NCEES
advancing licensure for engineers and surveyors

P.O. Box 1686 (280 Seneca Creek Rd.), Clemson, SC 29633 USA T: (864) 654-6824 NCEES.ORG

MEMO

DATE: November 29, 2011

TO: Member Board Administrators and Testing Services

FROM: Tim Miller, P.E., Director of Examination Services

RE: Notice of Future Changes to NCEES Exams and Supporting Materials

In the October 2012 exam administration, NCEES will implement changes to two examinations. This letter provides Member Boards and testing services with the 1-year notice required by the NCEES *Manual of Policy and Position Statements*, Exam Development Policy 9.

October 2012 Administration

In the October 2012 exam administration, NCEES will implement changes to the following Principles and Practice of Engineering (PE) exams.

- **PE Fire Protection**—The PE Fire Protection exam has revised specifications. The new exam specifications are attached and are also posted online at ncees.org.
- **PE Nuclear**—The PE Nuclear exam has revised specifications. The new exam specifications are attached and are also posted online at ncees.org.

Examinee Management System

NCEES will continue to use the Examinee Management System to register all NCEES examinees.

- Registration for the April 2012 exams will be open **December 15, 2011–February 23, 2012.** *All examinees must be registered in the NCEES Examinee Management System by February 23, 2012. Board approvals and cancellations must be complete by March 5, 2012.*
- Examinees will log into the NCEES Web site, obtain a unique ID number, and register for the exam they intend to take. For the PE Civil, PE Mechanical, Structural Engineering, and Fundamentals of Engineering exams, examinees must also select an afternoon module when they register.

If you have any questions about these changes or require additional information, please contact me.

C: NCEES Board of Directors
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NCEES Principles and Practice of Engineering Examination
FIRE PROTECTION Exam Specifications

Effective Beginning with the October 2012 Examinations

- The exam is an 8-hour open-book exam. It contains 40 multiple-choice questions in the 4-hour morning session, and 40 multiple-choice questions in the 4-hour afternoon session. Examinee works all questions.
- The exam uses both the International System of units (SI) and the US Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.
- Codes and standards applicable to the exam will be those effective December 31 of the year preceding the exam.

		Approximate Percentage of Examination
I.	**Fire Protection Analysis**	**20%**
	A. Types of Analysis	7.5%
	1. Hazard analysis (e.g., flammable liquids, high-piled storage, electrical)	
	2. Risk analysis (e.g., likelihood, severity, impact)	
	3. Limitations of analyses	
	4. Data interpretation	
	B. Information Sources for Analysis	12.50%
	1. Uncertainty and safety factors	
	2. Functional use and operation of facility (e.g., industrial processes, occupancy, facility contents)	
	3. Acceptable thresholds (e.g., maximal temperature, heat flux, gas concentration)	
	4. Codes and standards	
	5. Occupancy, hazard, and commodity classifications	
	6. Fire test methods (e.g., classification, product or material characteristics)	
	7. Fire test data (e.g., sources, interpretation)	
	8. Exposures (e.g., proximal distance from hazards)	
	9. Technical drawings, schematics, and plans (e.g., contract documents, shop drawings, riser diagrams)	
II.	**Fire Protection Management**	**5%**
	A. Risk management	
	B. Inspection, testing, and maintenance procedures and frequencies	
III.	**Fire Dynamics**	**12.5%**
	A. Fire and smoke behavior	
	B. Fire growth	
	C. Combustion	
	D. Plume entrainment (e.g., axisymmetric, balcony spill, window, corner, wall)	
	E. Material properties (e.g., heat of combustion, ignitability, thermal, mechanical, flammable and explosive limits)	
	F. Material compatibility (e.g., storage arrangements, water reactives)	
	G. Heat transfer from fire and smoke	

IV. Active and Passive Systems — 50%

A. Water-Based Fire Suppression Systems — 15%

1. Design criteria (e.g., water supply, densities, pressure requirements, design areas, capabilities and limitations)
2. Hydraulic calculations (e.g., new and existing systems validation, including pipe schedule systems)
3. System types (e.g., wet and dry pipe, pre-action)
4. System components (e.g., sprinkler types, valves, flow detection, pipe and fitting material selection, cross-connection control, hanging and bracing)
5. Placement (e.g., obstructions, ambient conditions)
6. Water supply and distribution (e.g., public, private, storage tanks)
7. Fire pumps and controllers
8. Testing protocol (e.g., hydrostatic, pneumatic, duration, environmental considerations, water supply)

B. Special Hazard Systems — 10%

1. Design criteria (e.g., capabilities and limitations of the design)
2. Design method (e.g., total flooding, local application, or coverage area)
3. Pipe sizing (calculation input and output)
4. System types (e.g., low-pressure and high-pressure CO2, chemical and inert clean agents, wet and dry chemical, water mist, foam)
5. System components (e.g., valves, nozzles, pipe and fitting selection, hanging and bracing)
6. Agent storage
7. Personnel safety
8. Controls (e.g., actuation, pre-alarm, release, detection)
9. Collateral damage (e.g., toxic or acid byproducts, positive and negative pressure effects, environmental considerations)
10. System interlocks (e.g., damper, process shutdown)
11. Test methods (e.g., enclosure integrity test, pipe integrity test)

C. Fire Detection and Alarm Systems — 7.50%

1. Design criteria (e.g., sequence of operation, full versus partial detection, capabilities and limitations of the design)
2. System types (e.g., addressable, conventional, emergency communication system, combination)
3. Control equipment
4. Initiating devices (e.g., type, placement, performance, ambient conditions)
5. Notification appliances (e.g., type, placement, performance, voice communication, intelligibility)
6. Circuit classification and wiring methods
7. Survivability
8. Power supplies
9. Building control functions and system interfaces (e.g., elevator recall, HVAC, smoke control, door releases)
10. Monitoring (e.g., central station, proprietary)
11. Test methods (e.g., verify sequence of operation)

D. Smoke Management Systems — 5%

1. Design criteria (e.g., objectives, equipment survivability, pressure limits, air leakage, door opening force, capabilities and limitations of the design)
2. System types (e.g., pressurized stairwells, zone smoke control, natural and mechanical venting, exhaust)
3. System components (e.g., control equipment, fans, dampers, ductwork)

4. Fluid mechanics (e.g., vent flows, plugholing, make-up air velocity)
5. Smoke movement (e.g., stack effect, wind, buoyancy)
6. Initiating mechanisms
7. Power supplies
8. System interfaces (e.g., fire alarm, HVAC)
9. Test methods (e.g., model code requirements, verification of sequence of operation, component performance, safety)

E. Explosion Protection and Prevention Systems 2.50%

1. Design criteria (e.g., protected hazard, maximum pressure, oven ventilation and explosion venting, agent considerations, capabilities and limitations of the design)
2. Design method (e.g., suppression, inerting, isolation, venting, containment, damage-limiting construction)
3. Prevention methods (e.g., ignition prevention, humidity control, fuel control [dust layers, vapor concentration])
4. Personnel safety (e.g., vent discharge, proximity)
5. Collateral damage (e.g., adjacent structures or exposures)
6. System interlocks (e.g., dampers, process shutdown)
7. Test methods (e.g., other system survivability)

F. Passive Building Systems 10%

1. Construction types (e.g., combustible, noncombustible, fire resistive, frame)
2. Construction materials (e.g., roofing, sheathing, insulation)
3. Height and area limits
4. Building separation distance
5. Interior finish (e.g., flame-spread rating, critical radiant flux)
6. Structural fire resistance (e.g., calculation methods, substitution rules)
7. Compartmentalization/barrier (e.g., fire, smoke)
8. Protection of openings (e.g., penetration seals, joint systems, dampers, doors, vertical openings)

V. Egress and Occupant Movement 12.5%

A. Means of Egress 8.75%

1. Design criteria
2. Exits (e.g., types, remoteness, travel distances, number, capacity)
3. Means of egress components (e.g., exit access, exit, exit discharge)
4. Component details (e.g., stairwells, corridors, doors, hardware, elevators)
5. Occupancy types (e.g., assembly, detention, business)
6. Occupant load
7. Emergency lighting
8. Marking of the means of egress

B. Human Behavior 3.75%

1. Evacuation movement (e.g., timed egress analysis, egress width, travel time, travel distance, flow rate)
2. Human performance capabilities
3. Human response to fire cues (e.g., alarm, smoke, and heat)
4. Occupant pre-movement
5. Toxicology of smoke and heat

NCEES Principles and Practice of Engineering Examination
NUCLEAR Exam Specifications

Effective Beginning with the October 2012 Examinations

- The exam is an 8-hour open-book exam. It contains 40 multiple-choice questions in the 4-hour morning session, and 40 multiple-choice questions in the 4-hour afternoon session. Examinee works all questions.
- The exam uses both the International System of units (SI) and the US Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

	Approximate Percentage of Examination
I. Nuclear Power Systems	**35%**
A. Design and Analysis	20%
1. Energy generation and conversion	
2. Application and interpretation of data from experimental measurements of key parameters in the power system (e.g., heat transfer, fluid mechanics, power distributions, void fractions, scaling)	
3. Applications of conservation of mass, energy, and momentum	
4. Probabilistic risk assessment (PRA) (e.g., fault trees and event trees, probability distribution functions and cumulative distribution functions, quantitative risk analysis [QRA])	
5. Reactor safety analysis (e.g., LOCA, transient thermal-hydraulic behavior, fuel-clad mechanical interactions, chemical interactions)	
6. Reliability analysis (e.g., reliability block diagram analysis, single failure analysis, failure modes and effects analysis [FMEA], parts count analysis [PCA], stress margin analysis)	
7. Severe accident analysis (e.g., degraded core, combustible gas control, radiolysis, zirconium water reaction)	
8. Systems interactions (e.g., integrated plant behavior, coupling and feedback, steam generator level response to throttle valve)	
9. Thermal-hydraulic analysis (e.g., heat transfer, fluid dynamics, thermodynamics, natural circulation, critical heat flux, departure from nucleate boiling [DNB], peak centerline temperature, peak clad temperature, hot channel factor, flow oscillations)	
10. Engineering decision making (e.g., cost/benefit analysis, environmental impact, economics, ALARA, alternatives analysis)	
11. Treatment of measurement uncertainties in reactor protection and safety systems (e.g., error analysis)	

B. Components and Systems 12.5%
   1. Power conversion systems (e.g., turbines, heat exchangers, reactor, steam generator, pressurizer, steam dryers and separators)
   2. Containment systems (e.g., ice condensers, pressure suppression, containment spray, control of radionuclides, hydrogen control)
   3. Emergency core cooling systems (e.g., high-pressure injection, low-pressure injection, accumulators, emergency power, passive safety)
   4. Materials (e.g., thermophysical and neutronic properties, performance characteristics)
   5. Mechanical and hydraulic systems (e.g., pump and turbomachinery performance, fluid-structure interactions)
   6. Instrumentation and control (e.g., pressure and temperature sensors, flow meters, interlocks and permissives, power meters, coincidence circuits)
   7. Nuclear Steam Supply System (NSSS) water chemistry (e.g., corrosion control, soluble poison)

C. Regulations, Codes, and Standards 2.5%
   1. Codes and standards (e.g., interpretation of excerpts of ASME pressure vessel, ANSI/ANS to a given situation)
   2. Regulations and regulatory guidance (e.g., interpretation of excerpts of 10 CFR parts 21, 50, 51, 52, 54, 72, 100, NRC Regulatory Guides to a given situation)
   3. Licensing documentation scope (e.g., interpretation of excerpts of Technical Specifications, Safety Analysis Report [SAR], Environmental Impact Study [EIS] to a given situation)

II. Nuclear Fuel Cycle 15%

A. Fuel Design and Analysis 12.5%
   1. Cladding (e.g., integrity, corrosion, strength, chemical composition, neutron cross section)
   2. Depletion, burnup, and transmutation (e.g., transuranics, fission products, spent fuel assay)
   3. Fuel cycle processes (e.g., material balance, fuel enrichment, SWU, tails assay)
   4. Fuel bundle design (e.g., fissile enrichment, chemical form, accommodation for fission gas release, materials behavior, thermal hydraulic analysis)
   5. Conversion and enrichment processes (e.g., uranium chemistry, gaseous diffusion)

B. Handling, Shipping, and Storage 2.5%
   1. Nuclear material accountability and control (e.g., inventory and accountability, Material Unaccounted For [MUF], special nuclear material [SNM] regulations)
   2. Radioactive materials storage (e.g., spent fuel pool, independent spent fuel storage installation [ISFSI])
   3. Transport and storage cask design (e.g., Safety Analysis Report for Packaging [SARP], criticality, shielding, cooling, structural integrity)

III. Interaction of Radiation with Matter — 25%

A. Analysis — 20%

1. Buildup factors (e.g., correction factors, energy flux)
2. Chart of the nuclides (e.g., radioactive decay, energy release, half lives, branching, neutron activation)
3. Counting statistics (e.g., error propagation, deadtime analysis, standard deviation, lower limit of detection [LLD])
4. Energy deposition (e.g., local, distributed, thermal analysis of shields, charcoal heating)
5. Interaction coefficients (e.g., μa, μtr, μe)
6. Interaction of photons with matter (e.g., interaction coefficients [μa, μtr, μe], Compton scattering, pair production, photoelectric effect)
7. Radiation effects on materials (e.g., swelling, creep, radiolytic decomposition, embrittlement)
8. Neutron activation analysis
9. Neutron transport (e.g., flux, current, scattering, absorption, streaming)
10. Nuclear reaction rates (e.g., capture, scattering, charged particle, neutron production)
11. Shield design (e.g., materials, shape and orientation, High Z, Low Z, neutron absorbers, streaming, skyshine)
12. Source terms (e.g., transuranics, fission products, spent fuel, coolant, radwaste)

B. Protection — 5%

1. Dose assessment and personnel safety (e.g., biological effects, quality factors, acute radiation effects, chronic radiation effects)
2. Dosimetry (e.g., calibration, thermoluminescent dosimeter [TLD], film)
3. Emergency plans (e.g., criticality alarm systems, evacuation, exclusion zone, emergency declarations)
4. Radiation detection (e.g., types, selection, detector sensitivity, charge multiplication)
5. Radioactive material monitoring (e.g., controlled areas, in-situ monitoring)
6. Regulatory requirements (e.g., interpretations of excerpts of 10 CFR part 20 to a given situation)

IV. Nuclear Criticality/Kinetics/Neutronics — 25%

A. Criticality — 6.25%

1. Criticality analysis (e.g., neutron balance, neutron reflection, leakage, combination of uncertainties, subcritical multiplication)
2. Subcritical systems analysis (e.g., neutron sources, neutron balance, neutron reflection, leakage, new fuel handling)
3. Lessons learned from case histories (e.g., criticality safety practices, double contingency, SL-1, Tokai-mura)
4. Minimum critical mass (e.g., different fissile materials, bare and reflected, H/U ratio)

B. Kinetics — 6.25%

1. Delayed neutrons (e.g., beta, energy spectrum)
2. Fission product poisoning (e.g., xenon, samarium)

3. Point kinetics (e.g., keff, delayed neutron fraction, fission spectrum, reactivity, neutron lifetime, prompt critical, delayed critical)
4. Reactivity coefficients (e.g., temperature, power, Doppler, void)
5. Spatially dependent kinetics (e.g., xenon oscillations, local control rod effects, impact of local detectors)

C. Neutronics 12.5%

1. Characterization of neutron spectra (e.g., fast and thermal reactors, spectral shift, moderator effectiveness)
2. Chart of the nuclides (e.g., transformations, half lives, fission yields)
3. Cross sections (e.g., macroscopic and microscopic, atomic number densities, inelastic scattering, elastic scattering, absorption, transport, fission, energy collapsing)
4. Effects of strong absorbers (e.g., control rod worth, burnable poisons, self-shielding)
5. Energy release from nuclear processes (e.g., fission, fission product decay, prompt gamma, fusion)
6. Reactor core analysis (e.g., multigroup transport, approximations: Fick's Law, diffusion approximation, diffusion coefficients, perturbation theory, Monte Carlo methods)
7. Reactivity transients (e.g., rod drop, anticipated transient without scram [ATWS], differential rod worth)
8. Slowing down and thermalization (e.g., lethargy, scattering kernels, logarithmic energy decrement, Maxwellian distribution, resonance capture, Doppler broadening, unresolved resonances, 1/v)