please indicate how frequently the steps below are performed on the job and how important each step is to the competent performance of a Blast Protection Professional.

	Frequency - How often is this task performed by a Blast Protection Professional?	Importance - How important is this task to the performance of a Blast Protection Professional?
Demonstrate blast-resistant design meets blast performance requirements		
Review blast-resistant design against overall building paradigm		
Document baseline assumptions and sources		
Summarize findings and recommendations		
Provide information on procedures and methodologies used		

Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Are there any duties, tasks or steps related to the job of a Blast Protection Professional that are missing from this survey?

- No
- Yes

If yes, what?

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Blast Protection Professional (BPP) Job/Task Analysis (JTA) Validation Survey

Thank you! We appreciate your input!

You have completed the survey, and we really appreciate the time you have taken to share your knowledge with us! The Combating Terrorism Technical Support Office would like to thank you for taking the time to help.

Appendix B: Tasks or Knowledge Missing: List of Written Comments

The comments that follow were provided in response to the BPP JTA validation survey question: "Are there any duties, tasks or steps related to the job of a Blast Protection Professional that are missing from this survey?" Comments are grouped according to overarching topic and reference the relevant task(s) and/or step(s) from the original DACUM chart, where applicable. The original language of the author's comment is preserved, although editorial changes have been made to correct spelling and remove redundant language (e.g., "A blast protection professional should be able to…").

1. PROPOSED STEPS CLOSELY ASSOCIATED WITH EXISTING TASK(S) AND/OR STEP(S)

1.1. Interpret Standards & Define Project Scope (A.1.b)

- Determine design requirement for blast-resistant design from clients.
- Demonstrate understanding of guidance document requirements such as VA/DoD design criteria or API 752/753/756 siting criteria.
- Assess and determine if the blast resistant feature would actually mitigate the defined threat. As an example, blast resistant windows offer no protection when the threat is inside the building...yet, the criteria might say to install the blast resistant windows as a prescriptive feature.
- Full understanding of criteria and implications of criteria.
- Identifying the scope and importance of the project. A lot of the questions posed may be relevant and important to some types of projects and less so to others.
- Standards knowledge, interpretation, and inference thereof.

1.2. Conduct Vulnerability Assessment on Existing Structure (A.1.f & D.3)

- Evaluate existing structures for blast resistance / blast protection analysis.
- Perform vulnerability assessment of an existing facility.
- Recommend upgrades as part of feasibility study.
- Survey and evaluation of buildings for blast when drawings are not available.
- Vulnerability and risk assessments.
- Interpret and evaluate threat and security assessments.
- Risk-based analysis is derived from the ability to perform Threat, Vulnerability and Risk Assessment.

1.3. Educate Client (A.1.k)

- Educate clients on blast requirements. Many potential clients (government contractors) don't understand the need for blast design as dictated by applicable standards and often move forward without incorporating them. Sometimes, they are able to get away with this, as the ultimate client (usually the government) also does not fully understand what is required.
- Education of clients about blast design to aid in decision making.
- Communicate the assumptions, threats, and performance of the blast issue /solution to the lay. The field is such that most do not have the background to know what the risks are or how blast protection could reduce those risks.
- Steer US government project managers in developing the applicable design basis threat and response criteria in protecting public health and welfare.

1.4. Predict Target Perforation for Arbitrary Projectile (B.6.d)

- Projectile/fragment perforation analysis.
- Debris perforation characterization and other localized response considerations.

1.5. Demonstrate Understanding of Analysis Method & Software Tool Limitations (C.2.c)

- Demonstrate understanding and application/use of pressure-impulse curves.
- Need to understand limitations of all design/analysis methods (however well established).
- Detailed knowledge of the various design software - SBEDS, BLASTX, SHOCK, FRANG, other SDOF tools, High Fidelity FE and CFD methods- and know when to use what tool for the specific project.
- Working expertise in theory of structural dynamics and computational structural dynamic analysis.
- Understand, perform and evaluate higher fidelity analysis methods, including computational fluid dynamic (CFD) methods for calculating blast loading and Finite Element Analysis (FEA) methods for nonlinear dynamic analysis of system behavior.
- Demonstrate understanding of difference between dynamic loading and static loading (very common issue among professionals claiming to be able to design for blast effects).

1.6. Demonstrate Understanding of Blast-Resistant Details (D.1.b & D.2)

- Demonstrate understanding of component design details (windows, doors, blast doors).
- Demonstrate understanding of typical building upgrade concepts such as limitations and intent of design (i.e. shield walls, post upgrades for masonry, FRP, etc.).
- Structural materials and the design of structural members and connections.

1.7. Perform Master Planning to Include Protective Design Considerations (D.1.c & D.2.c)

- Incorporate an appreciation of blast behavior in the master planning of a site (including functional programming).
- Interplay with operational security measures.
- Coordination with process safety (chemical or mechanical) engineers in better developing the potential explosion sources at petrochemical facilities.
- Egress / shelter in place determinations - rescue planning.
- Structure layout to inherently protect lifelines.

1.8. Perform Risk-Based Decision Making That Considers Cost (D.3)

- Risk-based cost/benefit analysis is important in identifying the most viable mitigation strategies.
- Assessment of risks vs. benefits for blast protection.
- Participate in cost-benefit analysis and make recommendations to clients on most effective way to upgrade facility within the allocated budget.
- Need to understand costs benefits and to understand alternatives (e.g. HVM increasing stand-off distances).
- Cost implications of hardening and the different levels of protection.
- Review of design recommend changes to improve blast level of protection at minimal cost.
- Ensure that blast-resistant components are not over-designed resulting in added cost.
- Blast-resistant designs (new and retrofits) must be reviewed for constructability.

1.9. Miscellaneous Proposed Steps Closely Associated with Existing Task(s) and/or Step(s)

- QAQC - I suppose this is the verification and validation portions. (A.1.i & D.1.d)
- Test execution and in-the-field data analysis. (A.2)
- Determine potential reactions of an explosive source [e.g., for AE classified as HD 1.3 (mass fire), consider whether confinement, say in a mixing bowl, could produce a HD 1.1 detonation.] (B.1)
- Explosive containment chamber analysis and design. (B.1.g)

- Debris density (including as function of azimuth) prediction. (B.4.c)

2. PROPOSED STEPS OUTSIDE SCOPE OR NOT CLOSELY ASSOCIATED WITH AN EXISTING TASK OR STEP

2.1. Hostile Vehicle Mitigation

- Even though it is not "blast" per se, BPPs are often involved in vehicle barrier impact analysis. The physics and process of incorporating these into a project is similar to blast elements and it may be wise to include this discipline into the responsibilities and qualifications of a BPP. I do not think there is much overlap with other engineering disciplines on this topic.
- Establish protected perimeter.
- Analyze/design anti-ram perimeter barriers.
- Other aspects of protection, e.g. HVM to control standoff.

2.2. Prescriptive Explosive Safety Criteria

- Determine permissible personnel locations during explosives operations.
- Determine/validate protection requirements (to personnel/public and property) from each explosives operation. In so doing, determine whether explosive reaction/detonation should be treated as accidental or intentional (explosives safety).
- Calculate default Q-Ds and determine whether they're satisfied (explosives safety).

2.3. Miscellaneous Proposed Steps Outside of Scope or Not Closely Associated with an Existing Task or Step

- Progressive collapse is a similar issue, but that shares overlap with structural engineering to a much greater extent. I think a qualified structural engineer could do a progressive collapse analysis without knowing much about blast physics.
- Multi-hazard environments.
- Fire hazards.
- Explosion incident investigation.
- Underwater environments.
- Peer review activities.
- Software development.
-

3. Continuing education.GENERAL COMMENT: “SCOPE IS TOO BROAD”

- Even if we ultimately decide to limit our certification to blast analysis/design, needed competencies will vary with the job type - e.g. researcher, developer/user of advanced computer models, or AE designer - and with the design threat. Regarding the design threat, AT analyses/designs typically focus on external, far range detonations of relatively low explosive weights, ignore fragmentation and thermal hazards, and may require evaluation of conventional construction and glass hazards; explosives safety designs typically focus on internal, close-in detonations/mass fires and in many cases, require evaluation/protection from fragmentation & thermal hazards. While there's some overlap in needed competencies, there also are areas/competencies that are unique to each community.
- It's going to be very difficult to find someone with expertise in the full range of duties a "Blast Protection Professional" may perform. At some point, decisions will need to be made on the specific duties/capabilities for which we're certifying competency.
- I think that the duties are at least broken out into 3 categories, calculation of dynamic loads (blast, fragments, etc.), analysis/design of structural components to resist the design dynamic loads, and hazard assessments (broader than previous two categories) to include ground shock,

debris, in-structure shock, soil-media interaction to ground shock, etc. There are many "blast engineers" who only do straight-forward blast analysis/designs to a defined blast load using dynamic analysis to pre-defined blast loads in the specifications or as calculated by others in their organization. These are primarily structural engineers. Similarly, there are some engineers who only calculate blast loads, although many in this category are more experienced engineers who also do analysis/design of component dynamic response to the loads. Finally, there are some engineers who have worked in this area a long time and have a much broader background to include hazard assessment (or another term could be used for this category). Someone can do a fine job on blast resistant design without knowing how to calculate primary fragments from a weapon, for example. So, my main point is that you have to define the role of an engineer in a case requiring blast protection in order to define the tasks or steps appropriate for that role.

- I think you are mixing job duties that are typically divided into 3 sub areas of practice in the field of blast protection: (1) operational evaluation and scenario development - typically done by individuals with little or no engineering experience, (2) explosion source analysis - should be done by experts in energetics but it usually done by structural engineers using overly simplified tables, and (3) structural design - practitioners in this area are typically simply FEA experts who honestly have limited understanding of energetics but think they do because they can run CONWEP or pull a number off a blast curve. The field of blast protection is dominated by structural engineers who understand the need for sophisticated structural response analysis but for some reason refuse to admit the need for sophisticated load analysis.
- I'm not sure if this is a duty or more a comment on the structure of the duties. I'm not sure if every person who obtains a BPP will/should be an expert in all the task we have included in this survey. Everyone currently in the industry has areas where they are an expert and areas where they are not and they might not conduct work in the lower knowledge areas. Should there been "core knowledge" that every BPP should have about blast loadings and calculations and the particulars of have they applied. And then there will be duties that are more specific to the testing, assessments, planning, evaluations and designing?
- Yes and no. The scope of the task areas previously surveyed are large and encompass multiple disciplines. It will be difficult to find someone able to cover all areas, at least with any true depth of knowledge. IN practice, the BPP will have certain areas of expertise, with passing knowledge in the others.
- The duties and tasks are comprehensively covered; however, the practice is so broad that some professionals may only be involved in a fraction of the activities in the course of their career. Therefore, familiarity with all of the duties, tasks and steps is important and desirable but mastery of the duties may be very limited to a person's primary area of practice. Although I tried to be objective, my responses to the occurrence and importance are therefore skewed by my personal areas of practice...some tasks are performed more frequently by me and some tasks are performed more frequently by others I work with.
- Blast Protection Professional usually has a set of specific competencies. Someone may be a specialist in Hostile Vehicle Mitigation but may not have skills in detailed CFD blast analysis.

4. MISCELLANEOUS COMMENTS

- This survey should provide an indication of the duties most commonly performed by blast protection AEs/consultants/government personnel. The question then is whether these are the capabilities for which certification is needed.
- The survey focuses primarily on the blast protection of buildings. The blast protection professional is commonly concerned with many other types of structures including vehicles, infrastructure (bridges, electric utility lines, pipelines, storage tanks, etc.), weapon magazines, test reaction structures and blast-containment chambers and test cells. Designing these other

structures can be very different from designing a building, and those differences should be considered in any BPP certification.

- Many of the questions in the survey were hard to answer from a DoD client perspective and as a recipient of these services vs. a provider of the services. So, from my perspective as a customer paying for theses blast professional services I answered them with the perspective of what would I expect from a contractor.
- I answered occasionally in this survey because industrial blast buildings are increasingly relocated rather than designed for blast. Our firm has a separate group that evaluates explosion risk and performs a dispersion analysis.

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