Engineering Competency Model

U.S. Department of the Interior

Office of Human Resources

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Table of Contents

Engineering Competency Model Study Summary

In 2016, the DOI Office of Human Resources (OHR), in collaboration with the U.S. Office of Personnel Management (OPM), identified multiple job series Government-wide and at the Department level that were either linked to strategic Department goals or at risk of failure due to human capital deficiencies (e.g., attrition). Civil Engineering (GS-0810) and Petroleum Engineering (GS-0881) were identified as top priorities during these efforts due to factors such as attrition and their relation to the Department's mission.

As a result, OHR conducted a comprehensive study to identify the critical competencies and tasks for successful performance of engineering work across the Department. OHR worked with engineering subject matter experts from across the Department in order to create a thorough and accurate representation of the work performed by DOI engineers and the knowledge, skills, and abilities required to perform that work. The approach used for this project allowed for the examination of multiple occupations at the same time. In addition to the GS-810 and GS-881 series, five other engineering occupations were deemed to have a large enough probable sample to include as part of this study. The occupations included in the study were:

- GS-801 – General Engineering
- GS-810 – Civil Engineering
- GS-819 – Environmental Engineering
- GS-830 – Mechanical Engineering
- GS-850 – Electrical Engineering
- GS-880 – Mining Engineering
- GS-881 – Petroleum Engineering

The study involved a variation of OPM's Multipurpose Occupational Systems Analysis Inventory – Closed-Ended (MOSAIC) method for gathering and analyzing information about work. The MOSAIC approach has been utilized to study and describe work performed within the Federal Government for over 25 years. The study included a wide-ranging literature review to build lists of tasks and competencies used to describe engineering work across the Department. Next, focus groups with DOI engineering subject matter experts were held to ensure these lists were complete and accurately represented the job. DOI subject matter experts also linked competencies to each task to confirm they were indeed required to perform the work. DOI engineers rated the tasks and competencies to demonstrate the importance and utility of each component of the study. Finally, engineering subject matter experts reviewed the results of the study to ensure its accuracy.

The results of this study establish a common set of engineering tasks and competencies across the Department, which can be used to create assessment and selection techniques and tools and establish common practices and terminology for recruitment, performance management, workforce planning, training, and employee development. This work provides DOI with current, validated information that can be used to ensure its engineering workforce has the tools to meet future challenges.

Please reference the Competency Model Interpretive Guidance for assistance in interpreting and applying the results of this study.

Table 1: Critical Competencies by Grade[1]

The following general competencies are considered critically important, distinguish between high and low performance, and are required upon entering a new engineering position. The competencies listed are valid for assessment and selection, performance management, and other related HR functions across the engineering occupational series included in this study at the grade levels listed below.

GS-5	GS-7	GS-9	GS-11
• *Attention to Detail* • *Integrity/Honesty* • *Interpersonal Skills* • *Learning*	• Attention to Detail • *Flexibility* • Integrity/Honesty • Interpersonal Skills • Learning • *Writing*	• Attention to Detail • *Customer Service* • Flexibility • Integrity/Honesty • Interpersonal Skills • Learning • *Problem Solving* • *Technical Competence*[2] • Writing	• *Accountability* • Attention to Detail • Customer Service • Flexibility • Integrity/Honesty • Interpersonal Skills • Learning • Problem Solving • *Resilience* • Technical Competence • Writing
GS-12	**GS-13**	**GS-14**	**GS-15**
• Accountability • Attention to Detail • Customer Service • Flexibility • Integrity/Honesty • Interpersonal Skills • Learning • *Legal Compliance* • *Oral Communication* • Problem Solving • Resilience • *Teamwork* • Technical Competence • Writing	• Accountability • Attention to Detail • Customer Service • Flexibility • Integrity/Honesty • Interpersonal Skills • Learning • Legal Compliance • Oral Communication • Problem Solving • *Project Management* • Resilience • *Risk Management* • *Teaching Others* • Teamwork • Technical Competence	• Accountability • Attention to Detail • Customer Service • Flexibility • *Influencing/ Negotiating* • Integrity/Honesty • Interpersonal Skills • Learning • Legal Compliance • Oral Communication • *Organizational Awareness* • Problem Solving • Project Management • Resilience • Risk Management	• Accountability • Attention to Detail • Customer Service • *Financial Management* • Flexibility • Influencing/ Negotiating • Integrity/Honesty • Interpersonal Skills • Learning • Legal Compliance • Oral Communication • Organizational Awareness • Problem Solving • Project Management

[1] Italics represent the lowest grade at which the competency appears.
[2] Technical competencies needed for specialized positions, as appropriate. Technical competencies are listed and defined in Appendix A.

	• Writing	• Teaching Others • Teamwork • Technical Competence • Writing	• Resilience • Risk Management • Teaching Others • Teamwork • Technical Competence • Writing

Table 2: Required Proficiency Levels by Grade Level

Proficiency Level Scale Definitions		
Proficiency Level	**General Competencies**	**Technical Competencies**
5 = Expert	• Applies the competency in exceptionally difficult situations • Serves as a key resource and advises others	• Applies the competency in exceptionally difficult situations • Serves as a key resource and advises others • Demonstrates comprehensive expert understanding of concepts and processes
4 = Advanced	• Applies the competency in considerably difficult situations • Generally requires little or no guidance	• Applies the competency in considerably difficult situations • Generally requires little or no guidance • Demonstrates understanding of concepts and processes
3 = Intermediate	• Applies the competency in difficult situations • Requires occasional guidance	• Applies the competency in difficult situations • Requires occasional guidance • Demonstrates understanding of concepts and processes
2 = Basic	• Applies the competency in somewhat difficult situations • Requires frequent guidance	• Applies the competency in somewhat difficult situations • Requires frequent guidance • Demonstrates familiarity with concepts and processes
1 = Awareness	• Applies the competency in simplest situations • Requires close and extensive guidance	• Applies the competency in simplest situations • Requires close and extensive guidance • Demonstrates awareness of concepts and processes

Table 2: Required Proficiency Levels of General Competencies[3]								
	GS-5	**GS-7**	**GS-9**	**GS-11**	**GS-12**	**GS-13**	**GS-14**	**GS-15**
Accountability	2	2	2	**3**	**3**	**4**	**5**	**5**
Attention to Detail	**2**	**2**	**3**	**3**	**3**	**4**	**5**	**5**
Contracting/Procurement	1	1	2	2	2	3	3	4
Cost Estimation and Analysis	1	1	2	2	2	3	3	3
Creative Thinking	1	1	2	2	3	3	4	4
Customer Service	2	2	**3**	**3**	**3**	**4**	**4**	**4**
Financial Management	1	1	1	2	2	3	4	**4**
Flexibility	2	**2**	**2**	**3**	**3**	**4**	**4**	**4**
Influencing/Negotiating	1	1	1	2	2	3	**4**	**4**
Information Management	1	1	2	2	3	3	4	4
Integrity/Honesty	**3**	**3**	**3**	**4**	**4**	**4**	**5**	**5**
Interpersonal Skills	**2**	**2**	**3**	**3**	**3**	**4**	**4**	**4**
Learning	**2**	**2**	**3**	**3**	**3**	**3**	**4**	**4**
Legal Compliance	1	1	2	2	**3**	**3**	**4**	**4**
Oral Communication	1	1	2	2	**3**	**3**	**4**	**4**
Organizational Awareness	1	1	2	2	3	3	**4**	**4**
Problem Solving	1	1	**2**	**3**	**3**	**4**	**4**	**4**
Project Management	1	1	2	2	2	**3**	**4**	**4**
Research and Statistics	1	1	2	2	2	3	4	4
Resilience	1	1	2	**3**	**3**	**4**	**4**	**4**
Risk Management	1	1	2	2	2	**3**	**4**	**4**
Teaching Others	1	1	1	2	2	**3**	**4**	**4**
Teamwork	1	2	2	2	**3**	**4**	**4**	**4**
Technical Competence	1	2	**3**	**3**	**3**	**4**	**4**	**4**
Technology Awareness	1	1	2	2	2	3	4	4
Writing	2	**2**	**3**	**3**	**3**	**4**	**4**	**4**

[3] Bolded competencies are validated for use for assessment and selection purposes.

Table 3: Behavioral Examples for Competencies

Competency Name	Definitions
Accountability	**Holds self and others accountable for measurable high-quality, timely, and cost-effective results. Determines objectives, sets priorities, and delegates work. Accepts responsibility for mistakes. Complies with established control systems and rules.** • *Takes responsibility for results and work products* • *Ensures work is completed on time and at the level of quality required* • *Understands the rules and regulations of the work performed and ensures compliance with them* • *Demonstrates responsibility with important materials, critical processes, or confidential information*
Attention to Detail	**Is thorough when performing work and conscientious about attention to detail. Recalls information that has been presented previously.** • *Sets the standards for the quality of the work completed for the organization* • *Leads others in attending to detail in difficult and/or high-pressure circumstances* • *Reviews and edits work completed by others to ensure that the quality of work meets acceptable work standards* • *Independently completes thorough and accurate work*
Customer Service	**Works with clients and customers (that is, any individuals who use or receive the services or products that your work unit produces, including the general public, individuals who work in the agency, other agencies, or organizations outside the Government) to assess their needs, provide information or assistance, resolve their problems, or satisfy their expectations; knows about available products and services; is committed to providing quality products and services.** • *Commits to serving the public and understands their advisory role* • *Utilizes outreach, needs assessment, evaluation, and other marketing skills to identify and anticipate customer needs and provide exemplary customer service* • *Understands diverse customer groups, their perspectives, issues and needs* • *Works to ensure customers' needs are met, even when those needs are outside of the typical role of the position* • *Identifies and develops metrics to assess customer service satisfaction* • *Continuously improves products and services* • *Works and plans strategically, using a systems perspective to anticipate developing customer issues and needs and to provide timely solutions that focus on long-term benefits*
Financial Management	**Prepares, justifies, and/or administers the budget for program areas; plans, administers, and monitors expenditures to ensure cost-effective support of programs and policies; assesses financial condition of an organization.** • *Prioritizes expenditures to ensure organizational needs are met* • *Ensures that projects, programs, or organizations adhere to established program budgets* • *Factors estimated costs into organizational decision making*

Engineering Competency Model

Flexibility	**Is open to change and new information; adapts behavior or work methods in response to new information, changing conditions, or unexpected obstacles; effectively deals with ambiguity.** • *Effectively adjusts strategies or course of action in response to changing conditions* • *Makes quality decisions when faced with ambiguous situations* • *Is willing to incorporate new information into decision making process* • *Adapts behavior to overcome challenges*
Influencing/Negotiating	**Persuades others to accept recommendations, cooperate, or change their behavior; works with others towards an agreement; negotiates to find mutually acceptable solutions.** • *Persuades and influences parties to cooperate and accept recommendations* • *Explains and clarifies perspectives of an issue and its impact on all parties* • *Negotiates to achieve consensus through changed opinion, attitude or behavior* • *Demonstrates logic, communicates and persuades others to see benefits of recommendations within and across groups* • *Understands all sides of an issue and its impact on all parties involved* • *Negotiates with individuals or groups, including those that are resistant, to consider cooperating in order to achieve an acceptable solution*
Integrity/Honesty	**Contributes to maintaining the integrity of the organization; displays high standards of ethical conduct and understands the impact of violating these standards on an organization, self, and others; is trustworthy.** • *Takes pride in exhibiting personal and organizational integrity and honesty* • *Acts in a just, fair, and ethical manner and encourages ethical behavior among others, even when risky to do so* • *Inspires trust and confidence among stakeholders through reliability, authenticity, and accountability*
Interpersonal Skills	**Shows understanding, friendliness, courtesy, tact, empathy, concern, and politeness to others; develops and maintains effective relationships with others; may include effectively dealing with individuals who are difficult, hostile, or distressed; relates well to people from varied backgrounds and different situations; is sensitive to [redacted], race, gender, disabilities, and other individual differences.** • *Shows respect for the values and ideas of others, even when not agreeing with them* • *Empathizes with the concerns of others* • *Demonstrates tact and courtesy when interacting with associates* • *Is proactive in defusing arguments among peers* • *Seeks feedback from others to avoid blind-spots that can cause misunderstandings* • *Explores issues with the team; shares information; solicits ideas' uses participative decision-making processes*

Engineering Competency Model

Learning	**Uses efficient learning techniques to acquire and apply new knowledge and skills; uses training, feedback, or other opportunities for self-learning and development.** • *Is proactive in seeking out new knowledge* • *Devotes time to building new skillsets or further developing existing skillsets* • *Understands instructions or assignments without much need for additional explanation or clarification* • *Is open to constructive feedback on performance* • *Rarely makes the same mistake more than once* • *Effectively applies new knowledge or skills in applied environments*
Legal Compliance	**Knowledge of the regulations, codes, executive orders, agency rules, organizations, and functions of the Federal Government.** • *Shows familiarity with the structure and terminology of various rules and regulations of the Federal Government* • *Demonstrates the ability to search for and find appropriate rules or regulations* • *Understands how to apply appropriate rules and regulations to guide direction of work or make decisions*
Oral Communication	**Expresses information (for example, ideas or facts) to individuals or groups effectively, taking into account the audience and nature of the information (for example, technical, sensitive, controversial); makes clear and convincing oral presentations; listens to others, attends to nonverbal cues, and responds appropriately.** • *Speaks honestly, effectively and with integrity* • *Makes convincing, articulate, and accurate oral presentations using non-verbal and vocal qualities that support the verbal spoken message* • *Effectively uses various communication channels, including meetings, presentations and briefings* • *Actively considers, plans for, and reacts appropriately to the audience and the contextual environment in order to minimize barriers to understanding* • *Explains complex information clearly and accurately, and seeks feedback to determine that understanding has occurred* • *Acts as an effective facilitator in group or team settings*
Organizational Awareness	**Knows the organization's mission and functions, and how its social, political, and technological systems work and operates effectively within them; this includes the programs, policies, procedures, rules, and regulations of the organization.** • *Demonstrates awareness of the mission, functions, and various levels of the organization* • *Understands how decisions or actions of one organizational component may affect other components* • *Leverages knowledge of organizational components, programs, and directions to improve products, actions, or decisions* • *Shows familiarity with the rules and regulations of the organization*
Problem Solving	**Identifies problems; determines accuracy and relevance of information; uses sound judgment to generate and evaluate alternatives, and to make recommendations.** • *Examines problems and solutions with a long-term perspective*

	• *Effectively leads others in the effort of developing, identifying, and formulating problem solving strategies consistent with organizational goals* • *Uses logic to develop and implement innovative tools and techniques to resolve complex problems and issues* • *Uses logic to resolve complex, unique, or unusual problems* • *Consistently anticipates challenges that are not obvious to others* • *Determines the relevance of information in reaching effective conclusions* • *Formulates recommendations for the best course of action to address problems*
Project Management	**Knowledge of the principles, methods, or tools for developing, scheduling, coordinating, and managing projects and resources, including monitoring and inspecting costs, work, and contractor performance.** • *Schedules and keeps track of major project milestones and persons responsible* • *Communicates with various stakeholders to ensure that projects stay on time and on budget* • *Identifies and plans for external and internal barriers to project delivery* • *Delegates work to team members as necessary and ensures completion of work*
Resilience	**Deals effectively with pressure; remains optimistic and persistent, even under adversity. Recovers quickly from setbacks.** • *Achieves desired results in face of adversity* • *Overcomes barriers to accomplish goals* • *Stays positive in spite of setbacks* • *Works successfully in high pressure environments*
Risk Management	**Knowledge of the principles, methods, and tools used for risk assessment and mitigation, including assessment of failures and their consequences.** • *Anticipates potential risks or threats* • *Evaluates the potential costs and other repercussions of various types of failures* • *Assesses the likelihood of failures or other threats* • *Makes recommendations for risk mitigation* • *Chooses or advocates for an appropriate course of action*
Teaching Others	**Helps others learn through formal or informal methods; identifies training needs; provides constructive feedback; coaches others on how to perform tasks; acts as a mentor.** • *Provides instruction and feedback to others* • *Acts as a mentor to others* • *Determines areas for improvement and training for others* • *Tutors others in the performance of tasks*
Teamwork	**Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals.** • *Volunteers to assist associates with projects* • *Commits to working toward team or group goals* • *Displays team pride and empowers team pride among other group members* • *Works effectively in group settings in order to achieve team objectives*

Writing	**Recognizes or uses correct English grammar, punctuation, and spelling; communicates information (for example, facts, ideas, or messages) in a succinct and organized manner; produces written information, which may include technical material that is appropriate for the intended audience.** • *Composes clear, concise, and logical documents or correspondence involving complex technical information* • *Consistently and effectively tailors written products to a wide range of audiences and for diverse purposes in order to achieve a desired outcome* • *Proofreads and edits the writing of others* • *Effectively explains complex technical material to a non-technical audience* • *Uses correct grammar, punctuation, and spelling* • *Writes in an organized fashion that is easy to understand*

Table 4: General Competencies by Assessment Tool

Competency	Occupational Questionnaire	Structured Interview	Biodata	Cognitive Ability Test
Accountability	Low	High	High	Low
Attention to Detail	Low	Medium	Low	High
Customer Service	Low	High	Low	Low
Financial Management	Medium	High	Low	Low
Flexibility	Low	High	Medium	Low
Influencing/ Negotiating	Low	High	Low	Low
Integrity/Honesty	Low	High	Medium	Low
Interpersonal Skills	Low	High	Low	Low
Learning	Low	Medium	Medium	High
Legal Compliance	Low	High	Low	Low

Competency	Job Knowledge Test	Personality Inventory	Situational Judgment Test	Work Sample
Accountability	Low	Medium	Medium	Low
Attention to Detail	Low	Low	Low	High
Customer Service	Low	Low	High	High
Financial Management	Low	Low	High	Medium
Flexibility	Low	High	Medium	High
Influencing/ Negotiating	Low	Medium	Medium	Medium
Integrity/Honesty	Low	Medium	High	Low
Interpersonal Skills	Low	Medium	Medium	Medium
Learning	Low	Low	Low	Medium
Legal Compliance	High	Low	Medium	Medium

Engineering Competency Model

Competency	Occupational Questionnaire	Structured Interview	Biodata	Cognitive Ability Test
Oral Communication	Medium	High	Medium	Low
Organizational Awareness	Low	High	Low	Low
Problem Solving	Low	High	Medium	High
Project Management	Medium	High	Medium	Low
Resilience	Low	High	Medium	Low
Risk Management	Medium	High	Low	Medium
Teaching Others	Low	High	Medium	Low
Teamwork	Low	High	Medium	Low
Technical Competence	High	High	Low	Low
Writing	Low	Low	Medium	Low

Competency	Job Knowledge Test	Personality Inventory	Situational Judgment Test	Work Sample
Oral Communication	Low	Low	Low	High
Organizational Awareness	Medium	Low	Low	Low
Problem Solving	Low	Low	Medium	High
Project Management	Low	Low	High	High
Resilience	Low	Medium	Low	Low
Risk Management	Medium	Low	High	High
Teaching Others	Low	Medium	Medium	High
Teamwork	Low	Medium	Medium	Medium
Technical Competence	High	Low	Medium	High
Writing	Low	Low	Low	High

Appendix A: Engineering General Competencies[4]

Accountability	Holds self and others accountable for measurable high-quality, timely, and cost-effective results. Determines objectives, sets priorities, and delegates work. Accepts responsibility for mistakes. Complies with established control systems and rules.
Attention to Detail	Is thorough when performing work and conscientious about attention to detail.
Contracting/ Procurement	Knowledge of various types of contracts, techniques, or requirements (for example, Federal Acquisitions Regulations) for contracting or procurement, and contract negotiation and administration.
Cost Estimation and Analysis	Knowledge of the principles, practices, and methods used to determine, estimate, and analyze costs or value of investments, including determining life cycle costs, application of cost models, and evaluation of cost realism.
Creative Thinking	Uses imagination to develop new insights into situations and applies innovative solutions to problems; designs new methods where established methods and procedures are inapplicable or are unavailable.
Customer Service	Works with clients and customers (that is, any individuals who use or receive the services or products that your work unit produces, including the general public, individuals who work in the agency, other agencies, or organizations outside the Government) to assess their needs, provide information or assistance, resolve their problems, or satisfy their expectations; knows about available products and services; is committed to providing quality products and services.
Financial Management	Prepares, justifies, and/or administers the budget for program areas; plans, administers, and monitors expenditures to ensure cost-effective support of programs and policies; assesses financial condition of an organization.
Flexibility	Is open to change and new information; adapts behavior or work methods in response to new information, changing conditions, or unexpected obstacles; effectively deals with ambiguity.
Influencing/ Negotiating	Persuades others to accept recommendations, cooperate, or change their behavior; works with others towards an agreement; negotiates to find mutually acceptable solutions.
Information Management	Identifies a need for and knows where or how to gather information; organizes and maintains information or information management systems.

[4] Includes competencies identified for positions by SMEs that were not considered "critical" across each occupational series. These competencies may still be used for training and development purposes.

Engineering Competency Model

Integrity/Honesty	Contributes to maintaining the integrity of the organization; displays high standards of ethical conduct and understands the impact of violating these standards on an organization, self, and others; is trustworthy.
Interpersonal Skills	Shows understanding, friendliness, courtesy, tact, empathy, concern, and politeness to others; develops and maintains effective relationships with others; may include effectively dealing with individuals who are difficult, hostile, or distressed; relates well to people from varied backgrounds and different situations; is sensitive to [redacted] race, gender, disabilities, and other individual differences.
Learning	Uses efficient learning techniques to acquire and apply new knowledge and skills; uses training, feedback, or other opportunities for self-learning and development.
Legal Compliance	Knowledge of the regulations, codes, executive orders, agency rules, organizations, and functions of the Federal Government.
Oral Communication	Expresses information (for example, ideas or facts) to individuals or groups effectively, taking into account the audience and nature of the information (for example, technical, sensitive, controversial); makes clear and convincing oral presentations; listens to others, attends to nonverbal cues, and responds appropriately.
Organizational Awareness	Knows the organization's mission and functions, and how its social, political, and technological systems work and operates effectively within them; this includes the programs, policies, procedures, rules, and regulations of the organization.
Problem Solving	Identifies problems; determines accuracy and relevance of information; uses sound judgment to generate and evaluate alternatives, and to make recommendations.
Project Management	Knowledge of the principles, methods, or tools for developing, scheduling, coordinating, and managing projects and resources, including monitoring and inspecting costs, work, and contractor performance.
Research and Statistics	Knowledge of scientific principles, methods, and tools of basic and applied research (for example, statistics and data analysis) used to conduct a systematic inquiry into a subject matter area.
Resilience	Deals effectively with pressure; remains optimistic and persistent, even under adversity. Recovers quickly from setbacks.
Risk Management	Knowledge of the principles, methods, and tools used for risk assessment and mitigation, including assessment of failures and their consequences.
Teaching Others	Helps others learn through formal or informal methods; identifies training needs; provides constructive feedback; coaches others on how to perform tasks; acts as a mentor.

Teamwork	Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals.
Technical Competence	Uses knowledge that is acquired through formal training or extensive on-the-job experience to perform one's job; works with, understands, and evaluates technical information related to the job; advises others on technical issues.
Technology Awareness	Knowledge of developments of current and emerging technologies and their applications to work processes to meet organizational requirements.
Writing	Recognizes or uses correct English grammar, punctuation, and spelling; communicates information (for example, facts, ideas, or messages) in a succinct and organized manner; produces written information, which may include technical material that is appropriate for the intended audience.

Engineering Technical Competencies

Architecture	Knowledge of the concepts, principles, theories, and practices used in the planning, design, construction, and maintenance of buildings or other structures, taking into consideration aesthetic and functional concerns.
Building and Construction	Knowledge of materials, methods, and the tools to construct objects, structures, and buildings.
Chemical Engineering	Knowledge of the concepts, principles, and theories related to the chemical composition or physical characteristics of materials for the design, construction, operation, and improvement of processes or systems.
Civil Engineering	Knowledge of the concepts, principles, theories, and methods required to plan, design, construct, operate, and maintain facilities such as buildings, transportation systems, water and sanitary systems, and other public works systems.
Computer Engineering	Knowledge of the concepts, principles, theories, and methods of integrating electrical engineering with computer science to design and develop computer systems or other technological devices.
Design	Knowledge of conceptualizing, developing, producing, understanding, and using plans, models, blueprints, and maps, including the use of tools and instruments to produce precision technical drawings, working prototypes, components, or systems.
Electrical Engineering	Knowledge of the concepts, principles, theories, and methods related to the design, analysis, test, and integration of electrical systems; energy conversion; electrical power generation; and energy transmission, control, distribution or use.
Environmental Engineering	Knowledge of the concepts, principles, theories, and methods to protect and improve the quality of the environment and its resources; and to monitor, control, abate, and prevent pollutants, hazardous materials, or waste.
General Engineering	Knowledge of the concepts, principles, and theories of engineering and their practical applications.
Geotechnical Engineering	Knowledge of the concepts, principles, theories, and methods related to the investigation and evaluation of subsurface soil or geologic conditions and properties for the purpose of designing stable foundation

	systems, earthen structures, or the remediation of subsurface conditions.
Hydraulic Engineering	Knowledge of the concepts, principles, theories, and methods applicable to analysis of the flow of fluids (open channel and pressure flow), estimation of river stages, and design of hydraulic structures, drainage structures, pipes, navigation facilities, reservoirs, locks, and dams.
Hydrology	Knowledge of the concepts, principles, theories, and methods related to the magnitude, distribution, and quality of water resources including watershed management, climatology, geomorphology, groundwater hydrology, water quality, water resource management, and groundwater/surface water interactions.
Landscape Architecture	Knowledge of the concepts, theories, and practices used in the planning, designing, construction, and adaptation of outdoor features, taking into consideration recreation planning, requirements, aesthetic value, and compatibility with other developments and resources.
Materials Engineering	Knowledge of the concepts, principles, theories, and methods related to the composition, structures, and properties of materials, their use, behavior and performance under environmental influences, and the identification, processing, and manufacture of optimal materials for various applications.
Measurement and Instrumentation	Knowledge of electronics and related electrical engineering disciplines necessary for the research and development of sensors, electronic measurement devices, and instrumentation systems.
Mechanical Engineering	Knowledge of the concepts, principles, theories, and methods related to planning, designing, developing, testing, or evaluating thermodynamic, mechanical, heat transfer, electro-mechanical, pneumatic, hydraulic, or structural equipment, systems, models, tools, or specialized mechanical devices.
Mine Safety and Health	Knowledge of mine safety and health principles and practices, techniques and procedures, regulations, and standards as they apply to conducting inspections/investigations, identifying and evaluating unsafe conditions, and recommending methods to correct unsafe conditions.

Mining Engineering	Knowledge of the concepts, principles, theories, and methods related to rock mechanics; the exploration, geology, excavation, extraction, processing and transporting of mineral resources; the conservation and development of mineral lands, materials, and deposits; use of explosives; and the analysis of in-place reserves.
Petroleum Engineering	Knowledge of the concepts, principles, theories, and methods related to the exploration, development, extraction, recovery, processing, and conservation of fluid minerals, geothermal resources, organic compounds, or natural gas resources.
Physics	Knowledge and prediction of physical principles, laws, and applications including air, water, material dynamics, light, atomic principles, heat, electric theory, earth formations, and meteorological and related natural phenomena.
Requirements Analysis	Knowledge of the principles and methods to identify, analyze, specify, design, and manage functional and infrastructure requirements; includes translating functional requirements into technical requirements used for logical design or presenting alternative technologies or approaches.
Safety Engineering	Knowledge of the concepts, principles, theories, and methods to identify, control, mitigate, and eliminate safety hazards in the design and use of facilities, equipment, operations, and work processes.
Structural Engineering	Knowledge of the concepts, principles, theories, and methods related to the design and analysis of complex structures using a variety of materials.

Appendix B

Engineering Study Tasks (Displayed by Functional Area)

Engineering (ALL)

1. Acquires and maintains a working knowledge of relevant laws, regulations, policies, standards, or procedures.
2. Analyzes contracts or coordinates grants or co-operative agreements.
3. Composes complex correspondence or other written work (e.g., technical reports, contract proposals).
4. Conducts assessments of technology used to make recommendations on the best available and safest technologies.
5. Conducts on-the-job training.
6. Creates cost estimates and develops economic analyses for projects, programs, or budgets.
7. Designs or conducts analytical studies or other research.
8. Determines availability of equipment and construction materials.
9. Develops and tests theoretical models or approaches in field of expertise (for example, engineering models, computational models, growth and yield models, structural models).
10. Oversees or coordinates manufacturing, construction, installation, maintenance, support, documentation, or testing activities to ensure compliance with specifications, codes, or customer requirements.
11. Discusses results, problems, plans, suggestions, terms, or conditions with others.
12. Evaluates and makes recommendations on contractors.
13. Evaluates operating plans or service orders.
14. Evaluates, develops, and improves technology to ameliorate environmental concerns.
15. Evaluates, monitors, or ensures compliance with laws, regulations, policies, standards, or procedures.
16. Explains or justifies decisions, conclusions, findings, or recommendations.
17. Explains technical information to a variety of stakeholders.
18. Identifies or follows up on safety issues, hazards, or hazard exposures.
19. Identifies risks and determines mitigations to minimize risk.
20. Implements and manages programs.
21. Initiates, establishes, guides, and controls design or construction projects from inception through completion.
22. Inspects completed installations and observes operations to ensure conformance to design and equipment specifications and compliance with permit and operational, safety, or environmental standards.
23. Investigates complaints to determine the nature and extent of problems.

24. Advises contracting officer on issuing “stop work” instructions, notices of violation, or cessation of operation orders for unsafe conditions or environmental violations.
25. Manages, leads, or administers programs, projects, operations, budgets or activities.
26. Obtains data or information from other entities, such as government, state, or local agencies.
27. Operates computer-assisted engineering or design software or equipment to perform engineering tasks.
28. Oversees project production efforts to assure projects are completed on time and within budget.
29. Provides technical support for negotiations.
30. Performs calculations to compute and establish manufacturing, construction, or installation standards or specifications.
31. Plans and/or analyzes space requirements.
32. Plans and conducts field surveys to locate new sites and analyze details of project sites.
33. Plans logistics (e.g., transportation, procurement, equipment) for field work.
34. Plans, designs, installs, tests, and operates field instrumentation and operating systems.
35. Prepares scopes of work for contracts.
36. Prepares specifications for purchases of material or equipment.
37. Provides program and policy guidance to management on the development of standards, regulations, and best practices.
38. Reads and interprets blueprints, technical drawings, schematics, or computer-generated reports.
39. Reviews and provides feedback on the content of complex information (e.g., research or contract proposals, technical reports).
40. Reviews proposed and existing statutes, regulations, policies and guidance.
41. Reviews reports, documents, records, data, or other materials to verify completeness, correctness, consistency, compliance, or authenticity.
42. Serves on panels, committees, or task forces as a representative for the organization on technical or professional issues.
43. Designs sampling procedures.
44. Conducts engineering analysis of proposed facilities and modifications to existing facilities.
45. Inspects facilities to assess need for installations, modifications, repairs, or decommissioning.
46. Performs engineering analysis of survey plans and results.
47. Prepares or designs layouts.
48. Provides advice or assistance on technical matters and actively keeps abreast of current, relevant engineering practices and principles.

49. Reviews safety systems and inspection programs and makes recommendations for improvements.
50. Works with stakeholders to determine the accuracy and adequacy of plans of work.
51. Conducts and documents environmental surveys, investigations, and economic feasibility studies to determine compliance required with statutes, policies, and directives.
52. Coordinates the installation, maintenance, and operation of equipment.
53. Determines scheduling of programs and projects.
54. Writes or presents technical papers to a variety of audiences.
55. Coordinates with individuals inside or outside of the organization to accomplish work-related activities.
56. Collects samples (e.g., air quality, surface water, etc.).
57. Reviews and evaluates data from analyses.

General Engineering

58. Leads interdisciplinary teams with varying objectives.
59. Implements tools or systems for managing infrastructure or projects.
60. Ensures technical aspects of work are performed by contractor.
61. Ensures designs meet energy efficiency or renewable standards.

Civil Engineering

62. Advises on the impact of environmental regulations on operations.
63. Drafts detailed dimensional drawings and design layouts for projects and to ensure conformance to specifications.
64. Identifies and incorporates relevant factors (for example, ecological, cultural, aesthetic, and economic) in site or facility planning and design.
65. Inspects project site and evaluates contractor work to detect design malfunctions and ensure conformance to design specifications and applicable codes.
66. Performs hydraulic calculations and completes designs for water related projects.
67. Performs structural design of buildings, bridges, roads, utilities and water control structures
68. Collects samples and performs analyses of surface water, ground water, or waste water for chemical data.
69. Reviews and assesses the professional and technical abilities of independent third parties hired to certify the engineering soundness of plans and structures.
70. Reviews plans for the design, fabrication, installation, modification, repair, and decommissioning of structures, and determines accuracy and adequacy of information provided.
71. Uses geologic or hydrologic information to determine in situ parameters.
72. Utilizes computer-aided design software and water modeling software for engineering design.
73. Analyzes or models hydraulic, hydrologic, geotechnical, static and dynamic stability, and stress/strain relationships created, or projected to be created, by the project.

74. Develops, designs, and analyzes transportation systems.
75. Develops geotechnical site investigations.
76. Assesses geologic hazards and develops geotechnical design parameters to support project design.
77. Analyzes civil engineering materials for suitability for design and construction.
78. Conducts engineering analysis of facility designs to determine critical failure modes, quantify risks, and design mitigations.
79. Conducts forensic analysis of facilities to identify cause for failure.
80. Analyzes proposed site factors and designs maps, graphs, tracings, and diagrams to illustrate findings.
81. Calculates dimensions, square footage, profile and component specifications, and material quantities using calculator or computer.
82. Conducts engineering operations, such as the design, fabrication, installation, modification, repair, or decommissioning of structures.
83. Conducts stability analysis of structures.
84. Designs, constructs, and tests systems for field monitoring of active landslides and marginally stable slopes.
85. Determines or plots locations of facilities or structures (for example: roads, bridges, grades, building corners, etc.).
86. Develops, analyzes, monitors, or reviews loading conditions (e.g., seismic, wind, snow, etc.).

Environmental Engineering

87. Assesses the existing or potential environmental impact of land use projects on air, water, or land.
88. Conducts or coordinates environmental compliance audits.
89. Designs systems, processes, or equipment for control, management, or remediation of water, air, or soil quality.
90. Develops and implements environmental management protocols to conduct inspections and evaluations of working environments, operations, procedures, equipment and processes to identify, analyze and evaluate potential environmental risk.
91. Develops or presents environmental compliance training or orientation sessions.
92. Develops, manages, and executes environmental initiatives.
93. Identifies facilities, activities, and processes that could significantly affect the environment through the accidental or incidental release of chemical, biological, and/or radioactive substances into the environment.
94. Recommends actions necessary to preempt the occurrence of environmental statutory violations and to achieve compliance.
95. Provides critical review of reports and positions taken.

Mechanical Engineering

96. Calculates energy losses for buildings.
97. Conducts research that tests or analyzes the feasibility, design, operation, or performance of equipment, components, or systems.
98. Designs mechanical systems.
99. Develops and implements plans for maintenance and repair of grounds, buildings, structures, and equipment.
100. Develops procedures for testing systems or equipment.
101. Directs the installation of heating, ventilating, and air conditioning (HVAC), water, power, or control systems.
102. Evaluates mechanical designs or prototypes for energy performance or environmental impact.
103. Investigates equipment failures or difficulties to diagnose faulty operation and recommend remedial actions.
104. Performs trouble-shooting for various facility systems.

Electrical Engineering

105. Designs electrical systems or components.
106. Designs, implements, maintains, or improves electrical instruments, equipment, facilities, components, products, or systems.
107. Performs life cycle cost analyses for evaluation of electrical options in construction projects.
108. Plans layout of electric power generating plants or distribution lines or stations.
109. Plans or implements research methodology or procedures to apply principles of electrical theory to engineering projects.

Mining Engineering

110. Conducts mine planning and economic investigations for coal and other solid fuels resources.
111. Implements and coordinates mine safety programs, including the design and maintenance of protective and rescue equipment and safety devices.
112. Inspects mining areas for unsafe structures, equipment, and working conditions.
113. Monitors mine production rates to assess operational effectiveness.
114. Selects or develops mineral location, extraction, and production methods, based on factors such as safety, cost, and deposit characteristics.
115. Selects or devises materials-handling methods and equipment to transport ore, waste materials, and mineral products efficiently and economically.
116. Tests air to detect toxic gases and recommends measures to remove them, such as installation of ventilation shafts.
117. Engineers, evaluates, and investigates blast designs relative to the mining industry.
118. Investigates and predicts the surface subsidence that could occur as a result of underground mining operations.

119. Conducts or directs mining experiments to test or prove research findings.
120. Designs, directs, and oversees mining and mineral processing equipment and ancillary facilities.
121. Designs, develops, and implements computer applications for use in mining operations such as mine design, modeling, or mapping or for monitoring mine conditions.
122. Designs, directs, and oversees mine construction operations, such as the construction of shafts and tunnels.
123. Designs, implements, and monitors the development of mines, facilities, systems, or equipment.
124. Devises solutions to problems of land reclamation and water and air pollution, such as methods of storing excavated soil and returning exhausted mine sites to natural states.
125. Examines maps, deposits, drilling locations, or mines to determine the location, size, accessibility, contents, value, and potential profitability of mineral, oil, gas, and geothermal resources.
126. Identifies technological, engineering, and other factors that could affect the costs, safety, and impacts of mining.

Petroleum Engineering

127. Analyzes data to recommend placement of wells and supplementary processes to enhance production.
128. Develops plans regarding offshore oil spill preparedness and response strategies.
129. Directs and monitors the completion and evaluation of wells, well testing, or well surveys.
130. Establishes methods or procedures for valuing natural resources.
131. Maintains records of drilling and production operations.
132. Monitors production rates and plans processes to improve production.
133. Simulates reservoir performance for different recovery techniques, using computer models.
134. Specifies and supervises well modification and stimulation programs to maximize oil gas recovery.
135. Supervises the removal of drilling equipment, the removal of any waste, and the safe return of land to structural stability when wells or pockets are exhausted.
136. Takes samples to assess the amount and quality of oil, the depth at which resources lie, and the equipment needed to properly extract them.
137. Conducts engineering analysis of plugging or drilling projects.
138. Assesses costs and estimates the production capabilities and economic value of oil and gas wells, to evaluate the economic viability of potential drilling sites.
139. Defines and analyzes oil and gas plays or petroleum systems, including developing appropriate engineering parameters to define conventional and continuous reservoirs.
140. Conducts incident or spill investigations.

141. Conducts market research.
142. Conducts or analyzes engineering research or information to improve or modify oil machinery and operations.
143. Conducts studies of highly-technical geological processes and makes conclusions and recommendations on the results.
144. Designs and implements environmental controls on oil and gas operations.
145. Develops plans for oil and gas field drilling, and for product recovery and treatment.

Appendix C

Technical Competencies by Occupational Series[5]

The following tables outline which technical competencies were associated with each occupational series by engineering subject matter experts. Technical competencies associated with an occupational series may be needed to successfully perform the tasks of that series, depending on the duties and scope of the position. Refer to job analyses, position descriptions, or subject matter expert feedback (including supervisors) to determine if the technical competencies are appropriate for human resources functions such as assessment or performance management.

Competency	GS-801	GS-810	GS-819	GS-830
Architecture	X		X	X
Building and Construction	X	X	X	X
Chemical Engineering	X		X	X
Civil Engineering	X	X	X	X
Computer Engineering				
Design	X	X	X	X
Electrical Engineering	X	X	X	X
Environmental Engineering	X	X	X	X
General Engineering	X	X	X	X
Geotechnical Engineering	X	X	X	X
Hydraulic Engineering	X	X	X	X
Hydrology		X		
Landscape Architecture	X			X
Materials Engineering				X
Measurement and Instrumentation	X		X	X
Mechanical Engineering	X		X	X
Mine Safety and Health	X			
Mining Engineering	X		X	
Petroleum Engineering	X		X	
Physics	X		X	X
Requirements Analysis	X	X	X	X
Safety Engineering	X		X	X
Structural Engineering	X	X	X	X

[5] An "X" indicates that the technical competency was identified by subject matter experts as being needed to perform work in that particular occupational series.

Engineering Competency Model

Competency	**GS-850**	**GS-880**	**GS-881**
Architecture			**X**
Building and Construction	**X**	**X**	
Chemical Engineering	**X**		**X**
Civil Engineering	**X**	**X**	**X**
Computer Engineering	**X**		
Design	**X**	**X**	**X**
Electrical Engineering	**X**	**X**	**X**
Environmental Engineering	**X**	**X**	**X**
General Engineering	**X**	**X**	**X**
Geotechnical Engineering	**X**	**X**	**X**
Hydraulic Engineering	**X**	**X**	**X**
Hydrology			
Landscape Architecture			
Materials Engineering			**X**
Measurement and Instrumentation	**X**		
Mechanical Engineering	**X**	**X**	**X**
Mine Safety and Health		**X**	**X**
Mining Engineering		**X**	**X**
Petroleum Engineering			**X**
Physics	**X**	**X**	**X**
Requirements Analysis	**X**	**X**	
Safety Engineering	**X**	**X**	**X**
Structural Engineering	**X**	**X**	**X**