U.S. Department of Energy

Washington, D.C.

ORDER

DOE 6430.1A

4-6-89

SUBJECT: GENERAL DESIGN CRITERIA

1. PURPOSE To provide general design criteria (GDC) for use in the acquisition of the Department's facilities and to establish responsibilities and authorities for the development and maintenance of these criteria.

2. CANCELLATION. DOE 6430.1, GENERAL DESIGN CRITERIA, of 12-12-83.

3. SCOPE. The provisions of this Order apply to all Departmental Elements except as otherwise provided by statute or by specific delegation of authority from the Secretary of Energy, and all contractors and subcontractors performing work for the Department whose contract may involve planning, design, or facility acquisitions. This includes DOE-owned, -leased, or -controlled sites where Federal funds are used totally or in part, except where otherwise authorized by separate statute or where specific exemptions are granted by the Secretary or his designee.

4. APPLICABILITY.

   a. The GDC provided by this Order shall be applied to all facilities which shall be reported on in the Department's Real Property Inventory System (RPIS), or which shall be reported on in the General Services Administration's annual "Summary Report of Real Property Owned by the United States Throughout the World."

   b. The GDC provided by this Order are not intended to provide complete coverage for the diverse facilities by type and complexity that are needed to support the varied Departmental program-mission requirements. Specific project criterta and/or specifications need to be developed to satisfy the needs for a particular facility, incorporating applicable requirements of these general design criteria and supplemented with required criteria from applicable codes and standards.

   c. It is recognized that many of the Departmental organizations having responsibilities for facility planning, design, and construction may establish and apply more comprehensive criteria to satisfy the particular program mission or operating requirements. There is no

intent that the GDC take precedence over such other criteria, where those criteria meet or exceed the GDC requirements. Where there exists a conflict between those criteria and the GDC provided by this Order, however, the GDC governs.

5. REFERENCES.

a. DOE 4700.1, PROJECT MANAGEMENT SYSTEM, of 3-6-87, which establishes the Department's project management system and provides implementing instructions, formats, and procedures, and sets forth the principles and requirements which govern the development, approval, and execution of the Department's outlay program acquisitions as embodied in the project management system.

b. Other Departmental Orders, applicable Federal laws, Executive orders, and Federal regulations, are identified in the various sections of the GDC where their requirements specifically apply and are contained in a general listing on page 1-7, in Section 0106, Regulatory Requirements.

c. All references and the section(s) in which they are cited in this Order are contained on page 17-35, Index of Referenced Documents.

6. DEFINITIONS. (See Abbreviations, page 1 and Glossary, page 9, which follow the Table of Contents.)

7. POLICY AND OBJECTIVES.

a. Policy. It is DOE policy that:

(1) Professional architectural and engineering principles and practices be applied to the planning, design, construction, alterations, and/or acquisition of the Department's facilities.

(2) All Departmental facilities will comply with the Federal and Departmental regulations for energy conservation and use of renewable energy.

(3) The planning, design and construction of the Department's facilities will be performed in a manner that will satisfy all applicable Executive Orders, Federal laws, and regulations. While the Department is not required to comply with state and local building codes, laws, and ordinance, the planning, design, and construction processes should accommodate them to the extent consistent with the accomplishment of the Department's mission.

(4) All Department facilities are to be designed and constructed to be reasonable and adequate for their intended purpose and consistent with health, safety, security, and environmental

protection requirements.

b. Objectives.

(1) To provide GDC that ensures implementation of the Department's policy covering:

(a) The basic architectural and engineering disciplines.

(b) Certain types of the Department's known facility requirements.

(c) Specialized requirements based on programmatic and operating experience.

(2) To establish authorities, responsibilities, and procedures that ensure timely development and maintenance of the GDC.

8. RESPONSIBILITIES AND AUTHORITIES.

a. Assistant Secretary, Management and Administration (MA-1), is responsible for development of budget, accounting, procurement, cost estimating, construction, facilitates management, site development, real estate, project management, and business related policy. Specific responsibilities with respect to this Order are carried out by the Deputy Assistant Secretary for Administration through the Director of Project and Facilities Management (MA-22).

(1) Establishes an advisory GDC Planning Board (see Glossary) and serves as the Department's focal point for the development, maintenance, and interpretation of the GDC. In fulfilling these responsibilities, technical advice and assistance are utilized from other Departmental organizations in their particular areas of interest.

(2) Maintains liaison with other Federal agencies, the architect-engineer professions, and the construction industries on current practices, procedures, criterta, and standards being applied to facility design and construction.

(3) Utilizes, as needed, technical advice and assistance of criteria users, support contractors, and consultants to develop and maintain criteria for specialized areas.

(4) Participates with the Building Research Board, a unit of the National Research Council, in activities relating to facility design and construction.

(5) When requested, provides technical advice and assistance to other Departmental organizations on matters relating to planning, design, and construction of facilities.

(6) Assures, through the GDC Planning Board, that proposed criteria revisions and additions of a substantive nature are reviewed with all appropriate Headquarters and field organizations.

(7) Participates with responsible Headquarters organizations identified in paragraph c, below, in reviewing and adopting comments received on their particular areas of responsibility.

b. Heads of Headquarters and Field Organizations Having Responsibilities for Construction Project Planning and Design or Facility Acquisitions.

(1) Assures that the GDC are applied throughout the planning and design of each construction project under his or her cognizance, whether contracted for by the Department or through the Department's management and operating contractors. The GDC shall be applied in the development of site-specific general design criteria, specific project design criteria, and technical specifications for facilities.

(2) Serves or appoints a member on the GDC Planning Board, and through that advisory body, recommends criteria revisions and additions to the Director of Project and Facilities Management; and provides technical input, advice, and assistance during revision or expansion of the criteria. A list of the current GDC Planning Board membership is as follows:

Deputy Assistant Secretary for Administration
Assistant Secretary for Environment, Safety, and Health
Assistant Secretary for Defense Programs
Director of Energy Research
Assistant Secretary, Conservation and Renewable Energy
Assistant Secretary for Nuclear Energy
Administrator, Western Area Power Administration
Administrator, Bonneville Power Administration
Manager, Albuquerque Operations Office
Manager, Chicago Operations Office
Manager, Idaho Operations Office
Manager, Nevada Operations Office
Manager, Oak Ridge Operations Office
Manager, Richland Operations Office
Manager, San Francisco Operations Office

Manager, Savannah River Operations Office
Director, Morgantown Energy Technology Center
Director, Pittsburgh Energy Technology Center

c. Heads of Headquarters Organizations Having Responsibilities for Establishing Policies, Performance Standards, or Operating Requirements That Need to be Applied to the Planning, Design Construction, or Acquisition of Department Facilities.

(1) Participate in the development and maintenance of the GDC, and assure that the GDC accurately reflects the design requirements associated with their particular areas of responsibility.

(2) Assist the Director of Project and Facilities Management in reviewing comments and recommendations received from other Departmental Elements and DOE contractors, as related to their particular areas of responsibility.

(3) Identify and develop revisions or additions to the criteria in their particular areas of responsibility in coordination with the Director of Project and Facilities Management.

(4) Provide assistance to the Director of Project and Facilities Management, other Headquarters organizations, and field organizations in making determinations of criteria applicability to specific facilities, and provide criteria interpretations in their particular areas of responsibility.

d Director, Naval Nuclear Propulsion Program. Executive Order 12344. statutorily prescribed by PL 98-525 (42 USC 7158 note), establishes the responsibilities and authority of the Director, Naval Nuclear Propulsion Program (who is also the Deputy Assistant Secretary for Naval Reactors within the Department) over all facilities and activities which comprise the joint Navy-DOE Program. In view of the unique nature of naval nuclear propulsion applications, and the statutorily prescribed responsibilities noted above, the Director shall determine the appropriate design criteria applicable to Program activities which will include consideration of appropriate parts of the criteria set forth by this Order.

9. BACKGROUND.

a. The organization of this Order is adapted from the MASTERFORMAT system developed by the Construction Specifications Institute. The 16 divisions are devoted to major building systems or design specialties. Additional information concerning the organization of the GDC is contained on page 1-3, Section 0101-3, Organization and Use of These Criteria. Note that the first two numbers of the section referred to, relate directly to the pertinent division. For example,

the section in the preceding statement is located in Division 1.

b. It is recognized that there will arise valid reasons for deviating from the GDC. Allowable deviations and deviations requiring prior Headquarters review or approval, and procedures to be followed, are described on page 1-2, Section O1O1-2, Criteria Deviations.

c. Assistance and support from Departmental organizations having responsibilities assigned in paragraph 8 and operating contractors will be required on a continuous basis for the effective development and maintenance of these GDC. The development of new criteria, where required, and the maintenance of these GDC will be supported by the GDC Planning Board.

d. Past experiences (lessons learned) can be of significant benefit in the planning and performance of construction projects. Incorporation of design-related lessons learned into the GDC will maximize the Department's benefits. Field organizations are encouraged to submit design-related lessons learned to the Director of Project and Facilities Management using the "GDC Improvement Proposal" form, a sample of which is provided on page 17-45. Proposed changes to the GDC will be evaluated by the GDC Planning Board with recommendations made to the Director of Project and Facilities Management. Copies of this form are available upon request to the Chairman, GDC Planning Board.

BY ORDER OF THE SECRETARY OF ENERGY:

LAURENCE F. DAVENPORT
Assistant Secretary
Management and Administration

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Abbreviations

A/E	Architect-engineer
AA	Aluminum Association
AAC	Associated Air Balance Council
AMMS	American Architectural Manufacturers Association
AASHTO	Amerian Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ABS	Acrylonitrile-butadiene-styrene
AC	Alternating current
ACB	Asbestos-cement board
ACFM	Actual cubic feet per minute
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete institute
ACSM	American Congress on Surveying and Mapping
ADM	Action description memorandum
ADP	Automated data processing
AEC	Atomic Energy Commission
AFM	U.S. Air Force Manual
AFR	U.S. Air Force Regulation
AFWL	U.S. Air Force Weapons Laboratory
AGA	American Gas Association
AHU	Air handling unit
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As low as reasonably achievable
AMC	Army Materiel Command
AMCA	Air Movement Contractors Association
AMC-R	Army Materiel Command Regulation
ANL	Argonne National Laboratory
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
AR	Army regulation
AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating Refrigeration and Air-Conditioning Engineers

ASME	American Society of Mechanical Engineers
ASTM	(formerly American Society for Testing and Materials, now ASTM)
AVLIS	Atomic Vapor Laser Isotope Separation
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
BAT	Best available technology
BATEA	Best available technology economically achievable
BCPCT	Best conventional pollutant control technology
BESEP	Base Electronic System Engineering Plan
BHP	Brake horsepower
BIA	Brick Institute of America
BIL	Basic impulse insulation level
BNL	Brookhaven National Laboratory
BOCA	Building Official Code Association
BOD	Biochemical oxygen demand
BRAB	Building Research Advisory Board (now Building Research Board)
BRB	Building Research Board
BTU	British thermal unit
0C	Degrees centigrade (Celsius)
C&GS	U.S. Coast and Geodetic Survey (now National Geodetic Survey)
CAA	Clean Air Act
CAMS	Continuous Air Monitoring System
CAS	Central alarm station
CCTV	Closed circuit television
CDR	Conceptual design report
CEM	Continuous emissions monitoring
CERC	Coastal Engineering Research Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CI	Cast iron
CISCA	Ceiling & Interior Systems Contractors Association
CISPI	Cast Iron Soil Pipe Institute
CMP	Corrugated metal pipe
CO 2	Carbon dioxide
COE	Army Corps of Engineers
CP	Concrete pipe
CPSC	Consumer Product Safety Commission
CPVC	Chlorinated polyvinyl chloride
CRI	Carpet and Rug Institute
CRT	Cathode ray tube
CSI	Construction Specifications Institute
CSOM	Computer Security Operations Manager
CSSO	Computer System Security Officer
CTI	Cooling Tower Institute
CUFT	Cubic foot

C_v	Flow coefficient
CWA	Clean Water Act
DAC	Derived air concentration
DARCOM	Department of the Army Readiness Command
DB	Dry bulb
DBA	Design basis accident
DBE	Design basis earthquake
DBF	Design basis fire
DBFL	Design basis flood
DBT	Design basis tornado
DBW	Design basis wind
DC	Direct current
DCG	Derived concentration guide
DCPA	Defense Civil Preparedness Agency
DEAR	DOE Acquisition Regulation
DL	Dead load
DM	NAVFAC Design Manual
DOD	U.S. Department of Defense
DOE/OR	U.S. Department of Energy/Oak Ridge
DOE	U.S. Department of Energy
DOP	Dioctylphthalate
DOT	U.S. Department of Transportation
DP-1	Assistant Secretary for Defense Programs
DP-34	Director of Safeguards and Security Agreement
DSC	Differential scanning calorimetry
DTA	Differential thermal analysis
ECC	Emergency Control Center
ECP	Entry control point
EMCS	Energy monitoring and control system
ECS	Emergency control station
EDE	Effective dose equivalent
EED	Elcctroexplosive device
EIA	Electronics Industries Association
EIMA	Exterior Insulation Manufacturers Association
EIS	Environmental impact statement
EM	Army Engineering Manual
EMS	Energy management system
EMT	Electrical metallic tubing
EO	Executive Order
EOC	Emergency operating center
EPA	U.S. Environmental Protection Agency
EPS	Emergency power system
ERDA	Energy Research and Development Administration (precursor to DOE)
ESF	Engineered safety feature
°F	Dcgrees Fahrenheit
FAA	Federal Aviation Administration
FAI	Fauske and Associates, Inc,
FAR	Federal Acquisition Regulation
FCC	Federal Construction Council
FEMA	Federal Emergency Management Agency

FGA	Flat Glass Marketing Association
FGCC	Federal Geodetic Control Committee
FGD	Flue gas desulphurization
FHA	Federal Highway Administration
FHDA	Fir and Hemlock Door Association
FIPS	Federal Information Processing Standards
FM	Factory Mutual
FPM	Feet per minute
FPMR	Federal Property Management Regulation
FR	Federal Register
FS	Federal Specifications
FSAR	Final safety analysis report
FWPCA	Federal Water Pollution Control Act
fy	Yield strength
GA	Gypsum Association
GDC	General Design Criteria, DOE 6430.1A
GPM	Gallons per minute
GSA	General Services Administration
HE	High explosives
HEPA	High-efficiency particulate air
HE-Pu	High explosives-plutonium
HF	High frequency
HF	Hydrogen fluoride
HI	Hydraulic Institute
HID	High intensity discharge
HLW	High-had waste
HOA	Hands-off-automatic
HP	Horsepower
HR	Hour
HTW	High temperature water
HVAC	Heating ventilating and air-conditioning
Hz	Hertz frequency
IAS	Intrusion alarm system
ICBO	international Conference of Building Officials
lCRP	International Commission on Radiological Protection
ID	Inside diameter
IDA	Intrusion detection and assessment
IDS	Intrusion detection system
IEEE	Institute of Electrical and Electronic Engineers
IES	Illumination Engineering Society
IFM	Irradiated fissile material
IFMSF	Irradiated fissile material storage facility
IHE	Insensitive high explosives
IMC	Intermediate metal conduit
ISDSI	Insulated Steel Door Systems Institute
J	Joule
0 K	Degrees Kelvin
K	Subgrade modulus
kPa	Kilo Pascal
kVA	Kilovolt ampere

kW	kilowatt
kWh	Kilowatt hour
LANL	Los Alamos National Laboratory
LCC	Life-cycle cost
LCD	Liquid crystal display
LL	Live load psf - pounds per square foot
LLNL	Lawrence Livermore National Laboratory
LLW	Low-level waste
LPG	Liquified petroleum gas
MA	Management and Administration (U.S. DOE)
MAA	Material access area
MBA	Material balance area
MBMA	Metal Building Manufacturers' Association
MC&A	Material control and accountability
mg/l	Milligrams per liter
MI	Miles, total level route
MIL-HDBK	DOD military handbook
MIN	Minute
ML/SFA	Metal Lath/Steel Framing Association
MPH	Miles per hour
mr/h	(milli) roentgen/hour
mrad/h	(milli) radiation, absorbed dose/hour
mrem	(milli) roentgen equivalent man
MSSA	Master safeguards and security agreement
MVA	Million-volt-amps
N_2	Nitrogen
NAAMM	National Association of Architectural Metal Manufacturers
NAD	North American Datum
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NBS	National Bureau of Standards
NC	Noise criteria
NCEL	Naval Civil Engineering Laboratory (references listed under NAVFAC)
NCMA	National Concrete Masonry Association
NDA	Nondestructive assay
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NFGS	Naval Facilities Guide Specification (references listed under NAVFAC)
NFPA	National Fire Protection Association
NGS	National Geodetic Survey (formerly U.S. Coast and Geodetic Survey)
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology (see NBS)
NOAA	National Oceanic and Atmospheric Administration
NO_x	Oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPDWS	National Primary Drinking Water Standards

NPSH	Net positive suction head
NRC	Nuclear Regulatory Commission
NRCA	National Roofing Contractors Association
NRTA	Near-real-time accountancy
NMTL	Nationally recognized testing laboratory
NSA	National Security Agency
NSPC	National Standard Plumbing Code
NSPS	New Source Performance Standards
NTLA	National Telecommunications and Information Administration
NTMA	National Terrazzo and Mosaic Association
NUREG	Nuclear Regulatory Commission-produced reference document
NWWDA	National Wood Window and Door Association
O&M	Operations and maintenance
OBA	Operating basis accident
OBE	Operating basis earthquake
OCS	Office of Computer Services (U.S. DOE)
ODH	Oxygen deficiency hazards
OMB	Office of Management and Budget
OPFM	Office of Project and Facilities Management (U.S. DOE)
ORNL	Oak Ridge National Laboratory
OS&Y	Outside screw and yoke
OSHA	Occupational Safety and Health Administration
OSR	Operational safety requirement
OSS	Office of Safeguards and Security (U.S. DOE)
OSTI	Office of Scientifc and Technical Information (U.S. DOE)
p	Minimum reinforcing ratio
PA	Protected area
PB	Polybutylene
PCB	Polychlorinated biphenyls
PCI	Prestressed Concrete Institute
PEL	Permissible exposure limit
PF	Protection factor
PI	Point of intersection
PI	Proportional-plus integral
PIV	Post indicator valve
PLF	Pounds per linear foot
PMFL	Probable maximum flood
POL	Petroleum, oil, and lubricants
POTW	Publicly-owned treatment works
PPHF	Plutonium processing and handling facility
PPM	Parts per million
PSAR	Preliminary safety analysis report
PSF	Plutonium storage facility
PSF	Pound-force per square foot
PSI	Pound-force per square inch
PSIG	Pound-force per square inch gauge
PTI	Post Tensioning Institute
Pu	Plutonium
PUBN	Publication
PURPA	Public Utility Regulatory Policy Act

PVC	Polyvinyl chloride
QA	Quality assurance
°R	Degrees Rankine
RCP	Reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
RDF	Refuse-derived fuel
REM	Roentgen equivalent man
RFCI	Resilient Floor Covering Institute
RG	Regulatory guide
RLWF	Radioactive liquid waste facility
RPFM	Real Property and Facilities Management (U.S. DOE)
RPIS	Real Property Inventory System (U.S. DOE)
RSWF	Radioactive solid waste facility
S&S	Safeguards and security
SAR	Safety analysis report
SARS	Safety analysis and review system
SAS	Secondary alarm station
SC	Safety class
SCFM	Standard cubic feet per minute
SCS	U.S. Department of Agriculture, Soil Conservation Service
SDI	Steel Deck Institute
SDI	Steel Door Institute
SDWA	Safe Drinking Water Act
SF	Safety factor
SISL	Special isotope separation laser
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SNL	Sandia National Laboratory
SNM	Special nuclear materials
SO_2	Sulfur dioxide
SOP	Standard operating procedure
SP	Special publication (of the American Concrete Association)
SPCC	Spill prevention control and countermeasure
SPRI	Single Ply Roofing Institute
SQFT	Square foot
SSE	Safe shutdown earthquake
SSFI	Scaffolding, Shoring, and Framing Institute
SSSP	Site safeguards and security plan
STC	Sound transmission classification
SWI	Steel Window Institute
TCA	Tile Council of America, Inc.
TCDD	Tetrachlorodibenzo-p-dioxin
TEC	Total estimated cost
TID	Tamper indicating device
TIMA	Thermal Insulation Manufacturers Association
TLV	Threshold limit value
TM	Army technical manual
TR	DOD technical report
TRU	Transuranic

TSCA	Toxic Substances Control Act
TSD	Treatment, storage and disposal
TV	Television
U value	Overall heat transfer coefficient value
UBC	Uniform Building Code
UCRF	Uranium conversion and recovery facility
UCRL	University of California Research Laboratory (references listed under LLNL)
UEF	Uranium enrichment facility
UEU	Unirradiated enriched uranium
UEUSF	Unirradiated enriched uranium storage facility
UF_4	Uranium tetrafluoride
UF_6	Uranium hexafluoride
UFAS	Uniform Federal Accessibility Standards
UHF	Ultra high frequency
UL	Underwriters Laboratory
UO_2	Uranium dioxide
UO_3	Uranium trioxide
UPA	Unit process area
UPC	Uniform Plumbing Code
UPHF	Uranium processing and handling facility
UPS	Uninterruptible power supply
URF	Uranium recovery facility
USC	U.S. Code
USGS	U.S. Geological Survey
USPHS	U.S. Public Health Service
USPS	U.S. Postal Service
VHF	Very high frequency
WB	Wet Bulb
WIPP	Waste isolation pilot plant
WPCF	Water Pollution Control Federation
WRC	Water Resources Council

Glossary

Accident (explosive). An incident or occurrence that results in an uncontrolled chemical reaction involving explosives.

Allowable soil-bearing capacity. The maximum permissible pressure on foundation soils under which the settlements of various footings will not exceed a reasonable value.

Ambient. Surrounding environmental conditions.

Anaerobic digestion. Biological stabilization of domestic wastewater sludge by microorganisms that function in the absence of oxygen.

Anticipated Operational Occurrence. An abnormal event that is expected to occur once or more during the lifetime of the facility (e.g., small radioactive materials spills, small fires).

Approved storage container. A container that is fabricated from noncombustible material(s); that satisfies container integrity criteria developed from the safety analysis for the particular form(s) of stored material under normal storage conditions, design basis fire and other design basis accident conditions; and that is approved for its intended use by the responsible DOE operating contractor and the responsible DOE field organization.

Aquifer. A groundwater bearing stratum sufficiently permeable to transmit and yield water in usable quantities.

As low as reasonably achievable (ALARA). As defined in DOE 5480.11.

Auxiliary air unit. A factory-fabricated option or addition to a fume hood that introduces some portion of the make-up air directly at the hood with features that do not minimize the performance of the hood nor create operator discomfort.

Ballast (railroad). Crushed stone used in a railroad bed to support the ties, hold the track in line, and help drainage.

Base course. The first layer of underlying material installed prior to the placement of a roadway pavement wearing surface.

Bearing capacity. A loading intensity that the bearing materials can sustain without such deformation as would result in settlement damaging to the structure.

Bench mark. A survey control monument installed to provide vertical control for construction purposes

Bentonite clay. A particular type of colloidal clay that swells when wet and forms a gel membrane.

Best available technology. The best available technology (BAT) that is economically achievable. This term is used only in the context of liquid waste treatment processing. BAT takes into account such factors as the age of equipment being used and facilities involved, the process used, the engineering aspects of the application of various types of control techniques, process changes, safety considerations, the cost of achieving effluent resuction, and non-water-quality environmental impact.

Bird strike. Airspace conflict between aircraft flight patterns and birds or waterfowl.

Borings. Boreholes drilled to collect soil samples as part of subsurface investigations conducted for the purpose of structural foundation design.

Building acquisitions (by lease or purchase). New pre-engineered metal buildings, other semipermanent or temporary facilities such as in-plant-fabricated modular/relocatable buildings and trailer units, and other buildings to be acquired.

Caisson foundation. A shaft of concrete placed under a building column or wall that extends down to rock or solid substratum (also known as a pier foundation).

Cantilever footing. A footing used to support a wall column near its edge without causing nonuniform soil pressure.

Capillary water. Soil moisture held as a continuous adsorbed film around soil particles and in interstices between the soil particles due to surface attraction.

Cased explosives. Explosives that are enclosed in a physical protective covering that will retain the explosives securely and will offer significant protection against accidental detonation during approved handling and intraplant transportation operations.

Classified information. Top Secret, Secret, and Confidential Restricted Data, Formerly Restricted Data, and National Security Information, for which the Department is responsible and that requires safeguarding in the interest of national security and defense.

Classified interest. Classified documents, information, or material including classified special nuclear material possessed by the Department, a contractor of the Department, a Departmental facility, or any other facility under the Department's jurisdiction.

Classified matter. Classified information, documents, parts components, or other material.

Classified telecommunications facility. A facility that contains both crypto equipment and input/output equipment for the electronic transmission, receipt, or processing of classified information. The crypto equipment and input/output equipment may either be installed in the same area and share common security measures or be installed in different parts of the

same security area connected by a protected distribution system, with each area having its own security measures.

Cognizant DOE authority. An entity in the DOE field organization unless otherwise stated.

Confinement area. An area having structures or systems from which releases of hazardous materials are controlled. The primary confinement systems are the process enclosures (glove boxes, conveyors, transfer boxes, other spaces normally containing hazardous materials), which are surrounded by one or more secondary confinement areas (operating area compartments).

Confinement system. The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous materials lower than allowable concentration limits.

Construction joint. A vertical or horizontal concrete surface where construction can be temporarily interrupted and continued later.

Construction projects. New facility, facility addition, and facility alteration projects where engineering and design are required in their performance

Construction project planning. All activities that are performed, after the initial identification of a project, for the purposes of developing the project concept, reliable cost estimates, realistic performance schedules, and methods of performance

Cooper E. The recommended live load in pounds per axle and the uniform trailing load for each track.

Corrosivity. The tendency of a metal to wear away another material by chemical attack

Cover. The depth of soil coverage above an underground utility.

Credible accident. Those accidents with an estimated probability of occurrence > 10^{-6}/year. Natural phenomena use separate probability criteria as stated in UCRL-15910.

Critical area. Those structures and enclosures containing safety class items whose continued integrity is essential to ensure the operability of those safety class items in the event of a DBA.

Critical facilities. Facilities such as those for radioactive material handling, processing, or storage and those facilities having high replacement value or vital importance to DOE programs

Criticality incident. An accidental, self-sustained atomic chain reaction.

Crossing frogs. A device that enables the wheels of a train to cross the rail of an intersecting track.

Crown, roadway. The high point of a roadway cross-section (usually at the centerline).

Crypto. A designation or marking applied to classified and unclassified telecommunications keying material indicating that it requires special accounting and safeguarding.

Cultural resource sites. Human-associated ruins of archaeologic significance.

Curb inlet. An inlet to a subsurface stormwater conveyance system.

Curb return. The end point of a curb radius.

Datum. A direction, level or position from which angles, heights or distances are conveniently measured

Dead load. A non-varying load exerted by the weight of a mass at rest.

Decommissioning. The process of closing and securing a nuclear facility, or nuclear materials storage facility so as to provide adequate protection from radiation exposure and to isolate radioactive contamination from the human environment.

Decontamination. The act of removing a chemical, biological, or radiologic contaminant from, or neutralizing its potential effect on, a person, object or environment by washing, chemical action, mechanical cleaning, or other techniques.

Dedicated tire water system. A water storage and distribution system that is available for and used solely for fire protection purposes, as opposed to a combined system that may be used for potable and process water supply in addition to fire protection.

Deflagration. A rapid chemical reaction in which the output of heat is sufficient to enable the reaction to proceed and be accelerated without input of heat from another source. Deflagration is a surface phenomenon, with the reaction products flowing away from the unreacted material along the surface at subsonic velocity. The effect of a true deflagration under confinement is an explosion. Confinement of the reaction increases pressure, rate of reaction and temperature and may cause transition into a detonation.

Deflection angle. The angle measured between a foresight and a prolongation of the backsight.

DepartmentaI-approved equipment. Equipment (e.g., alarm, assessment, monitoring detection) used in conjunction with all or other elements of a site-specific safeguards and security system as described in the site-specific safeguards and security plan (after such plan is approved by the Departmental element).

Departmental elements. DOE headquarters and field organizations.

Design basis accidents (DBAs). Postulated accidents, or natural forces, and resulting conditions for which the confinement structure, systems, components and equipment must meet their functional goals. These safety class items are those necessary to assure the capability to safely shut down operations, maintain the plant in a safe shutdown condition, and maintain integrity of the final confinement barrier of radioactive or other hazardous

materials; to prevent or mitigate the consequences of accidens; or to monitor releases that could result in potential offsite exposures.

Design basis earthquake (DBE) (equivalent to safe shutdown earthquake). An earthquake that is the most severe design basis accident of this type and that produces the vibratory ground motion for which safety class items arc designed to remain functional.

Design basis fire (DBF). A fire that is the most severe design basis accident of this type. In postulating such a fire, failure of automatic and manual fire suppression provisions shall be assumed except for those safety class items/systems that are specifically designed to remain available (structurally or functionally) through the event.

Design basis flood (DBFL). A flood that is the most severe design basis accident of that type applicable to the area under consideration.

Design basis tornado (DBT), explosion or criticality. A tornado that is the most severe design basis accident of that type applicable to the area under consideration.

Design flood. The flood, (either observed or synthetic) chosen as the basis for the design of a hydraulic structure.

Detection. The positive assessment that a specific object is the cause of an alarm.

Detection equipment. Any equipment or system that is designed to provide a high probability of positive assessment of intrusion.

Detonation or explosion. A violent chemical reaction within a chemical compound or mechanical mixture evolving heat and pressure. It is a reaction that proceeds through the reacted material toward the unreacted material at a supersonic velocity. The result of the chemical reaction is the exertion of extremely high pressure on the surrounding medium, forming a propagating shock wave of supersonic velocity. For the purposes of these criteria the terms detonation and explosion will be used interchangeably regardless of the velocity of the reaction or propagating shock wave.

Detonator. The explosive device that is used to initiate the detonation of other explosives.

DOE cognizant authority. See Cognizant DOE authority.

DOE Energy Management Coordinator. The DOE site representative designated responsible for energy management.

DOE Fire Protection Authority. The DOE site representative responsible for fire protection.

DOE Safeguards and Security Coordinator. The DOE site representative designated responsible for safeguards and security.

Duress system. A system that can covertly communicate a situation of duress to a security control center or other personnel who can notify a security control center.

Earth-lined channel. An open channel conveyance structure with sides and bottom constructed of naturally occurring earth materials.

Effective dose equivalent. The dose equivalent from both external and internal irradiation defined by $\Sigma_T \quad W_T H_T$ where H_T is the dose equivalent in tissue T and W_T is the weighting factor representing the ratio of the risk arising from irradiation of tissue T to the total risk when the whole body is irradiated uniformly. The effective dose equivalent is expressed in units of rem.

Effluent. Treated wastewater or airborne emissions discharged into the environment.

Egress. The act of departing from a point of access.

Electroexplosive device (EED). A device containing some reaction mixture (explosive or pyrotechnic) that is electrically initiated. The output of the initiation is heat, shock, or mechanical action.

Emergency controI center (ECC). A facility from which designated management can immediately direct the response to an emergency. The ECC may be an office, conference room, or other predesignated location having communication and informational materials appropriate to carry on the necessary supportive functions of directing an emergency response.

Emergency control station (ECS). A location within or near a designated critical facility or plant area for the purpose of maintaining control, orderly shutdown, and/or surveillance of operations and equipment during an emergency.

Emergency operations center (EOC). An alternate control center at a secure and protected location (where possible), designed and equipped to support a cadre of management and supporting personne, who will direct DOE field-organization operations necessary to carry out assigned, essential, major-emergency responsibilities.

Emergency planning zone. An area for which planning is done to ensure that prompt and effective actions can be taken to protect the environment and the health and safety of on-site personnel and the public in the event of a major emergency.

Emergency power. DBA-qualified and seismic category-I-qualified, fully redundant power generation, switching, and distribution system that meets the IEEE 1E criteria. It is designed to activate on loss of the normal power supply (or in the case of UPS systems, be on-line) and is used to supply SC-1 items, components, and/or systems with power to allow them to maintain their safety class functions.

Emergency Power Systems. The auxiliary power systems that provide power to safety and security related equipment during periods of partial or total power failure of associated primary power system.

Encasement, concrete. Placement of concrete around a sewer at its point of intersection with a potable waterline to provide a leakage barrier.

Enclosure. A primary confinement system such as process systems, glove boxes, conveyors, hot cells, and canyons.

Enegy monitoring and control system. See energy management system.

Energy management system. An automated system for monitoring and controlling energy-related systems and devices.

Engineered safety feature (ESF). Systems or design characteristics that are provided to prevent or mitigate the potential consequences of postulated design basis accidents. Art engineered-safety-feature system is a safety class system.

Entry control point. Controlled access entry point to a site or a secured area.

Exclusion area. A security area for the protection of classified matter where mere access to the area would result in access to classified matter.

Expansion joint. A joint between parts of a structure to avoid distortion when subjected to temperature change.

Explosive. Any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressures in the surrounding medium. The term applies to materials that either detonate or deflagrate.

Explosives activity. Each function (storage, handling, and processing) involving explosives from the manufacture or receipt of the explosives through the final shipping configuration, including final storage but excluding the movement of explosives between explosives areas.

Explosives bay. A location (room, cubicle, cell, work area) containing a single type of explosives activity that affords the requirement protection for the appropriate hazard classification (Class I, II, III, or IV as defined below) of the explosives activity involved Examples of such explosives activities are machining, pressing, meltcasting, nondestructive testing, and assembly operations.

Explosives building. Any structure containing one or more explosives bays.

Explosives hazard classes. The level of protection required for any specific explosives activity, based on the hazard class (accident potential) for the explosives activity involved. Four hazard classes are defined for explosives activities as follows in definitions for explosives hazard classes I-IV.

Explosives hazard Class I. Class I consists of those explosives activities involving a high *potential* for an accident that is unacceptable for the exposure of any personnel, thus requiring remote operations. In general, this would include activities where the energies that may interface with the explosives are approaching the upper limits of safety, and/or loss of control of the energy is likely to exceed the safety limits for the explosives involved. This category includes those research and development activities where the safety implications have not been fully characterized. Examples of class I activities are screening blending, pressing, extrusion, drilling of holes, dry machining, some wet machining, machining

explosives and metal in combination, development of some new explosives or explosives processing methods, and explosives disposal.

Explosives hazard, Class II. Class II consists of those explosives activities that involve a *moderate potential* for an accident because of the type of explosives, the condition of the explosives and/or the nature of the operations involved. This category consists of activities where the accident potential is greater than Class III but the exposure of personnel performing contact operations is acceptable. Included are activities where the energies that do or may interface with the explosives are normally well within the safety boundaries for the explosives involved but where the loss of control of these energies might approach the safety limits of the explosives. Examples of Class II activities involving HE are weighing, some wet machining, assembly and disassembly, and environmental testing (exposure of explosives samples to variations in temperature, humidity, etc.). It should be noted that some environmental testing is a Class I (remote) activity (e.g., heating an explosives sample to within 10°C of its critical temperature).

Explosives hazard Class III. Class III consists of those explosives activities that represent a *low potential* for an accident because of the type of explosives, the conditions of the explosives and/or the nature of the activity involved. Class III includes explosives activities where the accident potential of the operation being performed is not significantly different from explosives storage. Examples are normal handling, storage, packaging, unpackaging, and some inspection and nondestructive testing.

Explosives hazard, Class IV. Class IV consists of those explosives activities with insensitive high explosives (IHE) or IHE subassemblies that, although mass detonating, are so insensitive that there is negligible probability for accidental initiation or transition form burning to detonation. Explosions will be limited to pressure ruptures of containers heated in a fire. Although the fire hazards of IHE or IHE subassemblies are not as great as those of other explosives, it is classified as hazard class/division 1.3 (mass fire) to be consistent with DOD 6055.9. Most processing and storage activities with IHE and IHE subassemblies are class IV. However, the following are examples of explosive activities with IHE or IHE subassemblies that remain class I: pressing, some machining (see DOE/EV 06194); dry blending, dry milling, and dry screening.

External corrosion. Corrosion of that portion of a metal structure (i.e., pipe) that is exposed to external elements such as air, water, or soil.

Facilities. Buildings and other structures, their functional systems and equipment, and other fixed systems and equipment installed therein; outside plant, including site development features such as landscaping, roads, walks, and parking areas; outside lighting and communication systems; central utility plants; utilities supply and distribution systems; and other physical plant features. As used in these criteria, the term “nuclear facilities” is synonymous with the definition of this same term as contained in DOE 5480.5.

Facility authority. The individual, designated by the DOE project manager, developing specific project criteria not contained in the DOE 6430.1A.

Facility boundary. The fence or other barrier that surrounds and prevents uncontrolled access to the facility or facilities.

Fail-safe. A design characteristic by which a unit or system will become safe and remain safe if a system or component fails or loses its activation energy.

Field element. Any departmental organizational component located outside the Washington, D.C., metropolitan area.

Fissile material. A nuclide capable of undergoing fission by interaction with slow neutrons provided the effective thermal neutron production cross section, $\overline{\nu\sigma_f}$, exceeds the effective thermal neutron absorption cross section, $\overline{\sigma_a}$.

Flexural strength. The strength of a material in bending that is, resistance to fracture.

Force main. The discharge line from a savage or stormwater lift station.

Freeboard. The height between the normal water surface elevation and the top of a hydraulic structure.

GDC Planning Board. The DOE advisory group of major Headquarters and field organizations involved in the construction of facility acquisitions, which includes those organizations having planning, design, construction, environmental, safety and health, research, operations, and maintenance functions.

Grade beam. A reinforced concrete beam placed directly on the ground to provide the foundation for the superstructure.

Hazardous material. Any material that has been determined to be capable of posing an unreasonable risk to health, safety, or property.

Halogenated. Compounds that contain a halogen element (i.e., fluorine, chlorine, bromine or iodine).

High-efficiency particulate air (HEPA) filters. A high-efficiency particulate air filter having a fibrous medium that produces a particle removal efficiency of at least 99.97% for 0.3-micrometer particles of dioctylphthalate (DOP) when tested in accordance with MIL-STD-282.

High explosives (HE). Explosive substances capable of mass detonation, and for which there is a significant probability of accidental initiation or transition from burning to detonation.

High-level waste (HLW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations as to require permanent isolation.

Higher standard of protection. A level of fire protection that exceeds the improved risk level of protection. This level of protection may sometimes be justified for the purpose of national security, program continuity, or protection of the public.

Holdup (nuclear material). Holdup is the nuclear material that is retained in process equipment at inventory time.

Hot lines. Phone numbers of local service companies factory-authorized to replace system components or appurtenances or value repairs to same. Direct customer service phone numbers of manufacturers shall also be considered as "hot lines."

Human factors. The biomedical, psychosocial, work place environment, and engineering considerations pertaining to people in a human-machine system. Some of these considerations are allocation of functions, task analysis, human reliability, training requirements, job performance aiding, personnel qualification and selection, staffing requirements, procedures, organizational effectiveness, and workplace environmental conditions.

Human factors engineering. The application of knowledge about human performance capabilities and behavioral principles to the design, operation, and maintenance of human-machine systems so that personnel can function at their optimum level of performance.

Hydraulic structures. A structure for the conveyance and/or control of water under nonpressure open-channel flow.

IHE subassemblies. IHE hemispheres or spheres with booster charges, with or without detonators, that pass the DOE qualification tests listed in Table IX-2 of DOE/EV 06194.

IHE weapons. Weapons listed in DOE/DNA TP 20-7 as exempt from storage and transportation limits are classified as IHE weapons when stored or transported alone or in combination with each other. This classification is valid only by storage/shipping containers or, if out of containers, by the spacing specified in TP 20-7.

Impervious. That property of a surface that does not allow water or other fluids to pass through.

Improved risk. Generally, an improved risk level of property protection is one that would qualify for complete insurance coverage by the Factory Mutual system, the industrial risk insurers or other industrial insurance companies that limit their insurance underwriting to the best protected class of industrial risk.

Ingress. The act of entering a structure or area through a point of access.

Inhabited building distance. The minimum separation distance allowed between any explosives building and an installation boundary, between adjacent explosives buildings and/or other concentrations of personnel in non-explosives facilities such as administrative offices, shops, warehouses, inspection and test facilities, explosives laboratories, and so forth. This distance shall be determined based on maximum explosives weight, using the table in DOD 6055.9.

Initiation stimulus. Energy input to an explosive in a form potentially capable of initiating a rapid decomposition reaction. Typical initiation stimuli arc heat, friction, impact, electrical

discharge, and shock. An initiator is a device that provides initiation stimuli (e.g. detonators, squibs, etc.).

In-process or in-use material. Material that is integral to the manufacturing or production processes and is needed to maintain continuity of operations. Other material that requires temporary location near the pertinent process areas in readiness for near-term use or for movement to other process areas may also be considered "in-process." For material involved in laboratory operations, analogous definitions shall be applied to determine eligibility for the "in-process" or "in-use" category and consequent exclusion from storage requirements of these criteria.

Insensitive High Explosives (IHE). Explosive substances that, although mass detonating, are so insensitive that there is negligible probability of accidental initiation or transition from burning to detonation. The materials passing the DOE qualification tests in Table IX-1 of DOE/EV 06194 are classified as IHE, and are listed in Table IX-2 of the same document.

In-situ. In the existing or original location.

Interfaces. The relationships between two or more system components, or between the work environment and one or more system components. Human performance is a function of the physical interfaces between people and equipment; the environments within which people or equipment work; the type and amount of training people receive; the accuracy and ease of use of the procedures people are given for guidance; and the effectiveness of the organizations in which people work.

Intraline separation (barricaded). The minimum quantity-distance separation allowed between buildings as described in the paragraph below when an effective barricade (as defined in DOD 6055.9) is interposed between building This distance is one-half the unbarricaded intraline separation. This distance (corresponding to approximately 82.7Kpa (12 psi) peak overpressure for Class 1.1 explosives) shall be determined based on the maximum explosives weight, using the tables in DOD 6055.9.

Intraline separation (unbarricaded). The minimum quantity-distance separation allowed between explosives buildings on a plant site unless equivalent protection to personnel and property is provided by building design and construction, or a barricade as noted in the paragraph above. This distance (corresponding to approximately 24kPa (3.5 psi) peak overpressure for Class 1.1 explosives) shall be determined based on the maximum explosives weight, using the tables in DOD 6055.9.

Intrusion alarm system (perimeter or interior). Detection hardware and/or software composed of sensors, alarm assessment systems, and alarm reporting systems (including alarm communications and information display equipment).

Inverted siphon. A pressure pipeline crossing under a highway or other obstruction.

Ion exchange. A chemical reaction used in water or wastewater treatment processes in which mobile hydrated ions of a solid are exchanged (with ions of like charge in solution).

Isolation zone. An area surrounding a protected facility that has been cleared of any objects that could conceal vehicles or individuals, and that affords unobstructed observation of, or other means of detection of, entry into the area.

Joint frequency distribution. The result of a frequency analysis of the probability of the occurrence of two or more random events (e.g., hydrologic or meteorologic] parameters).

Karst terrain. An irregular limestone region with sinks, underground streams and caverns

Land application. A disposal method for wastewater effluents and sludges.

Landfill. A site for disposal of solid waste in which compacted layers are covered with soil.

Leachate. A solution containing dissolved and finely suspended solid matter and microbial waste products produced by groundwater or infiltrating surface water movement through solid waste.

Life-cycle cost. Ail costs except the cost of personnel occupying the facility incurred from the time that a space requirement is defined until that facility passes out of the government's hands.

Limited area. A security area for the protection of classified matter where guards, security inspectors, or other internal controls can prevent access by unauthorized persons to classified matter.

Live load. A moving load or a load of variable force acting on a structure, in addition to its own weight.

Load factor. The strength-to-service-load ratio.

Low-level waste (LLW). Radioactive waste not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct material, as defined by DOE 5820.2A

Magazine. Any building or structure, except an operating building, used for the storage of ammunition or explosives. A storage area containing magazines shall be located at not less than an inhabited building separation from other areas, such as operational explosives buildings, administration/office buildings, shop, and installation boundaries.

Magazine separation. The minimum quantity-distance separation between magazines (not including service magazines) within a storage area. Siting of magazines within a storage area with respect to one another and location of facilities such as guard shelters and loading docks in storage areas are covered in DOD 6055.9. Maximum explosives weight shall be used in determining separation distances.

Mass concrete. A large volume of cast-in-place concrete with dimensions large enough to require that measures be taken to cope with the generation of heat and attendant volume change and to minimize cracking.

Material access area. An area that contains a Category I quantity of special nuclear material and is specifically defined by physical barriers, located within a protected area, and subject to specific access controls.

Material balance area (MBA). A subsidiary account of a facility designed to establish accountability and to localize inventory differences.

Maximal effective pressure. The highest of: (1) the peak incident pressure, (2) the incident plus dynamic pressure, or (3) the reflected pressure.

Maximum probable flood. A hypothetical flood (peak discharge, volume, and hydrography shape) that is considered to be the most severe reasonably possible, based on comprehensive hydro-meteorological application of probable maximum precipitation and other hydrological factors favorable for maximum flood runoff such as sequential storms and snowmelts.

Monumentation. The act of setting a permanent survey control point.

New storage facility. A newly constructed facility or the conversion of existing facility, or portion of an existing facility, for use as an unirradiated enriched uranium storage facility.

Nationally recognized testing laboratory. An organization that is recognized by OSHA in accordance with Appendix A of 29 CFR 1910.7 and that tests for safety, and lists or labels or accepts equipment or materials. (Examples include FM and UL.)

Nuclear facility. A facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public. Includes are facilities that: (1) produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; (2) conduct separations operations; (3) conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; or, (4) conduct fuel enrichment operations. Incidental use of radioactive materials in a facility operation (e.g., check sources, radioactive sources, and X-ray machines) does not necessarily require the facility to be included in this definition. Accelerators and reactors and their operations are not included.

Occupiable area. See definition in 41 CFR 101-17.003.

Occupied area (explosives). Any work area to which personnel are assigned or any non-work area where persons regularly congregate. In the context of Class II bays for explosives facilities, sass ramps and plant roads are not considered occupied areas.

Operating area compartment. An area or series of areas that contain process enclosures, and/or their attendant equipment located within that area or series of areas.

Operating basis accident (OBA). Maximum severity accident under which the plant structure, systems, and components are designed to either remain operable or be readily restored to operating condition. This is the highest severity event that the operating contractor may recover from without DOE approval.

Operational DBA. Any design basis accident caused by an internal event. Direct causes are usually poor design or procedures, operator errors, equipment failures, or inadequate

technical development (unknowns) that lead to the accident. The major accident categories are explosion, fire, nuclear criticality, leaks to the atmosphere, and leaks to the aquatic environment.

Operational safety requirements (OSR). Those requirements that define the conditions, safe boundaries, and bases thereof and management control required to assure the safe operation of a nuclear facility.

Overpressure. The maximal effective pressure is the highest of (1) the peak incident pressure, (2) the incident plus dynamic pressure, or (3) the reflected pressure (ref. TM 5-1300).

Peak positive incident pressure The almost instantaneous rise from the ambient pressure caused by a blast wave's pressure disturbance.

Pervious. That property of a surface that allows water or other fluids to pass through

Permafrost. A permanently frozen layer of variable depth below the earth's surface in frigid regions.

pH. A term used to describe the hydrogen-ion activity or concentration of a solution.

Physical protection (physical security). The application of methods for preventing diversion of nuclear material or for detecting such diversion as it occurs.

Physically separated. Set apart by distance, fences, walls or similar obstructions.

Plastic yielding. The point at which permanent deformation occurs when tensile stress is imposed on a material.

Plutonium processing and handling facility. Any facility constructed primarily to process plutonium (including Pu 238) and that handles substantial quantities of in-process plutonium where there is a possibility of a release of plutonium to the environs under normal operations or design basis accident conditions in excess of limits set forth in the directive on Radiation Protection of the Public and the Environment in the DOE 5400 series.

Plutonium storage facility. Any facility constructed to store strategic (category I) quantities of plutonium.

Point of nearest public access. Location inside or outside the site boundary where a member of the public could legally be (e.g., visitor center or public highway) without the specific knowledge of the owner or operator

Portland cement. A mixture of lime-and clay-bearing materials that are calcined to form a clinker, which is then pulverized, to form a fine powder for mortar and concrete mixtures.

Preliminary safety analysis report (PSAR). See safety analysis report.

Primary confinement system. See confinement area.

Probable maximum flood (PMF). The hypothetical flood (peak discharge, volume, and hydrograph shape) that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff such as sequential storms and snowmelts.

Project design criteria. Those technical data and other project information developed during the project identification, conceptual design and/or preliminary design phases. They define the project scope, construction features and requirements, design parameters, applicable design codes, standards, and regulation, applicable health, safety, fire protection, safeguards, security, energy conservation, and quality assurance requirements; and other requirements. The project design criteria are normally consolidated into a document that provides the technical base for any further design performed after the criteria are developed.

Property protection area. An area set aside for the protection of property as required by these criteria.

Protected area. An area encompassed by physical barriers (e.g., walls or fences), subject to access controls, surrounding a material access area or containing Category II special nuclear material.

Public travel route. Any public street, road, highway, or passenger railroad (including roads on DOE-controlled land open to public travel).

Pyrophoric-igniting spontaneously. Emitting sparks when scratched or struck especially with steel.

Quality assurance. All those planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily and safely in service. Quality assurance includes quality control, which is all those actions necessary to control and verify the features and characteristics of a material, process, product, or service to specified requirements.

Quality assurance records. Includes results of reviews, inspections, audits, and material analyses; monitoring of work performance; qualification of personnel, procedures, and equipment; and other documentation such as drawings, special reports, and corrective action reports.

Quantity-distance. The quantity of explosives and the distance separation relationship that provides defined types of protection. These relationships are based on levels of risk considered acceptable for a stipulated exposure and are tabulated in the appropriate quantity-distance tables in DOD 6055.9. Separation distances shall be considered minimum distances; greater distances should be used whenever practicable.

Radio repeater stations. Unmanned radio transmission facilities, usually located in remote areas.

Rational method. As applied to drainage design, the expression of peak discharge as equal to the product of rainfall intensity, drainage area and a runoff coefficient depending on drainage basin characteristics.

Real Property Inventory System (RPIS). The Department of Energy's automated real property reporting system.

Receiving stream. Stream that receives outfall discharge of wastewater effluents.

Refractories. Refractoriea include nonmetallic materials having those chemical and physical properties that make them applicable for structures, or as components of systems, that are exposed to environments abov[illegible],000°F.

Regional frequency analysis. An analysis that addresses the probability of the occurrence of two or more random hydrologic events.

Reinforcement ratio. The percentage of tension reinforcement in a reinforced concrete beam.

Rem. A unit of dose equivalent that is the product of absorbed dose (D) in rads in tissue, a quality factor (Q), and other modifying factors (N). Derived from roentgen equivalent man.

Remote interrogation points. Locations for receiving information (e.g., printouts) transmitted by automatic data processing centers.

Required strength (U). Required strength to resist factored loads or related internal moments and forces.

Reservoir routing. A technique used in hydrology to compute the effect of reservoir inflow on reservoir outflow.

Response time. This term when used to specify performance of a rapid action deluge fire protection system represents the elapsed time between the initiation of the incident and water application to the material being protected.

Retaining wall. A wall designed to maintain differences in ground elevations by holding back a bank of material.

Return period. The average number of years within which a given hydrologic event will be equaled or exceeded.

Routine waste. Waste generated due to normal operations and anticipated abnormal events.

Safeguards. An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized possession, use, or sabotage of special nuclear materials. In practice, safeguards involve the development and application of techniques and procedures dealing with the establishment and continued maintenance of a system of activities including physical protection, quantitative knowledge of the location and use of special nuclear materials, and administrative controls and surveillance to assure that procedures and techniques of the system are effective and are being carried out. Safeguards include the timely indication of possible diversion or credible assurances by audits and inventory verification that no diversion has occurred.

Safe shutdom earthquake. See Design basis earthquake.

Safety analysis report (SAR). A report, prepared in accordance with DOE 5481.1B, that summarizes the hazards associated with the operation of a particular facility and defines minimum safety requirements. A Safety Analysis Report is designated as final when it is based on final design information. Otherwise, it k designated as preliminary.

Safety class (SC). Three levels that are assigned to items (components, systems, or structures) that must be designed to provide specific functions to protect operators, the public, or the environment. These levels are as follows:

SC-1: Provides function and/or structural integrity for mitigation of event severities up to and including DBAs.

SC-2: Provides function and/or structural integrity for mitigation of event seventies up to and including OBAs.

SC-3: Provides function and/or structural integrity for mitigation of event severities up to and including UBC and those that are industrial safety related.

Further description is contained in Section 1300-3.2, Safety Class Items.

Safety class item. Systems, components and structures, including portions of process systems, whose failure could adversely affect the environment or safety and health of the public. Determination of classification is based on analysis of the potential abnormal and accidental scenario consequences as presented in the SAR (as required by 5481.1B).

Safety limit. A limit on an important proms variable that is necessary to provide reasonable protection to the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity or an accidental criticality.

Sanitary engineering structures. Tanks, reservoirs, and other structures commonly used in water and waste treatment works, where dense, impermeable concrete with high resistance to chemical attack is required

Sanitary landfill. A system for disposal of garbage, trash, and other rubbish from domestic sources in compacted layers covered with soil to a depth sufficient to exclude rats, flies, and other vectors. Most sites provide for leachate control.

Saturated zone. That region below the ground surface where the groundwater is above atmospheric pressure.

Secure communications center. A security area devoted in whole or in part to the encryption and decryption of sensitive and/or classified information.

Security. Activities through which DOE defines, develops, and implements its responsibilities under the Atomic Energy Act of 1954, as amended, Federal statutes, Executive Orders, and other directives, for the protection of Restricted Data and other classified information or matter, nuclear weapons and nuclear weapon components, and for the protection of Department and Departmental contractor facilities, property, and equipment. Security is also applied to special nuclear materials. When physical, personnel, and technical security are

combined with material control and material accountability, the protection is referred to as safeguards.

Security area. A physically defined space containing a Departmental security interest and subject to physical protection and access controls.

Security interest. Any of the following that requires special protection classified matter, special nuclear material, security shipments, secure communications centers, sensitive compartmented information facilities, automatic data processing centers, or other systems including classified information, or Departmental property.

Seismic category I. A level and method of seismic qualification that provides documented assurance that an item, component, or system can continue to perform its required function. Qualification includes all SC-1 and selected SC-2 and SC-3 items, components, or systems.

Service magazine. An auxiliary building of an operating line used for the intermediate storage of explosives within the operational plant area. The amount of explosives is normally limited to a maximum consistent with intraline separation from other explosives buildings based on the quantity of explosives in the service magazine

Setback. Building offset from a property line, sidewalk, or street right-of-way.

Shall. Denotes a requirement.

Shall consider. Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc.

Sheet piling. Closely-spaced piles of wood, steel, or concrete driven vertically into the ground to obstruct lateral movement of earth or water.

Shoring. Temporary bracing of an existing building foundation to provide support during adjacent excavations. Also applies to supporting construction of above grade floors.

Should. Denotes a recommendation.

Single failure. An occurrence that results in the loss of capability of a component to perform its intended safety function(s). Multiple failures, i.e., loss of capability of several components, resulting from a single occurrence are considered to be a single failure. Systems are considered to be designed against an assumed single failure if neither (1) a single failure of any active component (assuming passive components function properly) nor, (2) a single failure of any passive component (assuming active components function properly) results in loss of the system's capability to perform its safety function(s).

Site boundary. A well-marked boundary of the property over which the owner or operator an exercise strict control without the aid of outside authorities.

Site-specific safeguards and security plan. A specific description of the systems and procedures implemented and planned to protect Departmental security interests and other property. The format for site-specific safeguards and security plans can be obtained from DP-34.

Slanting. The incorporation, without appreciable extra cost or reduction in efficiency, of certain architectural and engineering features into new structures (except temporary type) or portions of the structures to improve their ability to resist the effects of an attack and to offer protection to personnel and material.

Soil resistivity. The measured potential difference between two points in a naturally occurring soil between which a known electric current is passed.

Soil mechanics. The application of the laws of solid and fluid mechanics to soils and similar granular materials as a basis for design, construction, and maintenance of stable foundations and earth structures.

Special nuclear material (SNM). Plutonium, uranium-233, uranium enriched in uranium-233 or in the uranium-235, or any material artificially enriched in any of the foregoing (but does not include source material) and any other material that, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, has been determined to be special nuclear material.

SNM vault. A penetration-resistant, windowless enclosure that has (a) walls, floor, and ceiling substantially constructed of materials that afford penetration resistance at least equal to that of 8-inch thick reinforced concrete; (b) any openings greater than 96 square inches in area and over 6 inches in the smallest dimensionprotected by imbedded steel bars at least *5/8* inches in diameter on 6-inch centers both horizontally and vertically; (c) a built-in combination locked steel door that in existing structures is at least 1-inch thick exclusive of bolt work and locking devices and that for new structures at least meets the Class 5 standards as set forth in FS AA-D-6008 of the Federal Specifications and Standards cited in 41 CFR 101.

Staging bays (in-process). A bay(s) within an operating building used to stage explosives in excess of four hours supply. This practice is permissible as long as the bay(s) is designed to provide Class II level of protection.

Standby power. A reserve power generation or supply with switching devices that will supply power to selected loads in the event of a normal power failure. It is *not* required to have redundant equipment or to operate through events greater than UBC. A standby power system shall not be classified SC-1.

Storage area compartment. An area or series of areas that contain storage enclosures.

Structural collapse. The failure of a structural component as a direct result of loss of structural integrity of the facility being subjected to various loadings.

Subbase. A layer of granular material located beneath the base course of a highway pavement.

Subcritical flow. Open channel flow having a low velocity and a froude number less than unity (also described as tranquil or streaming flow).

Subgrade modulus. The slope of a load-settlement diagram constructed with data from field loading tests on the actual subgrade.

Subslab. Also known as a structural slab, base slab, mud slab, or wearing slab. The concrete slab below the waterproofing membrane in a double-slab configuration.

Substantial construction. If determined by the cognizant DOE security personnel, classified matter shall be stored in a building or portion thereof that provides a physical barrier of the required penetration times and resistance. NBS Technical Note 837 shall be used for a comparison of the forcible penetration time through different structural barriers.

Supercritical flow. Open channel flow having a high velocity and a froude number greater than unity (also described as rapid, shooting or torrential flow).

Superelevation. The practice of elevating one side of a roadway over the other on curves in alignment.

Support building. Any structure (including utilities) directly supporting explosives activities but containing no explosives.

Surfactant (surface-active agent). A soluble compound that reduces the surface tension of liquids, or reduces interracial tension between two liquids or a liquid and a solid.

Tactical response force. An armed combat force trained in security protection.

Tension wires. Wires placed along the top and bottom of a chain link fence to provide tension and structural rigidity.

TNT equivalent. A measure of the blast effects from the explosion for a given quantity of material expressed in terms of the weight of TNT that would produce the same blast effects when detonated. For safety and design purposes, a reasonable value can be obtained by substituting a measurement of energy release of blast effects.

Transient (re: explosives facilities). Any person within inhabited building distance but not inside an explosives bay or other occupied areas (offices, break areas, shops, etc.).

Transuranic elements. Those elements having an atomic number greater than 92 (uranium).

Transverse. That which is extended or is lying across.

TRU waste. Without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranic radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g.

Regarding the Waste Isolation Pilot Plant, high-level waste and spent nuclear fuel as defined by DOE 5820.2A are specifically excluded by this definition.

Unattended openings. Doors, operable windows, hatches, louvered openings, etc., that are not attended by security guards or guarded by safety devices.

Underpinning. Permanent supports replacing or reinforcing the older supports beneath a wall or column.

Uninterruptible power supply (UPS). A power supply that provides automatic, instantaneous power, without delay or transients, on failure of normal power. It can consist of batteries or full-time operating generators. It can be designated as standby or emergency power depending on the application. Emergency installations must meet the requirements specified for emergency power.

Unirradiated enriched uranium. Naturally occurring uranium enriched with U-235 above its natural abundance of approximately 0.72% (weight percent) that has not been exposed to a neutron flux.

Unit hydrography. A hydrography with a volume of l-inch of rainfall resulting from a storm of specified duration and areal pattern.

Unit masonry. Includes brick made of clay or shale, sand lime, and concrete; structural clay, concrete masonry units, solid load bearings, tile, load-bearing and non-load-bearing, hollow load-bearing, and hollow non-load-bearing; natural stone and cast stone; ceramic glazed clay masonry, solid units, and hollow units; and prefaced concrete masonry units.

Unpackaging room. The spaces in which receiving containers are opened and unpackaged and repackaged for storage or shipment and are surrounded by one or more secondary confinement areas.

Useful life. The time period in which a building element can be expected to perform effectively with proper maintenance.

Vault-type room. A DOE-approved room having combination-locked door(s) and protected by a Departmental-approved intrusion alarm system activated by any penetration of walls, floor, exiling, or openings or by motion within the room.

Vector. An agent such as an insect, rodent, or the wind capable of mechanical or biologically transferring a pathogen from one location to another.

Vital activity. Relating to integrity of a national security program or a public health and safety function.

Vital area. A security area for the protection of vital equipment.

Vital equipment. Equipment, systems, or components whose failure or destruction would cause unacceptable interruption to a national security program or harm to the health and safety of the public.

Vital facility. A facility where vital activities occur.

Vital program. A program designated vital by the program senior official.

Water hammer. Pressure rise in a pipeline caused by a sudden change in the rate of flow or stoppage of flow in the line.

Work environment. The surroundings in which systems operate. Includes all of the conditions that may affect one or more system components, e.g., temperature/humidity, noise, light, vibration, toxic materials, radioactive materials.

Division 1
General Requirements

0101 CRITERIA PURPOSE AND APPLICATION

0101-1 GENERAL

These criteria provide mandatory, minimally acceptable requirements for facility design. The predominant model building code in the region shall govern on issues not revered in these criteria.

State, municipal, county, and other local building and zoning codes and ordinances should be reviewed for possible conflicts with these criteria. While it is not mandatory that DOE projects comply with such local codes and regulations, the design professional is encouraged to cooperate with local officials and DOE personnel to accommodate the intent of local codes and regulations as much as possible.

These criteria apply to any building acquisition, new facility, facility addition and alteration, and leased facility that is required to comply with DOE 4300.1B. This includes on-site costructed buildings, pre-engineered buildings, plant-fabricated modular buildings, and temporary facilities. For existing facilities, original design criteria apply to the structure in general; however, additions or modifications shall comply with this Order and the associated latest editions of the references herein. Reactors and their safety systems shall be sited and designed according to DOE 5480.6.

These criteria shall be applied in the planning. design and development of specifications for facilities, including the preparation of site-specific general design criteria and project-specific design criteria during the project planning phase.

If there are any conflicts between these criteria and DOE directives, these criteria shall govern. Any such conflicts shall be brought to the attention of the Headquarters OPFM.

Information cited in these criteria as being provided by the cognizant DOE authority shall be obtained by the design professional through the designated cognizant DOE authority.

0101-2 CRITERIA DEVIATIONS

DOE organizations with first-line responsibilities for facility projects shall determine to what extent these criteria shall be applied to projects in process under prior issuances of DOE 6430.1. In making this determination for projects already in the planning, design, construction, operating, or decommissioning phases, consideration shall include the current stage of budgeting, design, or construction and the potential cost and schedule effects of applying these criteria.

For all projects subject to DOE 6430.1 series, these criteria are not intended to impose unnecessary design restrictions or requirements or to discourage design innovation. Professional architectural and engineering judgment shall be used in the interpretation and application of these criteria to specific projects.

The contractor and/or DOE organizations responsible for facility projects shall review these criteria early in the planning phase and at later phases during the project construction process to determine if any of these criteria are not applicable or are not appropriate. The contractor shall document the criteria being used for each project in the project's SAR (per Section 0110-5.2, Safety Analysis) such that compliance with these criteria can be verified during design, construction, and facility operation. Site-specific criteria shall be included in this documentation.

Deviations may be granted by DOE organizations responsible for facility projects or granted by the DOE programmatic office responsible for the design of facilities when any of the following apply:

- A specific portion of the general design criteria is determined to be inadequate or inappropriate for the facility under design.
- Minor deviations are necessary or advantageous in the design professional's professional judgment.
- A criterion does not reflect currently applicable codes, standards, regulations, or architectural or engineering principles and practices.
- A criterion affecting environmental protection or safety is less stringent than local or State codes or regulations.
- Deviations will achieve economies in facility construction, operation, or maintenance without significant adverse effects on programmatic or operating needs or DOE design policy and objectives.
- Deviations will not affect DOE design policy and objectives and are determined to be necessary in the acquisition of buildings by lease or purchase.
- Deviations will not affect DOE design policy and objectives, are necessay, and are allowable under existing exemption or variance provisions of another DOE directive.

Headquarters-level review and approval are not required for deviations from local or State codes or regulations that do not affect compliance with DOE policies or objectives.

When a deviation is granted without Headquarters-level review and approval, the project file or other files as appropriate shall include full documentation of the deviation, including an analysis and justification for giving the deviation.

Headquarters-level review and approval shall be required for the following deviations from these criteria:

- Deviations proposed for safety-class items (as defined in Section 1300-3.2, Safety Class Items, and determined by DOE 5481.1B) when such deviation will or may constitute an adverse impact on environmental protection, safety or health or other DOE design policies or objectives

- Deviations from requirements in Federal laws or regulations or Executive Orders; such deviations cannot be approved unless such laws, regulations, or Executive Orders provide for deviations or waivers

OPFM shall, where responsibility is not otherwise prescribed by Executive Order or statute:

- Be notified of any deficiencies in these criteria or conflicts that exist between them and other DOE directives

- Determine the need for formal submittal of a proposed deviation

- Coordinate with and determine appropriate Headquarters organizations necessary to review and approve any deviations

- Review design project files or other files as appropriate containing documentation of deviations

Requests for deviations requiring Headquarters level approval shall be prepared by the responsible field organization and submitted with justification to OPFM, the Headquarters outlay program organization(s) involved, and any other Headquarters organization as determined appropriate by OPFM.

Nothing in these criteria shall preempt the specific requirements contained in other DOE directives relative to their processes and procedures for requesting exemptions, variances, or deviations.

0101-3 ORGANIZATION AND USE OF THESE CRITERIA

0101-3.1 General

The organization of these criteria is adapted from the MASTERFORMAT system developed by the Construction Specifications Institute.

The 16 numerical divisions of these criteria arc devoted to major building systems or design specialties. For example, Division 15 covers mechanical systems; Division 2, site and civil. The number of each section, paragraph, and subparagraph within each division includes that

division's number (for example, 1550-2.2 is the second paragraph in section 1550-2, which is in Division 15).

0101-3.2 "Shall" and "Shall Consider"

"Shall" in these criteria denotes a requirement.

"Shall consider" requires that an objective assessment be performed to determine to what extent the specified factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be adequately documented. Such documentation shall be retrievable and can be in the form of meeting minutes, reports, internal memoranda, etc. Some sections of these criteria contain other documentation requirements.

0101-3.3 References to Other Sections and Documents

References to other parts of these criteria take the form "See Section 0110-12, Energy Conservation." The term "Section" is used to refer to topics, sections, paragraphs, and subparagraphs. The section's title is given after its number. The 16 divisions are referred to as divisions.

References to other documents are generally shorthand, as in "ACI 234" or "NFPA 13." Readers who are unfamiliar with an abbreviation can consult the Abbreviations section of these criteria.

Each standard, regulation, DOE directive, or other referenced document is listed in Section 0106, Regulatory Requirements, or Section 0109, Reference Standards and Guides. These sections are not comprehensive lists of all major design standards and guides. They contain *only* those standards specifically mandated in one or more sections of these criteria.

0101-3.4 Special Facilities

0101-3.4.1 "-99" Sections

Most criteria apply to all DOE facilities, including special facilities. Each division also contains requirements for special facilities; these criteria appear in sections numbered -99. For example, Division 15, Mechanical, contains criteria that apply to the design of all DOE facilities, both non-special and special facilities. *In addition,* Section 1550-99, Special Facilities, contains additional criteria on mechanical systems that apply only to the design of special facilities.

Within the -99 sections, facility types are designated by the following numbers:

- 99.0, Nonreactor Nuclear Facilities-General
- 99.1, Laboratory Facilities (Including Hot Laboratories
- 99.2, Emergency Preparedness Facilities
- 99.3, Plutonium Processing and Handling Facilities

- 99.4, Explosives Facilities
- 99.5, Unirradiated Enriched Uranium Storage Facilities
- 99.6, Plutonium Storage Facilities
- 99.7, Occupational Health Facilities
- 99.8, Telecommunications, Alarm, and ADP Centers and Radio Repeater Stations
- 99.9, Vaults and Vault-Type Rooms for Storage of Classified Matter
- 99.10, Secure Conference Rooms
- 99.11, secure offices
- 99.12, Uranium Enrichment Facilities
- 99.13, Uranium Processing and Handling Facilities
- 99.14, Irradiated Fissile Material Storage Facilities
- 99.15, Reprocessing Facilities
- 99.16, Uranium Conversion and Recovery Facilities
- 99.17, Radioactive Liquid Waste Facilities
- 99.18, Radioactive Solid Waste Facilities
- 99.19, Tritium Facilities
- 99.20, Fusion Facilities

If a -99 section has no criteria related to a given specialized facility type, no section with that facility type's number appears. This can cause the numbering in -99 sections to have gaps (for example, -99.1, -99.2, -99.4, -99.12).

0101-3.4.2 Division 13

Some special DOE facilities have additional design criteria that do not relate to the major building systems or design specialties in the "standard" MASTERFORMAT divisions. Such material appears in Division 13, Special Facilities.

0101-3.5 Indexes and Glossary

This document has a glossary containing definitions of key terms and two indexes-a key word index and an index to standards, regulations, and other documents referenced within these criteria.

0101-3.6 Document Improvement Proposals

A sample document improvement proposal sheet for suggesting changes to these criteria appears at the end of this document. See DOE 6430.1A, Cover Order, Section 9d.

0101-4 HANDICAPPED PROVISIONS

Any DOE facility whose intended use either will require that the building or facility be accessible to the public, or may result in the employment of physically handicapped persons therein, shall be designed in accordance with the Uniform Federal Accessibility Standards in 41 CFR 101.19.6.

The standards in 41 CFR 101-19.6 shall apply to the design, construction, alteration, or lease of any portion of a facility except when:

- Because of its intended use, it need not be made accessible to, or usable by, the public or by physically handicapped persons. This exception shall not be taken solely on the basis that the facility is not, or will not be, accessible to the public. Every facility shall be designed to assure across to physically handicapped persons unless a facility's intended use is specifically restricted to able-bodied personnel.

- The alteration of an existing building if the alteration does not involve the installation of, or work on, existing stairs, doors, elevators, toilets, entrances, drinking fountains, floors, telephone locations, curbs, parking areas, or any other facilities susceptible to installation or improvements to accommodate the physically handicapped.

- The alteration of an existing building, or of portions thereof, to which application of the standards is not structurally possible.

- The construction or alteration of a building for which plans and specifications were completed or substantially completed on or before September 2, 1%9, provided, however, that any building defined in 41 CFR 101-19.6 shall be designed, constructed, or altered in accordance with the standards prescribed in 41 CFR 101-19.6 regardless of design status or bid solicitation as of September 2, 1969.

- The leasing of space when it is found after receiving bids or offers not otherwise legally acceptable that a proposal meets most of the requirements of the Uniform Federal Accessibility Standards. If no offeror or bidder meets all the requirements, then preference must be given to the offeror or bidder who most nearly meets the standards in 41 CFR 101-19.6. If the award is proposed for a firm other than the one that most nearly meets these standards and whose bid or offer is reasonable in price, and is otherwise legally acceptable, a waiver or modification of the standards must be obtained.

The Real Property and Facilities Management Division, MA-22, is responsible for developing the composite DOE annual report on building accommodations for the physically handicapped from feeder reports provided by the responsible Departmental field elements. This division is responsible for submittal of those reports to GSA by September 15 each year.

Record keeping and reporting by Departmental elements responsible for design, construction, alteration, or lease of buildings and related facilities shall be in accordance with 41 CFR 101-19.6. Formalization of this requirement shall be made through the DOE RPIS.

Guidance on implementation of the above requirements and copies of the prescribed standards can be obtained from the Real Property and Facilities Management Division, MA-222.

Annual reporting information shall be installed into the DOE RPIS by the fith working say of September each year.

Also see Section 0110-8, Accommodations for the Physically Handicapped.

0106 REGULATORY REQUIREMENTS

This section lists the regulatory requirements cited in these criteria.

CFR Code of Federal Regulations
Superintendent of Documents
Government Printing Office
Washington, DC 20402
202/783-3238

- 10 CFR 20, Standards for Protection Against Radiation
- 10 CFR 6O, Disposal of High-Level Radioactive Wastes in Geologic Repositories, Licensing Procedures
- 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Wastes
- 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI)
- 10 CFR 435, DOE Energy Conservation (Interim)
- 10 CFR 436, Federal Energy Management and Planning Programs

- 1O CFR 1O22, Compliance with Floodplains/Wetlands Environmental Review Requirements

- 16 CFR 1630, Standards for Surface Flammability of Carpets and Rugs (FF 1)

- 29 CFR 1910, Occupational Safety and Health Standards

- 29 CFR 1926, Safety and Health Regulations for Construction

- 36 CFR 800, Protection of Historic Properties

- 40 CFR 61, National Emission Standard for Radionuclide Emissions from Department of Energy Facilities

- 40 CFR 112, Oil Pollution Prevention

- 40 CFR 122, Permitting Requirements for Land Disposal Facilities

- 40 CFR 125, Criteria and Standards for the NPDES (National Pollutant Discharge Elimination System)

- 40 CFR 141, National Primary Drinking Water Regulations

- 40 CFR 142, National Interim Primary Drinking Water Regulations Implementation

- 40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Wastes

- 40 CFR 192, Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

- 40 CFR 240, Guidelines for the Thermal Processing of Solid Wastes

- 40 CFR 241, Guidelines for the Land Disposal of Solid Wastes

- 40 CFR 249, Guideline for the Federal Procurement of Cement and Concrete Containing Fly Ash

- 40 CFR 256, EPA Guidelines for State Solid Waste Management Plans

- 40 CFR 260, Hazardous Waste Management System: General

- 40 CFR 261, Hazardous Waste Management System: Identification and Listing of Hazardous Wastes

- 40 CFR 262, Standards for Generators of Hazardous Wastes

- 40 CFR 263, Standards for Transporters of Hazardous Wastes

- 40 CFR 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
- 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- 40 CFR 267, Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities
- 40 CFR 270, EPA Ministered Permit Programs: The Hazardous Waste Permit Program
- 40 CFR 271, Requirements for Authorization of State Hazardous Waste Programs
- 40 CFR 280, Underground Storage Tanks
- 40 CFR 423, Protection of the Environment, Steam-Electric Power Generating Point Source Category
- 40 CFR 761, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
- 41 CFR 101, Federal Property Management Regulations
- 48 CFR 10, Federal Acquisition Regulations
- 49 CFR 101-19.6, Uniform Federal Accessibility Standards

CONGRESSIONAL
ACTS

Superintendent of Documents
Government Printing Office
Washington, DC 20402
202/275-3030

- (CAA) Clean Air Act, Pub. L. 88-206, 42 U.S.C. 1857 et seq.
- (CERCLA) Comprehensive Environmental Response, Compensation, and Liability Act, Pub. L. 96-510, 42 U.S.C. 9601 et seq.
- (CWA) Clean Water Restoration Act, Pub. L. 89-753, 43 U.S.C. 431 et seq.
- (FUA) Powerplant and Industrial Fuels Use Act, Pub. L. 95-620, 42 U.S.C. 8301 et seq.
- (FWPCA) Federal Water Pollution Control Act, Pub. L. 86-70, 33 U.S.C. 1157 et seq.
- (NEPA) National Environmental Policy Act, Pub. L. 91-190, 42 U.S.C. 4321 et seq.
- (NHPA) National Historic Preservation Act, Pub. L. 89-665, 16 U.S.C. 470 et seq.

- (PURPA) Public Utility Regulatory Policy Act, Pub. L. 95-617, 16 U.S.C. 823a et seq.

- (RCRA) Resource Conservation and Recovery Act, Pub. L. 94-580, 42 U.S.C. 6901 et seq.

- (SDWA) Safe Drinking Water Act, Pub. L. 93-523, 42 U.S.C. 201 et seq.

- (TSCA) Toxic Substances Control Act, Pub, L. 94-469, 15 U.S.C. 2601 et seq.

- (WQA) Water Quality Act, Pub. L. 89-234, 33 U.S.C. 1151 et seq.

DOE U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
202/586-9642

For non-directives DOE documents, see Section 0109, Reference Standards and Guides

- DOE 1360.2A, Unclassified Computer Security Program

- DOE 4300.1B, Real Property and Site Development Planning

- DOE 4330.2C, In-House Energy Management

- DOE 4700.1, Project Management System

- DOE 5100.4, Internal Review Budget Process

- DOE 5300.1B, Telecommunications

- DOE 5300.2B, Telecommunications: Emission Security (Tempest)

- DOE 5300.3B, Telecommunications: Communications Security

- DOE 5300.4B, Telecommunications: Protected Distribution System

- DOE 5400 series on:

  - Radiation Protection of the Public and the Environment
  - Radiological Effluent Monitoring and Environmental Surveillance

- DOE 5400.1, General Environmental Protection Program Requirements

- DOE 5400.3, Hazardous and Radioactive Mixed Waste Program

- DOE 5440.1C. National Environmental Policy Act

- DOE 5480.1B, Environmental, Safety, and Health Program for DOE Operations

- DOE 5480.3, Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes

- DOE 5480.4, Environmental Protection, Safety, and Health Protection Standards

- DOE 5480.5, Safety of Nuclear Facilities

- DOE 5480.6, Safety of Department of Energy-Owned Nuclear Reactors

- DOE 5480.7, Fire Protection

- DOE 5480.8, Contractor Occupational Medical Program

- DOE 5480.10, Contractor Industrial Hygiene Program

- DOE 5480.11, Radiation Protection for Occupational Workers

- DOE 5480.16, Firearms Safety

- DOE 5481.1B, Safety Analysis and Review System (SARS)

- DOE 5500.1A, Emergency Management System

- DOE 5500.3, Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations

- DOE 5630.11, Safeguards and Security Program

- DOE 5630.12, Safeguards and Security Inspection and Evaluation Program

- DOE 5630.13, Master Safeguards and Security Agreements

- DOE 5632 series on
  - Protection program operations
  - Physical protection of special nuclear material and vital equipment
  - Physical protection of classified matter
  - Physical protection of DOE property and unclassified facilities
  - Protective program operations - systems performance tests
  - Issuance, control, and use of badges, passes, and credentials

- DOE 5632.7, Protective Force

- DOE 5633.2, Control and Accountability of Nuclear Materials: Responsibilities and Authorities

- DOE 5633.3, Control and Accountability of Nuclear Materials

- DOE 5633.4, Nuclear Materials Transactions: Documentation and Reporting

- DOE 5636.3A, Technical Surveillance Countermeasures Program

- DOE 5637.1, Classified Computer Security Programs

- DOE 5700.6B, Quality Assurance

- DOE 5820.2A, Radioactive Waste Management

ERDA (See DOE)

EXECUTIVE ORDERS
National Archives and Records Administration
8th Street and Pennsylvania Avenue, NW
Washington, DC 20408
202/523-5230

- Executive Order 11490, Assigning Preparedness Functions to Federal Departments and Agencies

- Executive Order 11593, Protection and Enhancement of the Cultural Environment

- Executive Order 11988, Floodplain Management

- Executive Order 11990, Protection of Wetlands

- Executive Order 12088, Federal Compliance with Pollution Control Standards

FR
Federal Register
Superintendent of Documents
U.S. Government Printing Office
710 North Capitol Street, NW
Washington, DC 20402
GPO Order Desk 202/783-3238 (Charge Orders)
GPO Bookstore: 2021275-2091 (Cash Orders)

- 45 FR 12746, Preliminary Notification of Hazardous Waste Activity

- 54 FR 20694, DOE Guidelines for Compliance With the National Environmental Policy Act

GSA General Services Administration
Public Building Service
Office of Government-wide Real Property Policy and Oversight
19th and F Streets, NW
Washington, DC 20405
202/566-1426

- [Annual] Summary Report of Real Property Owned by the United States Throughout the World

OMB Office of Management and Budget
Old Executive Office Building
Washington, DC 20503
202/395-3000

- OMB Circular A-130, Management of Federal Information Resources

UFAS (See 49 CFR 101-19.6)

0109 REFERENCE STANDARDS AND GUIDES

This section lists the reference standards and guides cited in these criteria.

The latest edition of standards and guides shall be used.

AA Aluminum Association
900 19th Street, NW, Suite 300
Washington, DC 20006
202/862-5100

- Aluminum Finishes for Architecture

- Finishes for Aluminum in Building

AABC Associated Air Balance Council
1518 K Street, NW
Washington, DC 20005
202/737-0202

- Volume A-82, National Standards for Total System Balance Air Distribution-Hydronic Systems-Sound-Vibration-Field Surveys for Energy Audits

AAMA American Architectural Manufacturers Association
2700 River Road, Suite 118
Des Plaines, IL 60018
312/699-7310

- AAMA 101, Aluminum Prime Windows and Sliding Glass Doors

- AAMA 800, Sealant Specifications for Use With Architectural Aluminum

- AAMA 1002.10, Aluminum Insulating Storm Products for Windows and Sliding Glass Doors

- AAMA 1102.7, Aluminum Storm Doors

AASHTO American Association of State Highway and Transportation Officials
444 N. Capitol St, NW, Suite 225
Washington, DC 20001
202/624-5800

- AASHTO GD-2, A Policy on Geometric Design of Rural Highways

- AASHTO GDHS, A Policy on Geometric Design of Highways and Streets

- AASHTO GSDB, Guide Specification for Seismic Design of Highway Bridges

- AASHTO GU-2, Policy on Design of Urban Highways and Arterial Streets

- AASHTO HB-13, Standard Specifications for Highway Bridges

- AASHTO LTS-1, Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

- AASHTO T 258, Determining Expansive Soils

ABMA American Boiler Manufacturers Association
590 North Glebe Road
Suite 160
Arlington, VA 22203
703/522-7350

ACGIH American Conference of Governmental Industrial Hygienists
6500 Glenway Avenue, Building D-7
Cincinnati, OH 45211
513/661-7881

- Industrial Ventilation Manual of Recommended Practice

- TLVs: Threshold Limit Values and Biological Exposure Indices

ACI American Concrete Institute
P.O. Box 19150
Detroit, MI 48219
313/532-2600

- ACI 207.1R, Mass Concrete for Dams and Other Massive Structures
- ACI 207.4R, Cooling and Insulating Systems for Mass Concrete
- ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete
- ACI 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
- ACI 305R, Hot Weather Concreting
- ACI 306R, Cold Weather Concreting
- ACI 318, Building Code Requirements for Reinforced Concrete
- ACI 336.2R, Suggested Design Procedures for Combined Footing and Mats
- ACI 336.3R, Suggested Design and Construction Procedures for Pier Foundations
- ACI 347, Recommended Practice for Concrete Formwork
- ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures
- ACI 350R, Concrete Sanitary Engineering Structures
- ACI 352R, Recommendations for Design of Beam-Column Joints in Monolithic Reinforced Concrete Structures
- ACI 503.4, Standard Specifications for Repairing Concrete with Epoxy Mortars
- ACI 531, Building Code Requirements for Concrete Masonry Structures
- ACI 531.1, Specifications for Concrete Masonry Construction
- ACI 543R, Recommendation for Design, Manufacture and Installation of Concrete Piles
- ACI 546.1R, Guide for Repair of Concrete Bridge Superstructures

- ACI SP-4, Formwork for Concrete

- ACI SP-66, Detailing Manual

- Guide to the Use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete

ACSM American Congress on Surveying and Mapping
210 Little Falls Street,
Falls Church, VA 22046
703/241-2446

- ACSM Horizontal Control as Applied to Local Surveying Needs

AFM (see USAF)

AFWL (see USAF)

AISC American Institute of Steel Construction
400 North Michigan Avenue
Chicago, IL 60611
312/670-2400

- AISC M011, Manual of Steel Construction

- AISC N690, Nuclear Facilities Steel Safety-Related Structures for Design, Fabrication and Erection

- AISC S326, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (included in AISC Manual of Steel Construction)

AISI American Iron and Steel Institute
1133 15th Street, NW
Washington, DC 20005
202/452-7100

- Manual for Structural Applications of Steel Cables for Buildings

- Specifications for the Design of Cold-Formed Steel Structural Members

AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004
312/394-0150

- Publication 99, Standards Handbook

- Publication 201, Fans and Systems

- Publication 261, Directory of Products Licensed to Bear the AMCA Certified Rating Seal

- Standard 210, Laboratory Methods for Testing Fans for Ratings

AMCR/
DARCOM (See ARMY)

ANL Argonne National Laboratory
9800 South Cass Avenue
Argonne, IL 60439
312-972-2000

- ANL/EES TM-264, Rev.1, Environmental Protection Appraisals: A Suggested Guide for U.S. Department of Energy Field Organizations

ANS American Nuclear Society
555 North Kensington Avenue
LaGrange Park, IL 60525
312/352-6611

- ANS 6.4, Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants

- ANS 6.4.2, Specification for Radiation Shielding Materials

- ANS 8.1, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors

- ANS 8.3, Criticality Accident Alarm Systems

- ANS 8.5, Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Materials

- ANS 8.6, Guide for Nuclear Criticality Safety in the Storage of Fissile Materials

- ANS 8.9, Nuclear Criticality Safety Guide for Pipe Intersections Containing Aqueous Solutions of Uranyl Nitrate

- ANS 8.10, Criteria for Nuclear Criticality Controls in Operations Where Shielding Protects Personnel

– ANS 8.12, Nuclear Criticality Control and Safety of Homogeneous Plutonium-Uranium Fuel Mixtures Outside Reactors

– ANS 8.15, Nuclear Criticality Control of Special Actinide Elements

- ANS 8.17, Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Reactor Fuel Outside Reactors

- ANS 8.19, Administrative Practices for Nuclear Criticality Safety

ANSI American National Standards Institute (Note: Generally, references cross-listed as ANSI/ASME, ANSI/IEEE, etc., are listed only once-under their originating organization rather than under ANSI.)

1430 Broadway
New York NY 10018
212/354-3300

– ANSI A39.1, Safety Requirements for Window Cleaning

- ANSI A58.1, Building Code Requirements for Minimum Design Loads in Buildings and other Structures

– ANSI Al 15 series, Door and Frame Preparation

– ANSI A156 series, Hardware

– ANSI A216.1, Sectional Overhead Type Doors

– ANSI C2, National Electrical Safety Code

– ANSI C84.1, Electric Power Systems and Equipment - Voltage Ratings (60 Hz)

– ANSI C136 series, Roadway Lighting

– ANSI D6.1, Manual on Uniform Traffic Control Devices for Streets and Highways

– ANSI D12.1, Roadway Lighting

– ANSI N2.3, Immediate Evacuation Signal for Use in Industrial Installations

– ANSI N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

– ANSI N16.1, Safety Standards for Operations with Fissionable Materials

– ANSI N42.18, Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactive Effluents

– ANSI N512, Protective Coatings (Paint) for the Nuclear industry

- ANSI Z88.2, Practices for Respiratory Protection

- ANSI Z358.1, Eyewash and Shower Equipment, Emergency

API American Petroleum Institute
1220 L Street, NW
Washington, DC 20037
202/682-8159

- API 650, Welded Steel Tanks for Oil Storage

AREA American Railway Engineering Association
50 F Street, NW, Suite 7702
Washington, DC 20001
202/639-2190

AREA Manual for Railway Engineering (Fixed Properties), Volume I and II

ARI Air Conditioning and Refrigeration Institute
1501 Wilson Boulevard, 6th Floor
Arlington, VA 22209
703/524-8800

- ARI 410, Forced Circulation Air Cooling and Air-Heating Coils

- ARI 430, Central Station Air Handling Units

- ARI 450, Water-Cooled Refrigerant Condensers, Remote Type

- ARI 460, Remote Mechanical-Draft Air-Cooled Refrigerant Compressors

– ARI 520, Positive Displacement Refrigerant Compressors and Condensing Units

- ARI 550, Centrifugal Water Chilling Packages

- ARI 590, Reciprocating Water Chilling Packages

- ARI 850, Commercial and Industrial Air Filter Equipment

- ARI 1010, Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers

ARMA Asphalt Roofing Manufacturers Association
6288 Montrose Road
Rockville, MD 20852
301/231-9050

- Guide to Preparing Built-Up Roofing Specifications

- Recommended Performance Criteria for Roofing Membranes Using Polymer Modified Bituminous Products

- Residential Asphalt Roofing Manual

ARMY U.S. Department of the Army
National Technical Information Services
5485 Port Royal Road
Springfield, VA 22161
703/487-4684

– AMCR/DARCOM 385-100, Safety Manual (available from NTIS)

– TM 5-809-10, Seismic Design for Buildings (available from NTIS)

– TM 5-809-10.1, Seismic Design Guidelines for Essential Facilities, 2/86 (available from NTIS)

– TM 5-81O-7/AFM 88-12, Joint Department of the Army and Air Force, USA Technical Manual, High Pressure Gas and Cryogenic systems (available from NTIS)

– TM 5-814-1, Sanitary and Industrial Wastewater Collection-Gravity Sewers and Appurtenances (available from NTIS)

– TM 5-814-2, Sanitary and Industrial Wastewater Collection-Pumping Stations and Force Mains (available from NTIS)

– TM 5-815-2, Energy Monitoring and Control Systems (available from NTIS)

– TM 5-818-1, Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures) (available from NTIS)

– TM 5-818-5, Dewatering and Groundwater Control (available from NTIS)

– TM 5-830-3, Dust Control (available from NTIS)

– TM 5-1300, Structures to Resist the Effects of Accidental Explosions (available from NTIS)

– TM 11-486-5, Electrical Communications Systems Engineering Outside Plant, Wire (available from NTIS)

ASCE American Society of Civil Engineers
345 East 47th Street
New York NY 10017
212/705-7496

- ASCE 37, Design and Construction of Sanitary and Storm Sewers

- ASCE 52, Guide for Design of Steel Transmission Towers

- ASCE 1978-1, Design of Steel Transmission Pole Structures

- ASCE Manual 63, Structural Plastic Design Manual

ASHRAE American Society of Heating Refrigerating and Air-Conditioning Engineers
1791 Tullie Circle, NE
Atlanta, GA 30329
404/636-8400

- Standard 15, Safety Code for Mechanical Refrigeration
- Standard 20, Methods of Testing for Rating Remote Mechanical Draft Air Cooled Refrigerant Condensers
- Standard 24, Methods of Testing for Rating Liquid Coolers
- Standard 51, Methods of Testing Fans for Rating
- Standard 55, Thermal Environmental Conditions for Human Occupancy
- Standard 62, Ventilation for Acceptable Indoor Air Quality
- Standard 90, Energy Conservation in New Building Design
- Standard 100, Energy Conservation In Existing Buildings
- Applications Handbook
- Equipment Handbook
- Fundamentals Handbook
- Refrigeration Handbook
- Systems Handbook
- Manual, Design of Smoke Control Systems for Buildings

- Publication GRP 158, Cooling and Heating Load Calculation Manual

ASME American Society of Mechanical Engineers
22 Law Drive
Box 2300
Fairfield, NJ 07007
201/882-1167, 800/843-2763

- ASME A17.1, Elevators and Escalators

- ASME B16 series, Fittings, Flanges and Valves

- ASME B31.1, Power Piping

- ASME B31.3, Chemical Plant and Petroleum Refinery Piping

- ASME N509, Nuclear Power Plant Air Cleaning Units and Components

- ASME N510, Testing of Nuclear Air Cleaning System

– ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

- ASME PTC 4.1, Steam Generating Units

- ASME Boiler and Pressure Vessel Code

ASTM formerly, American Society for Testing and Materials; now ASTM
1916 Race Street
Philadelphia, PA 19103
215/299-5585

- ASTM A312, Specification for Seamless and Austenitic Stainless Steel Pipe

- ASTM B1, Specification for Hard-Drawn Copper Wire

- ASTM B8, Specification for Concentric-Lay Stranded Copper Conductors

- ASTM C55, Concrete Building Brick

- ASTM C62, Building Brick

- ASTM C71, Definition of Terms Relating to Refractories

- ASTM C90, Hollow Load-Bearing Concrete Masonry Units

- ASTM C145, Solid Load-Bearing Concrete Masonry Units

- ASTM C270, Mortar for Unit Masonry

- ASTM C635, Standard Specification for Metal Suspension Systems for Acoustical Tile and for Lay-in Panels

- ASTM C636, Standard Recommended Practice for Installation of Metal Ceiling Systems for Acoustical Tile and for Lay-in Panels

- ASTM C840, Standard Specification for Application and Finishing of Gypsum Board

- ASTM C1036, Specification for Fiat Glass

– ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils

– ASTM D1587, Thin-Walled Tube Sampling of Soils

– ASTM D2113, Diamond Core Drilling for Site Investigation

- ASTM D2488, Description and Identification of Soils (Visual-Manual Procedure)

- ASTM D3656, Specification for Insect Screening and Louver Cloth Woven From Vinyl-Coated Glass Fiber Yam

- ASTM D4256, Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants

- ASTM D4546, Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils

- ASTM E84, Test Method for Surface Burning Characteristics of Building Materials

- ASTM E413, Determination of Sound Transmission Class

- ASTM E580, Standard Recommended Practice for Application of Ceiling Suspension Systems for Acoustical Tile and for Lay-in Panels

- ASTM E648, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

- ASTM F693, Practice for Sealing Seams of Resilient Sheet Flooring Products by Use of Liquid Seam Sealers

- ASTM G46, Recommended Practice for Examination and Evaluation of Pitting Corrosion

AWS American Welding Society
550 NW LeJeune Road
P.O. Box 351040
Miami, FL 33135
305/443-9353

- AWS D1.1, Structural Welding Code - Steel

- AWS D1.2 Structure Welding Code - Aluminum

- AWS D1.3, Structural Welding Code - Sheet Steel

- AWS D5.2, Standard for Welded Steel, Elevated Tanks, Standpipes and Reservoirs for Water Storage

AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235
303/794-7711

- AWWA C652, Standard for Disinfection of Water Storage Facilities

- AWWA C5186, Standard for Disinfecting Water Mains

- AWWA D1OO, Welded Steel Tanks for Water Storage

- Water Treatment Plant Design

BIA Brick Institute of America
11490 Commerce Park Drive, Suite 300
Reston, VA 22091
703/620-0010

- Building Code Requirements for Engineered Brick Masonry

- Dampproofing and Waterproofing Masonry Walls

BOCA Building Officials and Code Administrators International, Inc.
4051 West Flossmoor Road
Country Club Hills, IL 60477
312/799-2300

- Basic/National Mechanical Code

CAA (See Congressional Acts in Section 0106, Regulatory Requirements)

CERC Coastal Engineering Research Center
U.S. Army Corps of Engineers
P.O. Box 631
Vicksburg, MA 39180
601/634-2485

- Shore Protection Manual

CERCLA (See Congressional Acts in Section 0106, Regulatory Requirements)

CFR (See Section 0106 Regulatory Requirements)

CGA Compressed Gas Association
Crystal Gateway One, Suite 501
1235 Jefferson Davis Highway
Arlington, VA 22202
703/979-0900

Pamphlet G-4.1, Cleaning Equipment for Oxygen

Pamphlet G-4.4, Industrial Practices for Gaseous Oxygen Transportation and Distribution Piping Systems

Pamphlet P-1, Safe Handling of Compressed Gases in Containers

Pamphlet S-1.1, Pressure Relief Device Standards, Part 1-Cylinders for Compressed Gases

Pamphlet S-1.2, Pressure Relief Device Standards, Part 2-Cargo and Portable Tanks for Compressed Gases

Pamphlet S-1.3, Pressure Relief Device Standards, Part 3-Compressed Gas Storage Containers

CISCA Ceiling & Interior Systems Contractors Association
1800 Pickwick Avenue
Glenview, IL 60025
312/940-8800

- Acoustical Ceilings-Use and Practice

CMAA Crane Manufacturers Association of America
1326 Freeport Road
Pittsburgh, PA 15238
704/522-8644

- CMAA-70, Specification for Electric Overhead Traveling Cranes

CONF (See DOE)

CONGRESSIONAL ACTS (See Section 0106 Regulatory Requirements)

CRI Carpet and Rug Institute
310 Holiday Avenue
Box 2048
Dalton, GA 30720
404/270-3176

- Carpet Specifiers Handbook

- Standard for Installation of Textile Floor Covering Materials

CTI Cooling Tower Institute
P.O. Box 73383
Houston, TX 77273
713/350-1995

- Bulletin ATC-105, Test for Water Cooling Towers

CWA (See Congressional Acts in Section 0106, Regulatory Requirements)

DM (See NAVFAC)

DNA Defense Nuclear Agency
6801 Telegraph Road
Alexandria, VA 22310
703/325-7060

DOD U.S. Department of Defense
Attention: NPFC Code 1052
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120-5099
215/697-4374
Emergency Requests (24 Hours/Day): 215/697-3321
For additional information write for: A Guide for Private Industry

DOD 6055.9, Ammunition and Explosives Safety Standards

- MIL-HDBK-419, Grounding, Bonding and Shielding for Electronic Equipment and Facilities
- MIL-HDBK-l004/4, Electric Utilization Systems
- MIL-HDBK-1013/1, Physical Security
- MIL-P-43951, Padlocks and Padlock Sets, Key Operated, Medium Security, Regular Shackle
- MIL-STD-282, Filter Units, Protective Clothing, Gas Mask Components and Related Products: Performance Test Methods
- MIL-STD-1330, Cleaning Test on Shipboard Oxygen and Nitrogen Gas Piping Systems
- MIL-STD-1472C, Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
- MIL-STD-1630, Oxygen Systems and Component Cleanliness; Servicing and Certification Requirements For
- Van Cott and Kincade, Editors, Human Engineering Guide to Equipment Design Joint Army-Navy-Air Force Steering Committee, 1972, U.S. Government Printing Office, Washington, DC

DOE U.S. Department of Energy

For DOE Orders, see Section 0106, Regulatory Requirements

- CONF-86-09116-1 (Conference paper), Evaluation of Potential for Incidents Having Health or Safety Impact, by I. G. Speas (available from DOE/OSTI)
- DOE/DNA TP-20-7, Nuclear Safety Criteria (Classified) (available from DNA)
- DOE/EP/0035, Safeguards Seal Reference Manual (12/86) (available from NTIS)
- DOE/EP 0108, Standard for Fire Protection of DOE Electronic Computer/Data Processing Systems (available from NTIS)
- DOE/EV 0051/1, Electrical Safety Criteria for Research and Development Activities (available from Water Maybee, DOE/EH-332, tel. 301/353-5609)
- DOE/EV 06194, DOE Explosives Safety Manual (available from NTIS)
- DOE/MA 0129, Site Development Planning for Energy Management (P-3) (available from DOE/OSTI)

- DOE/TIC 11268, A Manual for the Prediction of Blast and Fragment Loading on Structures (available from NTIS)

- DOE/TIC 11603, Rev. 1, Nonreactor Nuclear Facilities: Standards and Criteria Guide (available from NTIS)

- DOE Design Guide, Graphic Design Standard 8 (available from Jack Metier, DOE/MA-222, tel. 202/586-4543)

- DOE Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities (William A. Vaughn memorandum, August 5, 1985) (available from Darrell Huff, EH-332, tel. 301/353-2136)

- DOE Threat Statement, Generic Threats for DOE Nuclear Programs and Facilities, 1/31/83 (Confidential, NSI) (available from DOE Safeguards and Security Coordinators)

- DOE TSCM (Technical Surveillance Countermeasures) Procedural Guide (available from DOE Safeguards and Security Coordinators)

– ERDA 76-21 (ORNL-NSIC-65-1), Nuclear Air Cleaning Handbook The Design, Construction and Testing of High Efficieny Air Cleaning Systems (available from NTIS)

DOE/OSTI DOE/Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831
615/576-1222

DREW CHEMICAL One Drew Chemical Plaza
Boonton, NJ 07005
201/263-7600

- Ameroid Engineer's Manual of Marine Boiler and Feed Water Treatment, 1972

- Principles of Industrial Water Treatment, 1977

EIA Electronics Industries Association
2001 Eye Street NW
Washington, DC 20006
202/457-4900

- EIA-222-D, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

EIMA Exterior Insulation Manufacturers Association
Box 75037
Washington, DC 20013
202/783-6582

- Guideline Specification for Exterior Insulation and Finish Systems Class PB Type A

- Guideline Specification for Exterior Insulation and Finish Systems Class PM Type A and B

EPA Environmental Protection Agency
401 M. Street, SW
Washington, DC 20460
202/829-3535

- EPA 430/9-75-002, A Guide to the Selection of Cost Effective Wastewater Treatment systems

- EPA 450/4-80-023, Determination of Good Engineering Practice Stack Height

- EPA 450/4-81-003, Guideline for Use of Fluid Modeling to Determine Good Engineering Practice: Stack Height

- EPA 600/8-81-009, Guideline for Fluid Modeling for Atmospheric Diffusion

- EPA 625/1-77-009, Process Design Manual: Wastewater Treatment Facilities for Sewered Small Communities

- EPA 625/1-80-012, Design Manual: On-Site Wastewater Treatment and Disposal Systems

- EPA Project #17090, Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities

- EPA Radiation Protection Guidance to the Federal Agencies for Occupational Exposure, Federal Register, Vol. 52 No. 17, 1987

EPRI Electric Power Research Institute
P.O. Box 10412,
Palo Alto, CA 94303
415/855-2000

- EPRI NP-3659, Human Factors Guide for Nuclear Power Plant Control Room

ERDA (See DOE)

Executive Orders (See Section 0106, Regulatory Requirements)

FAA Federal Aviation Administration
U.S. Department of Transportation
400 7th Street, SW
Washington, DC 20590
202/366-5580

- FAA AC 150/5020-1, Noise Control and Compatibility Planning for Airports
- FAA AC 150/5050-5, The Continuous Airport System Planning Process
- FAA AC 150/5070-6A, Airport Master Plans
- FAA AC 150/5210-6C, Aircraft Fire and Rescue Facilities and Extinguishing Agents
- FAA AC 150/5300-2D, Airport Design Standards-Site Requirements for Terminal Navigational Facilities
- FAA AC 150/5300-4B, Utility Airports-Air Access to National Transportation
- FAA AC 150/5300-12, Airport Design Standards-Transport Airports
- FM AC 150/5320-5B, Airport Drainage
- FAA AC 150/5320-6C, Airport Pavement Design and Evaluation
- FM AC 150/5325-5B, Aircraft Data
- FAA AC 150/5340-1E, Marking of Paved Areas on Airports
- FAA AC 150/5390-2, Heliport Design Guide

FAI Fauske & Associates, Inc.
16W070 West 83rd Street
Burr Ridge, IL 60521
312/323-8750

- FAI/83-9, Safety Analysis of SISL Process Module

FCC Federal Construction Council
Building Research Board
National Research Council
2101 Constitution Avenue, NW
Washington, DC 20418
202/334-3378

- FCC Technical Report No. 37, High Temperature Water for Heating and Light Process Loads

- FCC Technical Report No. 44, Boiler Rating Criteria for Nonresidential Heating Boilers

- FCC Technical Report No. 51, Combustion Equipment for Nonresidential Heating Boilers

- FCC Technical Report No. 57, Impact of Air Pollution Regulations on Fuel Selection for Federal Facilities

- FCC Technical Report No. 69, Stationary Diesel Engines for Use with Generators to Supply Electric Power

- FCC Technical Report No. 71, Nonresidential Steam Boilers and Hot Water Generators

FEMA Federal Emergency Management Agency
Federal Center Plaza
500 C Street, SW
Washington, DC 20472
202/646-4600

- FEMA CPG2-17, Electromagnetic Pulse Protection Guidance

- FEMA TR-83A, Interim Guidelines for Building Occupant Protection From Tornadoes and Extreme Winds

- FEMA TR-83B, Tornado Protection-Selecting and Designing Safe Areas in Buildings

- FEMA TR-87, Standards for Fallout Shelters

FGMA Flat Glass Marketing Association
White Lakes Professional Building
3310 Harrison Street
Topeka, KS 66611
913/266-7013

- Glazing Manual

- Sealant Manual

FINK AND BEATY

- Donald G. Fink and H. Wayne Beaty, *Standard Handbook for Electrical Engineers,* 12th Edition, McGraw-Hill Book Co., New York

FIPS Federal Information Processing Standards
National Bureau of Standards
Room 64-B, Technology
Gaithersburg, MD 20899
301/975-2816

- **FIPS PUB** 94, Guidelines on Electrical Power for ADP Installations

FM Factory Mutual Engineering and Research
1151 Boston Providence Turnpike
Norwood, MA 02062
617/762-4300

- FM 1-57, Loss Prevention Data Sheet On Rigid Foamed Polyurethane

- FM 5-4/14-8, Loss Prevention Data Sheet On Transformers

– Approval Guide

FR (See Section 0106, Regulatory Requirements)

FS Federal Specifications
Attention: NPFC Code 1052
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120-5099
215/697-2667
Emergency Requests (24 Hours/Day): 215/697-3321
For additional information write for: A Guide for Private Industry

- FS AA-D-600B, Door, Vault, Security

- FS FF-P-001480, Padlock, Key Operated

- FS FF-P-11O, Padlock, Changeable Combination

- FS W-A-450B, Alarm Systems, Interior, Security, Components for

- FS W-C-596, General for Connector, Electrical, Power

- FS WW-P-541 series, Plumbing Fixtures

FUA (See Congressional Acts in Section 0106, Regulatory Requirements)

GA Gypsum Association
810 First Street, NW, Suite 300
Washington, DC 20002
202/289-5440

- Manual of Gypsum Veneer Plaster

HES Health Education Services
P.O. Box 7282
Albany, NY 12224

- Recommended Standards for Sewage Works (Ten States Standards)

IAEA International Atomic Energy Agency
Vienna International Center
Wagranerstrasse 5
Post Fach 100
A-1400 Vienna, Austria

- Safety Series No. 30, Manual on Safety Aspects of the Design and Equipment of Hot Laboratories

IAPMO International Association of Plumbing and Mechanical Officers
5032 Alhambra Avenue
Los Angeles, CA 90032-3490
A-1400 Vienna, Austria

- UPC, Uniform Plumbing Code

ICBO International Conference of Building Officials
5360 South Workman Mill Road
Whittier, CA 90601
213/699-0541

- Report 4071, Suspended Ceilings, July 1984

- UBC (Uniform Building Code)

– UBC Standard No. 17-6, Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Panel Assemblies Using Foam Plastic Insulation

- UBC Standard No. 47-18, Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings

ICRP International Commission on Radiological Protection
Maxwell House
Fairview Park
Elmsford, NY 10523
914/592-7700

- Report No. 26, Recommendations of the ICRP

IEEE Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017
212/705-7960

IEEE 80, Guide for Safety in Substation Grounding

IEEE 141, Recommended Practice for Electric Power Distribution for Industrial Plants

IEEE 142, Recommended Practice for Grounding Industrial and Commercial Power Systems

IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

IEEE 308, Standard Criteria for Class 1E Power System for Nuclear Power Generating Stations

IEEE 379, Standard Application of the Single Failure Criterion to Nuclear Power Generating Station Class 1E Systems

IEEE 384, Standard Criteria for Independence of Class 1E Equipment and Circuits

IEEE 399, Recommended Practice for Power System Analysis

IEEE 446, Recommended Practice for Emergency and Standby Power for Industrial and Commercial Applications

IEEE 493, Recommended Practice for Design of Reliable Industrial and Commercial Power systems

IEEE 602, Recommended Practice for Electrical Power Systems in Health Care Facilities

IEEE 739, Recommended Practice for Energy Conservation and Cost-Effective Planning in Industrial Facilities

IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding

IEEE C37 series, Circuit Breakers, Switchgear, Relays, Substations and Fuses

- IEEE C37.91, Guide for Protective Relay Applications to Power Transformers

IES Illuminating Engineering Society of North America
345 East 47th Street
New York, NY 10017
212/705-7920

- Lighting Handbook, application and reference volumes

ISDSI Insulated Steel Door Systems Institute
712 Lakewood Center North
14600 Detroit Avenue
Cleveland, OH 44107
216/226-7700

- ISDSI 102, Installation Standard for Insulated Steel Door Systems

LANL Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, NM 87545
505/667-7000

– LA-10294-MS, A Guide to Radiological Accident Considerations for Siting and Design of Nonreactor Nuclear Facilities (available from NTIS)

LBL Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, CA 94720
415/486-4000

- LBL-9143, Seismic Safety Guide (available from DOE/OSTI)

LLNL Lawrence Livermore National Laboratory
Livermore, CA 94550
415/422-4599

- UCRL 15673, Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities (available from NTIS)

– UCRL 15714, Suspended Ceiling System Survey and Seismic Bracing Recommendations (available from NTIS)

– UCRL 15910, Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, 1988 (available from NTIS)

- UCRL 53526, Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy, Sites, by D.W. Coats and R.C. Murray, August 1985 (available from NTIS)

- UCRL 53582, Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for Department of Energy Sites, by D.W. Coats and R.C. Murray, November 1984 (available from NTIS)

MBMA Metal Building Manufacturers Association
1230 Keith Building
Cleveland, OH 44115-2180
216/241-7333

- Metal Building Systems Manual

MEISTER AND
RABIDEAU

- D. Meister and G. Rabideau, *Human Factors Evaluation in System Development,* John Wiley & Sons, New York 1965

MIL (See DOD)

MLSFA Metal Lath/Steel Framing Association
221 North LaSalle Street
Chicago, IL 60601
312/346-1600

- Steel Framing Systems Manual

NAAMM National Association of Architectural Metal Manufacturers
600 South Federal Street
Chicago, IL 60605
312/922-6222

- Metal Finishes Manual

NAPIICC National Association of Plumbing-Heating-Cooling Contractors
180 South Washington Street
P.O. Box 6808
Falls Church, VA 22046
703/237-8100

- NSPC, National Standard Plumbing Code

NASA National Aeronautics and Space Administration
Code NTT-3
Washington, DC 20546
202/453-2928

- NHB 7320.1B, NASA Facilities Engineering Handbook

– SP-3072, ASRDI Oxygen Survey Vol.2, 1972, Cleaning Requirements, Procedures and Verification Techniques

NAVFAC U.S. Naval Facilities Engineering Command
Attention Cash Sales/Code 1051
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120-5099
215/697-4374/6

- DM-7.03, Soil Dynamics, Deep Stabilization, and Special Geotechnical Construction

- NCEL UG-OO1O, User Guide for Single Building Controllers (available from NTIS by requesting Pub. No. ADA 180490)

NBS National Bureau of Standards (currently National Institute of Standards and Technology)
Gaithersburg, MD
301/975-2000

- Handbook 135, Life Cycle Cost Manual for Federal Energy Management Programs

- Technical Note 837, Barrier Penetration Tests

NCEL (See NAVFAC)

NCMA National Concrete Masonry Association
2302 Horse Pen Road
P.O. Box 781
Herndon, VA 22070
703/435-4900

– NCMA TR 75B, Specifications for the Design and Construction of Load-Bearing Concrete Masonry

– Waterproof Coatings for Concrete Masonry

- Waterproofing Concrete Masonry Basements and Earth-Sheltered Structures

NEC (See NFPA 70)

NEMA National Electrical Manufacturers Association
2101 L Street, NW, Suite 300
Washington, DC 20037
202/457-8400

- NEMA ICS, Industrial Controls and Systems
- NEMA MG-1, Motors and Generators

NEPA (See Congressional Acts in Section 0106, Regulatory Requirements)

NFPA National Fire Protection Association
Batterymarch Park
Quincy, MA 02269
800/344-3555

- NFPA 10, Portable Fire Extinguishers
- NFPA 11, Low Expansion Foam and Combined Agent Systems
- NFPA 11A, Medium High Expansion Foam Systems
- NFPA 12, Carbon Dioxide Extinguishing Systems
- NFPA 12A, Halon 1301 Fire Extinguishing Systems
- NFPA 12B, Halon 1211 Fire Extinguishing Systems
- NFPA 13, Installation of Sprinkler Systems
- NFPA 14, Installation of Standpipe and Hose Systems
- NFPA 15, Water Spray Fixed Systems for Fire Protection
- NFPA 16, Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems
- NFPA 16A, Installation of Closed-Head Foam-Water Sprinkler Systems
- NFPA 17, Dry Chemical Extinguishing Systems
- NFPA 20, Installation of Centrifugal Fire Pumps

- **NFPA 22,** Standard for Water Tanks for Private Fire Protection
- **NFPA 24,** Installation of Private Fire Service Mains and Their Appurtenances
- **NFPA 30,** Flammable and Combustible Liquids Code
- **NFPA 31,** Oil Burning Equipment
- **NFPA 37,** Stationary Combustion Engines and Gas Turbines
- **NFPA 45,** Fire Protection for Laboratories Using Chemicals
- **NFPA 50,** Oxygen Systems, Bulk, at Consumer Sites
- **NFPA 54,** National Fuel Gas Code (ANSI Z 223.1)
- **NFPA 58,** Storage and Handling of Liquid Petroleum Gas
- **NFPA 68,** Explosion Venting
- **NFPA 70,** National Electrical Code (NEC)
- **NFPA 71,** Installation, Maintenance and Use of Central Station Signalling Systems
- NFPA 72A, Installation, Maintenance and Use of Local Protective Signaling Systems
- NFPA 72B, Installation, Maintenance and Use of Auxiliary Protective Signaling Systems
- NFPA 72C, Installation, Maintenance and Use of Remote Station Signaling systems
- NFPA 72D, Installation, Maintenance and Use of Proprietary Protective Signaling Systems
- NFPA 72E, Standard on Automatic Fire Detectors
- NFPA 72F, Standard on Emergency Voice/Alarm Communication Systems
- NFPA 72G, Guide on Notification Appliances for Protective Signaling Systems
- NFPA 72H, Guide on Testing Procedures for Local, Auxiliary, Remote Station and Proprietary Protective Signaling Systems
- NFPA 75, Protection of Electronic Computer/Data Processing Equipment
- NFPA 78, Lightning Protection Code
- NFPA 80, Fire Doors and Windows
- NFPA 80A, Protection from Exposure Fires

- NFPA 85A, Prevention of Furnace Explosions in Fuel Oil and Natural Gas Fired Single Burner Boiler Furnaces
- NFPA 85B, Prevention of Furnace Explosions in Natural Gas Fired Multiple Burner Boiler Furnaces
- NFPA 85D, Prevention of Furnace Explosions in Fuel Oil Fired Multiple Burner Boiler Furnaces
- NFPA 85E, Prevention of Furnace Explosions in Pulverized Coal Fired Multiple Burner Boiler Furnaces
- NFPA 8SF, Installation and Operation of Pulverized Fuel Systems
- NFPA 85G, Furnace Implosions in Multiple Burner-Boiler Furnaces
- NFPA 90A, Air Conditioning and Ventilation Systems
- NFPA 91, Blower and Exhaust Systems
- NFPA 96, Cooking Equipment, Vapor Removal
- NFPA 99, Standard for Health Care Facilities
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 232, Protection of Records
- NFPA 255, Test of Surface Burning Characteristics of Building Materials
- NFPA 403, Aircraft Rescue and Firefighting Service at Airports and Heliports
- NFPA 407, Aircraft Fuel Servicing
- NFPA 409, Aircraft Hangers
- NFPA 496, Purged and Pressurized Enclosures for Electrical Equipment
- NFPA 1221, Public Fire Service Communication Systems
- NFPA 1410, Training Standard on Initial Fire Attack

NHPA (See Congressional Acts in Section 0106, Regulatory Requirements)

NIJ National Institute of Justice
633 Indiana Avenue, NW
Washington, DC 20531
202/724-2942

- NIJ Standard 0108.01, Ballistic Resistant Protective Materials

NOAA National oceanic and Atmospheric Administration
Washington Science Center, Building 5
6010 Executive Blvd.
Rockville, MD 301/443-8330

- NGS Special Publication 247, Manual of Geodetic Triangulation

- NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volumes I-XI

- NOAA Manual NOS NGS 1, Geodetic Bench Marks

- NOAA Manual NOS NGS 3, Geodetic Leveling

- NOAA/National Weather Service Technical Paper No. 40, Rainfall Frequeny Atlas of the United States for Durations From 30 Minutes to 24 Hours and Return Periods From One to 100 Years

NORDELL

- Eskel Nordell, *Water Treatment for Industrial and Other Uses*, Reinhold Publishing, New York 1961

NPDES (See 40 CFR 125 in Section 0106, Regulatory Requirements)

NRC U.S. Nuclear Regulatory Commission
Publications Division
Washington, DC 20555
202/492-9508

– NUREG 0700, Guidelines for Control Room Design Reviews

– NUREG CR-2496, Human Engineering Design Considerations for Cathode Ray tube Generated Displays

– NUREG CR-3331, A Methodology for Allocating Nuclear Power Plant Control Functions to Human or Automatic Control

- R.G. 3.10, Liquid Waste Treatment System Design Guide for Plutonium Processing and Fuel Fabrication Plants

- R.G. 3.12, General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants

- R.G. 3.13, Guide for Acceptable Waste Storage Methods at UF_6 Production Plants

- R.G. 3.14, Seismic Design Classification for Plutonium Processing and Fuel Fabrication Plants

- R.G. 3.17, Earthquake Instrumentation for Fuel Reprocessing Plants

- R.G. 3.18, Confinement Barriers and Systems for Fuel Reprocessing Plants

- R.G. 3.20, Process Off-Gas Systems for Fuel Reprocessing Plants

- R.G. 3.22, Periodic Testing of Fuel Reprocessing Plant Protection System Actuation Functions

– R.G. 3.27, Nondestructive Examination of Welds in the Liners of Concrete Barriers in Fuel Reprocessing Plants

- R.G. 3.32, General Design Guide for Ventilation Systems for Fuel Reprocessing Plants

- R.G. 3.33, Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant

- R.G. 3.34, Assumptions Used for Evaluating the Potential Consequences of Accidental Nuclear Criticality in a Uranium Fuel Fabrication Plant

- R.G. 3.35, Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Plutonium Processing and Fuel Fabrication Plant

- R.G. 3.43, Nuclear Criticality in the Storage of Fissile Materials

- R.G. 3.49, Design of an Independent (Water Basin Type) Spent Fuel Storage Installation

- R.G. 3.54, Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation

- R.G. 8.8, Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Reasonably Achievable

NRCA National Roofing Contractors Association
One O'Hare Center, Suite 8030
6250 River Road
Rosemont, IL 60018
31 2/318-6722

- Construction Details

- Handbook of Accepted Roofing Knowledge

- Roofing and Waterproofing Manual

- Steep Roofing Manual

NSA National Security Agency/Central Security Service
Fort Meade, MD 20755
301/688-7111

- NACSIM 5203, Guidelines for Facility Design and Red/Black Installation

NSPC (See NAPHCC)

NTIA National Telecommunications and Information Administration
Main Commerce Building
Washington, DC 20230
202/377-1551

- NTIA Manual, Regulations and Procedures for Radio Frequency Management

NTIS National Technical Information Service
5485 Port Royal Road
Springfield, VA 22161
703/487-4650

NUREG (See NRC)

NWWDA National Wood Window and Door Association
1400 East Touhy Avenue
Des Plaines, IL 60018
312/299-5200

- NWWDA IS-1, Wood Flush Doors

- NWWDA IS-2, Wood Window Units

- NWWDA IS-3, Wood Sliding Patio Doors

- NWWDA IS-6, Wood Style and Rail Doors

- NWWDA IS-7, Wood Skylight/Roof Window Units

OMB (See section 0106, Regulatory Requirements)

PCA Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077
312/966-6200

- Clear Coatings for Exposed Architectural Concrete
- Effect of Substances on Concrete and Guide to Protective Treatment
- Painting Concrete
- Surface Treatments for Concrete Floors

PCI Prestressed Concrete Institute
175 West Jackson Boulevard, Suite 1859
Chicago, IL 60604
312/786-0300

- PCI MNL-116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

- PCI MNL-120, Design Handbook

PDCA Painting and Decorating Contractor of America
7223 Lee Highway,
Falls Church, VA 22046
703/534-1201

– Architectural Painting and Wall Covering Manual

POWELL

- Sheppard T. Powell, *Water Conditioning for Industry,* McGraw-Hill Book Company, New York 1954

PTI Post-Tensioning Institute
301 West Osborne, Suite 3500
Phoenix, AZ 85013
602/265-9158

- Post-Tensioning Manual

PURPA (See Congressional Acts in Section 0106, Regulatory Requirements)

RCRA (See Congressional Acts in Section 0106, Regulatory Requirements)

RFCI Resilient Floor Covering Institute
966 Hungerford Road
Suite 12-B
Rockville, MD 20850
301/340-8580

- Recommended Work Procedures for Resilient Floor Covering

R.G. (See NRC)

SAND (See SNL)

SCS Soil Conservation Service, U.S. Department of Agriculture
14th and Independence Avenue, SW
Washington, DC 20250
202/447-2791

- SCS National Engineering Handbook

SDI Steel Deck Institute
P.O. Box 9506
Canton, OH 44711
216/493-7886

- SDI-Publ. 25, Design Manual for Composite Decks, Form Decks and Roof Decks

- SDI-Publ. DDM01, Diaphragm Design Manual

SDI Steel Door Institute
712 Lakewood Center North
14600 Detroit Avenue
Cleveland, OH 44107
216/226-7700

- SDI 100, Standard Steel Doors and Frames

- SDI 108, Selection and Usage Guide for Standard Steel Doors

SDWA (See Congressional Acts in Section 0106, Regulatory Requirements)

SJI Steel Joist Institute
1205 48th Avenue North Suite A
Myrtle Beach, SC 29577
803/449-0487

- Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

SMA Screen Manufacturers Association
Park Place, Suite 201
655 Irwing Park
Chicago, IL 60613

- SMA 2005, Aluminum Sliding Screen Doors

- SMA 3001, Aluminum Swinging Screen Doors

SMACNA Sheet Metal and Air Conditioning Contractors National Association
8224 Old Courthouse Road
Vienna, VA 22182
703/790-9890

- Architectural Sheet Metal Manual

- Energy Recovery Equipment and systems Manual

- Fibrous Glass Duct Construction Standards

- HVAC Air Duct Leakage Test Manual

- HVAC Duct Construction Standards-Metal and Flexible

- HVAC Duct Design Manual

- Round Industrial Duct Construction Standards

SNL Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185
505/844-8065

- SAND 87-1926, Access Delay Technology Transfer Manual (Draft-UNCI) (In some cases availability is subject to approval from DOE/DP-34, OSS, Headquarters.)
- SAND 87-1927, Entry Control Technology Transfer Manual (Draft-UNCI) (In some cases availability is subject to approval from DOE/DP-34, OSS, Headquarters.)
- SAND 87-1928, Intrusion Detection Technology Transfer Manual (Draft-UNCI) (In some cases availability is subject to approval from DOE/DP-34, OSS, Headquarters.)

SPRI Single Ply Roofing Institute
104 Wilmot Road, Suite 201
Deerfield, IL 60015-5195
312/940-8800

- Single Ply Roofing A Professional's Guide to Specifications
- Wind Design Guide for Ballasted Single Ply Roofing Systems
- Wind Design Guide for Fully Adhered Single Ply Roofing Systems
- Wind Design Guide for Mechanically Attached Single Ply Roofing Systems

SSFI Scaffolding, Shoring, and Framing Institute
1230 Keith Building
Cleveland, OH 44115
216/241-7333

- SH 300, Steel Frame Shoring Safety

SWI Steel Window Institute
1230 Keith Building
Cleveland, OH 44115-2180
216241-7333

- Specifications Brochure for Steel Windows

TCA Tile Council of America, Inc.
Box 326
Princeton, NJ 08542
609/921-7050

- Handbook for Ceramic Tile Installation

TIMA Thermal Insulation Manufacturers Association
7 Kirby Plaza
Mount Kisco, NY 10549
914/241-2284

- Economic Thickness Manual

TM (See Army)

TSCA (See Congressional Acts in Section 0106, Regulatory Requirements)

UBC (See ICBO)

UCRL (See LLNL)

UFAS (See 49 CFR 101-19.6 in Section 0106, Regulatory Requirements)

UL Underwriters Laboratories
333 Pfingsten Road
Northbrook, IL 60062
312/272-8800

- UL 10A, Tin Clad Fire Doors
- UL 155, Tests for Fire Resistance for Vault and File Room Doors
- UL 207, Refrigerant-Containing Components and Accessories, Nonelectrical
- UL 325, Door, Drapery, Louver, and Window Operators and Systems
- UL 365, Police Station Connected Burglar Alarm Units and Systems
- UL 493, Cabled Underground Feeder and Branch Circuits, Thermoplastic-Insulated
- UL 508, Industrial Control Equipment
- UL 586, High Efficiency Particulate, Air Filter Units
- UL 723, Test for Surface Burning Characteristics of Building Materials
- UL 752, Bullet-Resisting Equipment
- UL 768, Standards for Safety, Combination Locks

- UL 779, Safety Standard for Electrically Conductive Floorings

- UL 900, Test Performance of Air Filter Units

- UL 984, Hermetic Refrigerant Motor-Compressors

- UL 992, Test Method for Measuring the Surface Plane Propagation Characteristics of Flooring and Floor Covering Materials

- UL 1479, Fire Test of Through-Penetration Firestops

- UL Building Materials Directory

- UL Fire Resistance Directory

UPC (See IAPMO)

USAF U.S. Department of the Air Force
Manuals may be ordered from headquarters
of any Air Force Base

- AFM 88-29, Engineering Weather Data

- AFWL-TR-74-62, Air Force Manual for Design and Analysis of Hardened Structures

USNRC (See NRC)

VAN COTT AND KINCADE (See DOD)

WINTERKORN AND FANG

- Hans F. Winterkorn and Hsai-Yang Fang, *Foundation Engineering Handbook*, Van Nostrand Reinhold and Co., New York 1975

WPCF Water Pollution Control Federation
601 Wythe Street
Alexandria, VA 22314-1994
703/684-2400

- MOP/8 CTG-77, Wastewater Treatment Plant Design

WQA (See Congressional Acts in Section 0106, Regulatory Requirements)

WRC Water Resources Council, Hydrology Committee
U.S. Department of the Interior
C Street between 18th and 19th Streets, NW
Washington, DC 20240
202/3434841

- Bulletin No. 17A, Guidelines for Determining Flood Flow Frequency

0110 ARCHITECTURAL AND SPECIAL DESIGN REQUIREMENTS

0110-1 DESIGN, PROGRAMMATIC, AND OPERATING REQUIREMENTS

0110-1.1 General

0110-1.1.1 Design

Designs shall produce facilities that are straightforward and businesslike. Designs must respond to user needs but reflect a responsible use of public finds. Designs shall be defensible in terms of scope, cost, and appearance. Appropriate, defensible design is:

- Well planned
- Effective in function
- Simple in form
- Cost-effective
- Constructible
- Adaptable and durable over time
- Clean in appearance
- Maintainable

Appropriate design shall meet and not exceed users' needs. Appropriate architecture for DOE facilities shall blend and balance four elements:

- Respect of image
- Respect of function
- Respect of environment
- Respect of economy

0110-1.1.2 Programming

Programmatic studies shall include a detailed consideration of the functional requirements of the activities to be housed to determine the amount of space to be provided in the facility. The design criteria document shall make programmatic and operating requirements explicit in compliance with DOE 4700.1.

The process of programming will vary depending on the specific project, location, and individual DOE field organization requirements. The designer shall consider the program and

resolve perceived deficiencies with the user and cognizant DOE authority. The designer shall question apparently excessive scope demands when they occur.

0110-102 Systems Integration

When two or more services or systems such as those noted below are to be incorporated into a facility or a facility complex, these systems shall be considered to determine if they can be integrated and to identify the most cost-effective level of systems integration:

- Telecommunications
- Data communications (local area networks)
- Lighting controls
- HVAC control
- Energy management system
- Security and alarm
- Closed-circuit television
- Vertical transportation controls
- Fire detection and alarm
- Public address system

0110-1.3 Emergency Planning

Emergency planning requirements, including the provision of space for storage of emergency equipment, shall be considered early in the conceptual design phase to ensure that facility features provide for evacuation and other emergency requirements and that facility emergency plans are coordinated with the overall plant-complex emergency plan.

0110-2 ALTERNATIVE DESIGNS

During the project planning phase (conceptual design), alternative designs shall be developed in accordance with DOE 4700.1. Alternative designs shall be considered during Title I against programmatic and operating requirements and criteria.

0110-3 FLEXIBILITY

Flexibility is a major design requirement for all facilities except those with highly specialized functions. Even in those special facilities, however, the design shall, to the maximum extent practicable, provide sufficient flexibility to accommodate for programmatic changes or operational modifications.

The layouts and type of architectural, structural, mechanical, and electrical elements of all facility elements shall address anticipated future needs. The placement of columns and beams shall be coordinated with the initial and estimated future equipment installations, utility services, operational requirements, and room and furniture layouts. Changeable, movable, and remountable materials shall be considered where functional requirements are likely to change. Design solutions shall demonstrate methods for modification and expansion including modularity, additional capacities (unless otherwise restricted in other sections of these criteria), interstitial space, access flooring systems, and other techniques when justified on an LCC basis.

0110-4 OPERATIONAL EFFICIENCY

Organizational, functional, spatial, and adjacency aspects of design shall be promote operational efficiency in a workable and logical manner. The selection of interior materials, finishes, and colors shall be based primarily on building function and user requirements. In office and administrative areas, space planning shall maximize the potential for personnel and team productivity by providing, where appropriate, a mix of unpartitioned open spaces and enclosed office space. See also Section 0110-3, Flexibility.

0110-5 HEALTH AND SAFETY

0110-5.1 Performance Objectives

Health and safety performance objectives to be achieved in the design of DOE facilities include:

- Protection of the public and all personnel from injury and from exposure to toxic materials, radiation, and other hazards in accordance with DOE requirements and allowable limits
- Protection of private and public property against damage resulting from DOE operations
- Continuation of operations by minimizing accident potential
- Limitation of loss or damage to Federal property, including losses associated with the inability to readily decontaminate or decommission facilities for other subsequent uses

Specific project design criteria in the areas of emergency preparedness and emergency management shall be developed with the advice and assistance of DOE organizations responsible for DOE emergency management/emergency preparedness programs. Such criteria shall comply with:

- DOE 5500.1A
- DOE 5500.3

See also Section 0110-10, Fallout Shelters, and Section 0110-99.2, Emergency Preparedness Facilities.

0110-5.2 Safety Analysis

All DOE facilities shall be evaluated for potential risks to the operators, the public, and the environment. DOE 5481. 1B contains criteria for determining the level of reporting required based on facility functions and potential accident risks. Safety analysis report timing, content, and format criteria and approval provisions are contained in DOE 5481.1B. This section contains a brief summary of the basic requirements of 5481.1B.

The preliminary safety analysis shall be initiated during the conceptual design phase of the project and further developed during preliminary (Title I) design and detailed Title II) design phases. In most cases, these analyses are included in the project planning and design documentation (e.g., in conceptual design reports, Title I design reports). Facility design and construction features identified as a result of the PSAR shall be factored into the conceptual design before establishing the project cost estimate and requesting Congressional authorization for design and construction. The PSAR shall be completed and approved prior to the start of construction (including site preparation), consistent with DOE 4700.1.

The Final Safety Analysis Report (FSAR) shall be developed during the instruction phase of the project and shall be completed and approved prior to the initiation of facility operations. The FSAR shall be updated as appropriate to reflect changes affecting safety that are made to the facility during its lifetime.

Areas to be addressed in the safety analysis include, but are not necessarily limited to, the following:

- Form, type, and amount of hazardous materials (nuclear or other) to be stored, handled, or processed
- Principal hazards and risks that can be encountered in facility operation, including potential accidents and predicted consequences of fire, explosion, radiation, toxic exposure, structural failure, wind, flood, earthquake, tornado, operating error, failure of essential operating equipment, and failure of safety systems
- selected design basis accidents such as DBF, DBW, DBE, DBT, OBA, and DBFL. These shall be postulated and quantified, including the rationale for selection.
- Principal design, construction, and operating features selected for preventing accidents or reducing risks to acceptable levels, including the safety margins used

0110-53 Emergency Prepardness Planning

Each facility that has potential on-site or off-site effects during normal or abnormal operations shall have an Emergency Plan prepared which shall be incorporated with the Site Emergency Preparedness Plan.

0110-5.4 Asbestos-Containing Materials

Maintenance, repair, and demolition of DOE facilities shall comply with OSHA-29 CFR and EPA-40 CFR.

0110-5.5 Polychlorinated Biphenyls (PCBs)

If the use, storage, or disposal of polychlorinated biphenyls (PCBs) or materials containing PCBs is to be encountered in a facility, the facility design shall comply with 40 CFR 761.

See Section 1630-2.3.5, Oil-Filled Equipment.

0110-6 FIRE PROTECTION

0110-6.1 General

Facilities shall comply with the following

- DOE 5480.4 Attachment 2, Section 2.C
- DOE 5480.7
- Section 1530, Fire Protection

Facilities shall also comply with 29 CFR 1926 and 29 CFR 1910. Except as required by other sections of these criteria, NFPA 101 shall apply where 29 CFR 1926 and 29 CFR 1910 does not apply or where NFPA 101 exceeds the requirements of 29 CFR 1926 and 29 CFR 1910.

Definitions, fire resistance ratings, and types of construction shall be as contained in the UBC.

Any materials with unusual fire characteristics, such as urethane foams, and any materials that develop significant quantities of toxic or other harmful products of combustion, shall not be used as interior finishes or other interior applications without the approval of the cognizant DOE fire protection authority. The use of foamed plastics in construction shall be prohibited unless it fully complies with FM 1-57.

0110-6.2 Fire Protection Design Analysis

A special fire protection design analysis shall be made of each facility vital to DOE mission accomplishment. The analysis shall use time parameters established in accordance with DOE 5480.7. The analysis shall identify the special fire prevention and protection features and controls deemed by the cognizant DOE fire protection authority to achieve a level of fire protection for vital facilities and programs that meets or exceeds the "improved risk" level.

As a part of determining the “improved risk” level, the analysis shall address those conditions in a facility where

- Large or unusual fire potential exists.

- There are special life-safety hazards.
- Toxic chemicals or biological agents exist.
- The consequences of fire include radioactive contamination of the facility, the site, or the public environment.
- National security is adversely affected by fire.

Special precautions for preventing the spread of fires, such as multiple fire suppression systems, rapid detection of incipient fires, confining fires, increased fire ratings of construction materials, and rapid-response fire departments shall be provided.

A *general* fire-protection design analysis shall be made of each facility to ascertain and limit the cost of future damage repair and replacement of facilities and their contents from fire. The analysis shall be made using those parameters established in DOE 5480.7. The analysis shall determine the special fire prevention and protection features and controls deemed by the cognizant DOE fire protection authority to achieve a level of improved risk fire protection that limits damage to an acceptable level. The analysis shall be documented in report form in the facility project files and reference by the SAR.

Fire-protection design analysis shall be done as soon as possible and included as a portion of the Title I Design Summary document required by DOE 4700.1.

0110-6.3 Fire Resistance Ratings

All facilities shall be divided into areas in which the total potential fire loss to each area and its equipment does not exceed $75 million as described in DOE 5480.7. These areas shall be separated by fire walls and barriers with not less than 4-hour fire-resistance ratings. Where exceptions are necessary for reasons of operations or equipment, exemption procedures shall comply with DOE 5480.7.

Adjacent occupancies of non-compatible groups shall be separated by 2-hour, or better, fire-rated walk, floors, and ceilings as required by the NFPA codes.

Wall, floor and ceiling, and roof and ceiling assemblies shall be tested and rated for their fire resistance by UL or similar nationally accredited testing laboratories, or shall be listed for their fire resistance as approved by FM or similar national insurance organizations. Untested, unrated or unapproved assemblies shall be approved by the cognizant DOE fire protection authority before being considered for use in a DOE facility.

0110-6.4 Hazardous Areas

When exemptions are granted to specific DOE fire protection standards for reasons unique to DOE facilities, as in the case of some containment structures, fire protection shall be provided so as to assure the life safety of facility occupants as required by the cognizant DOE fire protection authority.

Hazardous areas, such as radioactive spaces or spaces with inert atmospheres, shall have sufficient alarms and interlocks to assure that access by emergency personnel will not endanger such personnel or result in a public hazard.

The design of hazardous areas shall facilitate access by emergency personnel from the exterior and, at the same time, shall maintain any required confinement or containment using air locks or other features.

The design of the exteriors of facilities shall follow the recommendations of NFPA 80A. Facilities that are not separated as recommended by NFPA 80A shall have fire protection systems such as exterior sprinklers or barrier walls.

0110-7 ENVIRONMENTAL PROTECTION AND POLLUTION CONTROL

The construction of all DOE facilities shall comply with the environmental protection and pollution control portions of the following

- DOE 4700.1, Chapter V
- DOE 5480.4
- DOE 5480.1B
- DOE 5440.lC

For more specific criteria, see Section 0273, Water Pollution Control; Section 0275, Industrial Wastewater Treatment; Section 0285, Solid Waste System; and Section 1589, Air Pollution Control.

0110-8 ACCOMMODATIONS FOR THE PHYSICALLY HANDICAPPED

The extent to which facilities are designed to accommodate the physically handicapped shall be determined at the earliest stages of project planning and implemented through each phase of design.

See Section 0101-4, Handicapped Provisions, for regulatory and design criteria.

0110-9 OPERATION, MAINTENANCE, REPAIR, AND REPLACEMENT

Planning and design of buildings and other structures, including their operating components and systems, shall take into account all aspects of operation and maintenance including:

- Equipment accessibility
- Dismantling
- Replacement

- **Repair**

- Frequency of preventive maintenance
- Inspection requirements
- Personnel safety
- Day-to-day operation

Design decisions for all projects shall be based on considerations of LCC as well as all other programmatic requirements affecting the facility. Studies shall be made that balance initial construction cost with the operating and maintenance costs over the anticipated life of the facility.

LCC analyses used to select materials and equipment shall include the cost and availability of materials, parts, and labor required for operation, maintenance, repair, and replacement.

Space for the operation, maintenance, repair, and replacement of materials and equipment shall be provided and shall be included in LCC analyses used to select materials and equipment.

LCC analyses shall be appendices in a project's design criteria document or other such project file,

0110-10 FALLOUT SHELTERS

Executive Order 12656 (superseding Executive Order 11490) requires the Secretary of Energy to identify facilities essential to the national defense and national welfare, to develop plans and programs to provide for the security of such facilities, and to avoid or minimize disruptions of essential services during any national security emergency. The Secretary of Energy shall also, in coordination with the Secretary of Defense, ensure continuity of nuclear weapons production consistent with national security requirements. Executive Order 12656 does not specifically require the provision of fallout shelters. Therefore, until that time when the Secretary of Energy specifically defines the Department's policy with respect to fallout shelters, provision for such space shall be considered only in dual-purpose spaces where little or no additional costs to the total estimated cost will be incurred. Examples of possible spaces are interior corridors, interior rooms, or below-ground spaces.

This new guidance supersedes the instructions for "Preparation of Construction Project Data Sheets" in DOE 5100.4, which currently could be interpreted to require the unnecessary inclusion of fallout shelter space. Coordination of this new guidance will be reflected in future revisions of that Order.

0110-11 WORK SPACE MANAGEMENT STANDARDS

Office and administrative space standards shall comply with the following

- 41 CFR 101-17
- DOE 4300.1B

These standards shall be applied to new buildings, additions to buildings, leased space, and contractor-occupied space.

The FPMR requirements shall be applied to those specific areas used for ordinary office functions. The goal of the criteria is to achieve an average workstation utilization rate of 135 occupiable square feet or less per person. In general, spaces dedicated to a machine or process, or spaces where people support equipment and not vice versa, do not fit into this category, and the workstation utilization rate does not apply.

See 41 CFR 101-17.003 and 17.600 for definitions and further guidance regarding exceptions.

0110-12 ENERGY CONSERVATION

0110-12.1 Coverage

For purposes of this section, the term "building" shall mean new commercial, industrial, or residential building, or new building additions, unless otherwise stated. The term "Federal Building" means any building, structure, or facility that is constructed, renovated, leased, or purchased, in whole or in part for use by the United States, which includes a heating system, a cooling system, or both.

These criteria shall be applied in the planning and design of the following DOE facilities:

- New buildings and building additions including their operating systems and energy using equipment
- Building and building system alteration projects
- Semi-permanent facilities (owned directly or indirectly by the Government) such as pre-engineered metal buildings, trailer units, or other types of temporary buildings
- Other energy-using facilities such as new or modified central utility plants, utility distribution systems, and exterior lighting systems

These criteria shall be applied with the following objectives:

- Minimizing consumption of nonrenewable energy sources on the basis of LCC effectiveness
- Encouraging the use of renewable energy sources

Employee health, safety and environment (including indoor air quality) shall not be compromised in achieving energy efficiency.

0110-12.2 **General**

For new construction, DOE facilities shall be designed to comply with the more stringent requirements of "Interim Energy Conservation Standards for New Commercial Buildings." when promulgated, or ASHRAE Standard 90.

For existing construction, ASHRAE Standard 100 shall apply.

DOE has designated ASHRAE Standard 90 as the minimum efficiency standard for new Federal Buildings with the following two exceptions:

- That the DOE LCC methodology shall be used (rather than the ASHRAE methodology)
- That this standard shall not limit further reduction in energy use where such reductions can be achieved on the basis of LCC analysis

The building envelope shall meet the minimum prescriptive energy conservation requirements of ASHRAE Standard 90 and the criteria in Section 0110-123, Building Envelope Thermal Transmittance Values, and Section 0110-12.4, Building Envelope Air Leakage Criteria. The mechanical and electrical systems shall meet the minimum prescriptive energy conservation requirements of ASHRAE Standard 90 and the requirements of Division 15, Mechanical, and Division 16, Electrical

Relative to electrical distribution systems, utilization equipment rated greater than 1,000 W and lighting equipment with an inductive reactance load component shall have a power factor of not less than 85 percent under rated load conditions. Utilization equipment with a power factor of leass than 90 percent shall be corrected to at least 90 percent under rated load conditions. Power-factor corrective devices, installed to comply with this criterion, shall be switched with the utilization equipment, except where this results in an unsafe condition or interferes with the intended operation of the equipment

Energy conservation alternatives for measures exceeding the minimum requirements of ASHRAE Standard 90 shall be considered for any building described in Section 0110-121, Coverage, according to the procedures outlined in Section 0110-127, Building Analysis Procedures, with the objective of obtaining the greatest opportunities for energy conservation for the subject building.

Analysis of the building to determine energy conservation features and energy source alternatives shall be accomplished in the preliminary design (Title I) phase. The conceptual design phase cost estimates shall include adequate funding to cover energy conservation alternatives. Determination shall be made before the completion of the preliminary (Title I) design phase as to which energy conservation alternatives shall be incorporated into the building design based on LCC.

The building energy conservation analysis or waiver thereof shall be reported and documented according to the procedures outlined in Section 0110-12.8, Energy Conservation Report Requirements.

HVAC design shall comply with ASHRAE Standard 62.

0110-12.3 Building Envelope Thermal Transmittance Values

The following building envelope criteria shall be the minimum values to be used in the architectural design of new buildings and building alteration projects and in considering the acquisition of pre-engineered metal buildings, modular buildings, trailer units, and temporary facilities.

As a minimum requirement, the thermal transmittance values ("U" values) and overall maximum allowable combined transmittance values as determined from ASHRAE Standard 90 shall be used as basic building envelope criteria. Lower thermal transmittance values shall be considered by LCC analysis as discussed in Section 0110-12.7, Building Analysis Procedures.

Buildings with solar energy sources, high internal heat loads, or other special requirements shall be considered according to the procedures given in ASHRAE Standard 90 in order to determine if deviations from the maximum allowable thermal transmittance values would actually result in less annual energy consumption.

0110-12.4 Building Envelope Air Leakage Criteria

Building envelope air leakage through walls, windows, and doors shall comply with ASHRAE Standard 90.

0110-12.5 Use of Renewable Enerygy Systems

0110-12.3.1 Active Solar Systems

The DOE Energy Management Coordinator shall determine whether the use of active solar systems shall be considered for a building. The application of active solar systems shall be considered based on LCC. Geographical location, site solar access, conventional fuel availability, and load characteristics are major factors in determining when an active solar system shall be considered. Active solar systems shall be considered when it is determined they can be LCC effective.

0110-12.5.2 Passive Solar Techniques and Daylighting Techniques

The application of passive solar techniques including passive space heating, passive cooling, and daylighting shall be considered for all building projects as directed by the DOE Energy Management Coordinator. Passive solar techniques shall be used wherever they are determined to be technically feasible and economically justifiable.

0110-12.5.3 Other Renewable Systems

The DOE Energy Management Coordinator shall determine whether other renewable energy sources such as photovoltaics, wind, geothermal, or other sources shall be considered.

0110-12.6 Energy Management Systems

Criteria and methodology for the design of an EMS shall comply with TM 5-815-2

Methodology for estimating the energy conservation performance of an EMS shall comply with NCEL UG-0010.

Implementation and installation of an EMS, a micro EMS (single-building controller) or an interface to an existing EMS, shall be considered in the preliminary (Title 1) design phase for all building projects. Energy management systems shall be evaluated by LCC analysis.

0110-12.7 Building Analysis Procedures

0110-12.7.1 LCC Analysis Procedures

LCC analysis shall be used to compare the total life-cycle value of various building parameters and systems based on initial cost, annual maintenance costs, and annual operating costs. Furthermore, the present value of future benefits and costs shall be calculated for the various energy conservation alternatives. This analysis shall then form a basis for selecting the optimum building systems for any specific use. LCC analysis shall comply with 10 CFR 436, as amended.

LCC analysis shall use energy costs obtained from the most current four successive quarters as reported in the Quarterly Energy Conservation Report for the site. The annual supplement of NBS Handbook 135, which contains current factors and escalation rates for energy, shall be used for the LCC analysis.

0110-12.7.2 Use of Computer or Other Energy Analysis Techniques

Total energy consumption in a building shall be defined to include both building energy consumption and process energy consumption.

Building energy consumption shall be defined as the energy that is used primarily for heating, ventilation, cooling, domestic inter heating, enerygy distribution and lighting. Process energy consumption shall be defined as energy used in a process, production or research program. A "base-case" annual building energy consumption shall be determined by the methods described in Section 0110-12.7.3, Design Analysis Procedures. Energy analysis of building energy conservation alternatives shall be compared to the "base-case" building.

If the estimated annual total building energy consumption as indicated in the DOE project criteria is expected to exceed 500 million BTU, or the building is larger than 10,000 gross square feet, the evaluation of the “base-case” energy consumption and the analysis of energy conservation alternatives shall be performed using a computer analysis technique approved by the DOE Energy Management Coordinator. If the estimated total building annual energy consumption is not expected to exceed 500 million BTU, the design professional can use either a computerized analysis or a manual analysis method using ASHRAE’s Simplified Energy Analysis using the modified bin method to evaluate the energy conservation alternatives and the "base-case" design energy consumption for the building.

The computerized energy analysis shall be made part of the "Energy Conservation Report" as discussed in Section 0110-12.8, Energy Conservation Report Requirements. Energy analysis need not be included in a formal report if the usage is less than 500 million BTU/year.

0110-12.7.3 Design Analysis Pocedures

The energy use of building systems shall be considered at the start of the building design planning process because selection of fundamental building features, such as form, orientation, window/wall ratio, building envelope construction, lighting system types, and HVAC system types have the greatest effect on energy consumption.

Energy Consumption characteristic of different building features shall be defined to identiy the building energy-consuming systems with the greatest potential for reduction in energy consumption. Systems that shall be considered are lighting, heating, cooling, energy (media) distribution, domestic water heating, and ventilation. Factors that affect these systems, such as building thermal transmittance values, infiltration and ventilation rates, occupancies, building orientation, shading, HVAC system design, and lighting system design shall be optimized. The most effective design solutions shall be identified using LCC analysis.

Energy consumption characteristics of process energy systems shall also be analyzed l nd the optimum parameters selected.

A “base-case" annual energy consumption for the building shall be determined as described in Part I below. This “base-case” annual energy consumption shall be reported in accordance with Section 0110-12.8, Energy conservation Report Requirements.

Part I-"Base-Case" Building Annual Energy Consumption

1. New Buildings and New Building Additions

A. The "base-case" energy usage shall be defined as the energy the building would consume resulting from only the implementation of the energy conservation requirements of ASHRAE Standard 90. The “base-case" energy usage shall define the fraction of the building’s energy consumption attributable to lighting, cooling, heating. domestic water heating, energy distribution, and ventilation. The "base-case" energy usage shall l lso define the energy required for process functions. The base-case energy usage shall be determined by simulating the “base-case” building through use of energy analysis techniques as discussed in Section 0110-12.7.2, Use of Computer or Other Energy Analysis Techniques. Project criteria shall indicate process energy requirements and related information.

B. The "base-case” building energy analysis shall include input of all building envelope characteristics, including U-values, areas, building orientation, shading features, window/ wall/roof thermal characteristics, and infiltration characteristics. The analysis shall include input of all building internal characteristics including lighting demand and usage schedules, occupancy demand and schedules, equipment and miscellaneous heat gains, building usage schedules, and ventilation rates and schedules. The analysis shall include calculations of the building’s heat gains and heat losses and total block heating and cooling loads using all of the above listed characteristics and local weather data obtained from AFM 88-29, Chapter 6, bin weather data, or hour-by-hour weather data. The

heating and cooling loads shall include the delineation of the portions associated with solar, transmission, ventilation, and internal components.

c After the thermal heating and cooling loads are calculated, the "base-case" building energy analysis shall indicate the selection of the HVAC systems to be applied to the building to offset the heat gains and heat losses. The "base-case" HVAC systems shall meet the requirements of ASHME Standard 90 and the other design requirements as described in Division 15, Mechanical. The energy analysis shall simulate a full year's performance of the systems based on the thermal loads, full and part load efficiencies of HVAC equipment, demand and usage schedules of energy distribution equipment (fans, pumps, auxiliary burdens, etc.) and demand and usage schedules for domestic water heating. Domestic hot water usage shall be calculated according to the methods described in the ASHRAE Systems handbook. Process energy usage analysis and optimization of the selection of process equipment shall be evaluated separately according to DOE project criteria.

2. Existing Buildings

To analyze energy conservation modifications for existing buildings, a similar "base-case" situation shall be determined. In many cases the base case will be the energy consumption of the particular system in the "as operating" condition. The DOE Energy Management Coordinator will determine when the base case will require a simulation of a building's annual energy consumption. In this case, existing building characteristics for thermal envelope transmittance values, lighting demand and usage schedules, occupancy load and occupancy schedules, and miscellaneous equipment and usage schedules shall be determined from plant operating personnel and used as input. Actual efficiencies of existing HVAC equipment, miscellaneous equipment, and domestic water heating equipment shall also be used as the input for the "base-case" energy analysis. The simulation of the building energy usage should then be plotted against the historical utility bills or beat available information from the facility operator to obtain a "match" of the building's energy dynamics and energy consumption An initial evaluation of possible energy conservation improvements for existing buildings shall be derived from the ASHRAE Standard 100 series.

Part II-Evaluation of Energy Conservation Alternatives

Once the "base-case" building energy usage simulation has been determined, the following steps shall be performed in the building energy usage analysis:

1. Evaluate building envelope energy conservation opportunities by analyzing the effects of modifications to "base-case" thermal transmittance values, fenestration areas, building orientation, building exposure to weather conditions, and building shading characteristic or the use of possible solar technologies.

2 Either evaluate the energy effectiveness of various different mechanical/electrical environmental systems by simulating the energy usage of each of these systems using a constant thermal load "base-case" and comparing the results, or evaluate energy conservation modifications to the "base-case" HVAC system. Again, life-cycle evaluation of mechanical/electrical environmental systems shall be performed using efficiencies

exceeding the minimum HVAC system or lighting system requirements of ASHRAE Standard 90.

3. Evaluate energy conservation alternatives to systems or compare energy usage between systems in an ordered sequence so that energy consequences of one modification over another are included.

4. Evaluate energy conservation modifications to the "base-case" domestic water beating.

5. If potentiality feasible, based on fossile fuel types, availability, and costs, DOE project criteria shall direct the design professional to evaluate cogeneration alternatives. After all system comparisons are evaluated for energy savings, evaluate energy sources based on energy cost to the building. Select fuels and energy sources in conformance with DOE 4330.2C. Discussion of fuel source availability shall be included in the "Energy Conservation Report."

6. LCC analysis shall be performed using typical cost values provided in DOE project criteria and the incremental energy costs determined from Items 1-5 above according to the methods discussed in Section 0110-12.7.1, LCC Analysis Procedures, to determine the optimum energy conservation alternatives.

0110-12.7.4 Waivers of Design Analysis Requirements

Comparative analysis of building envelope, lighting, or HVAC systems can be modified given the following conditions:

- No further comparative analysis of building thermal envelope modifications is required if the building orientation or building construction features are pre-determined and cannot be modified because of special site, safety, or programming considerations. The building still must meet minimum building envelope standards required by ASHRAE Standard 90.

- No further comparative analysis between HVAC systems is required if the type of HVAC system is unique to the building or process and cannot be modified due to rigid temperature control, humidity control, air movement requirement, or special programming. The pre-selected system shall still be evaluated for all possible energy conservation modifications available to that particular system.

- No further comparative analysis is required if selections of overall HVAC systems or ancillai sub-systems or equipment are available that by empirical observation clearly consume the least energy and that can be shown through simple cost estimation to have no significant additional first cost and no significant annual maintenance costs over other HVAC systems. A description of these findings shall be in accordance with Section 0110-12.8, Energy Conservation Report Requirements.

Waivers of design analysis of this type must be submitted for approval to the DOE Energy Management Coordinator. Unusual limiting considerations concerning the building envelope, the HVAC systems, the lighting systems, or other systems that allow for waiver of comparative analysis shall be discussed in the "Energy Conservation Report."

0110-12.8 Energy Conservation Report Requirements

0110-12.8.1 General

An "Energy Consewation Report" (summary evaluation) shall be developed for each new building and building addition where *total* energy consumption is expected to exceed 500 million BTU per year or the building is larger than 10,000 gross square feet.

For projects or retrofits of existing buildings where *total* energy consumption is less than 500 million BTU per year, an "Energy Conservation Report" shall be developed at the discretion of the DOE Energy Management Coordinator.

The report shall be included as a part of the preliminary (Title I) design, where final selections of energy conservation features or renewable energy sources are made.

The report shall contain the results of the annual energy consumption calculations for the "base-case" building and the results of the energy analysis and LCC analysis of energy conservation alternatives as listed below. If parts of this analysis are waived, an explanation shall be included in the report. The report shall:

1. Identify the methods used for simulating building energy consumption and the methods of LCC analysis (e.g., dynamic computer analysis, static computer analysis, or manual calculations) used to consider alternative building systems and the use of renewable energy sources.

2. Describe the "case-case" building, including

   - Building envelope parameters, including U-values, types of fenestration, and percent of gross wall area occupied by feneatration, and orientation
   - Building heating and air-conditioning systems, including types of mechanical refrigeration systems, types of heating systems, types of energy distribution systems, types of automatic temperature controls, types of ventilation systems, and any health and safety requirements that the ventilation system design must satisfy
   - Types of building lighting systems and controls
   - Building domestic water heating systems
   - Process energy consumption systems, if any

3. Provide backup data to indicate that criteria of ASHRAE Standard 90 have been met or exceeded for "base-case" new buildings and criteria of ASHRAE Standard 100 have been met or exceeded for existing retrofitted buildings.

4. Estimate total energy consumption of the "base-case" building, separately identifying building energy consumption and process energy consumption, including:

- BTU/year by types of energy source (e.g., at point of use electricity, natural gas)
- Total BTU/year for entire building
- Total BTU/gross-square-foot/year
- Total BTU/month and per year and kW/month and per year for each energy usage category (e.g., lighting, pumps, fans, refigeration, heating, and domestic water heating)

5. Describe the major energy conservation modifications to the "base-case" building selected, such as modifications to the building envelope, including "U" values, types of fenestration and percentage of glass in the gross wall area and addition of active or passive solar energy futures; modifications to the types of heating and air-conditioning systems, including ventilation, refrigeration, heating and automatic temperature control systems; modification to building systems lighting levels and controls; and all other major modifications considered.

6. Estimate total energy consumption of the "modified" building for each type of proposed energy conservation modification or combination of modifications, separately identifying building energy consumption and process energy assumption. Use the same format as required for the "base-case" building.

7. Estimate energy savings from incorporation of each major energy conservation feature and provide LCC analysis for the addition of each major energy conservation feature.

8. If analyses of active solar systems or use of other renewable energy sources are required by the DOE Energy Management Coordinator, provide the results of the analyses, including backup data for LCC analysis.

9. Discuss the types of permanent metering for energy inputs to the building types of submetering for process energy use, and compatibility with existing or projected energy management systems. Estimate the total cost for metering and submetering provisions.

0110-12.8.2 Distribution of "Energy Conservation Reports"

For buildings that are expected to exceed 500 million BTU per year in total energy consumption or buildings larger than 10,000 square feet, DOE field organizations shall provide one copy of the "Energy Conservation Report" from the Title I design documentation to the In-house Energy Management Branch, Office of Project and Facilities Management, DOE Headquarters, for review and comment. This report should be submitted immediately on completion of Title I. Reconciliation of Headquarters comments shall be incorporated into Title II design by the design professional and responses to comments provided to Headquarters by DOE field organizations.

DOE field organizations shall include a completed summary form in its "Energy Conservation Report" submission to DOE Headquarters with the following information: 1) site; 2) building; 3) TEC (SM); 4) dcsign/construction status; 5) energy type; 6) building

energy consumption (MBTU/yr; 7) process energy consumption (MBTU/yr); 8) total energy consumption (MBTU/yr): 9) metering provided; 10) gross square feet (GSF): 11) BTU/GSF per year; 12) LCC method; 13) major energy conservation features; and 14) LCC.

0110-13 PHYSICAL PROTECTION

0110-13.1 General

DOE security interests are to be protected from theft or diversion of special nuclear material, sabotage, espionage, loss or theft of classified matter or Government property, and other hostile acts which may cause unacceptable adverse impacts on national security, program continuity, or on the health and safety of employees, the public, or the environment. Levels of protection appropriate to particular safeguards and security interests are to be provided in a graded fashion in accordance with the potential risks to national security and the health and safety of employees or the public.

Protection programs must be tailored to address site-specific characteristics on the basis of DOE Orders. Site-specific protection programs are documented in protection program plans and/or MSSAs.

0110-13.2 Access Control and Security Areas.

0110-13.2.1 General

Controls shall be established to prevent unauthorized access to security areas or removal of security interests. In general, the following apply:

- A minimum number of entrances shall be provided for security areas. However, exits from security areas shall be adequate to satisfy the requirements of NFPA 101. Some exits may be provided for emergency use only.

- Entrances to and exits from security areas shall be equipped with doors, gates, rails, or other movable barriers that will direct and control the movement of personnel or vehicles through designated portals.

- Door locks and latches used on security area perimeters shall comply with NFPA 1O1.

A security area denotes a physically defined space containing a Departmental security interest and subject to physical protection and access controls. Security areas shall be established when the nature, size, revealing characteristics, sensitivity, or importance of the classified matter or associated security interests is such that access to them cannot be effectively controlled by other internal measures. The type of security area established depends on the nature of the security interests to be protected, with the following types required for the protection of the listed security interests:

- *Property Protection Area* for protection of DOE property, located at property protection facilities

- *Limited Area* for protection of classified matter where guards, security inspectors, or other internal controls can prevent access to classified matter by unauthorized persons
- *Exclusion Area* for protection of classified matter where mere access to the area would result in access to classified matter
- *Protected Area* to control Category I and II quantities of special nuclear material
- *Material Access Area* within a protected area to control access to areas containing Category I quantities of special nuclear material
- *Vital Area* within a protected area for protection of vital equipment

0110-13.2.2 Property Protection Area Requirements

Security areas normally do not need to be established for offices of consultants or other individuals, small laboratories, or other facilities with limited scope and volume of work However, adequate security must be in place to preclude unauthorized access.

Verification of the identity of persons authorized access to a limited security area shall be accomplished at the area entrance.

0110-13.2.3 Limited-Area Requirements

Limited-area requirements are as follows:

- Clearly defined physical barriers shall be utilized to control, impede, or deny access, and shall effectively direct the flow of personnel and vehicles through designated portals, and allow effective searches. Permanent barriers shall be used to enclose security areas except during construction or transient activities, when temporary barriers may be erected.
- A means shall be provided to detect unauthorized intrusion by use of alarm systems, random patrols, or visual surveillance.
- Adequate protective illumination shall be provided to permit or assist in detection and assessment of adversaries, reveal unauthorized persons, and, at pedestrian and vehicular entrances, to permit examination of credential and vehicles. See Section 0283-7, Lighting.
- The protection program shall include suitable means to assess alarms and/or activities of adversaries.
- Measures shall be in place to prevent unauthorized visual or aural access to classified matter as required by DOE 5636.3A.

0110-13.2.4 Exclusion Area Requirements

An exclusion area must meet all the requirements for a limited area, except that when the exclusion area is located within a larger limited area, additional trespass signs are not required, additional inspections or searches need not be performed, and an unattended access control system may be used.

0110-13.2.5 Protected Area, Material Access Access, and Vital Area

See Section 1300-10.2.3, Baseline Protection Requirements.

0110-13.3 Physical Barriers

Physical barriers shall protect DOE property and facilities as follows:

- Barriers such as walls or fences are intended to control or impede access.
- Unoccupied facilities shall be locked with tamper-resistant locks. A system of accountability and positive controls for keys and combinations shall be in place.

0110-13.4 Intrusion Detection

When determined by the Field Element to be required, intrusion detection and assessment systems shall protect in a manner consistent with their value and the impact of loss or sabotage of property and facilities. At a minimum:

- A means of timely detection of intrusion shall be provided by the use of alarm systems or patrols.
- Adequate illumination shall be provided to detect intruders, reveal unauthorized persons, and, at pedestrian and vehicular entrances, permit examination of credentials and vehicles. See Section 0283-7, Lighting.

0110-13.5 Communications Equipment

Communications equipment shall be provided to allow effective protection

0110-99 SPECIAL FACILITIES

0110-99.0 Nonreactor Nuclear Facilties-General

0110-99.0.1 General

Whenever feasible, special facilities shall be planned and layout developed on the basis of repetitive or discrete processing steps, grouped according to facilities services (HVAC requirements, functional disciplines, and operating hazards) and shall be contained in individual process rooms or cells to the extent practical. Unless there are specific requirements for providing office areas within the special facilities, they shall be located with other offices and common-use facilities (e.g., data computation and processing, word processing) in a centralized location. The design professional shall consider the need for safe normal and emergency access, egress, and internal traffic flow. Support areas such as the health physics laboratory/office shall be located near the exit from the process area. The exit areas shall have adequate space for personnel circulation and egress and monitoring equipment. All normal routes of egress shall be directed through exits that contain monitoring stations.

The type and level of hazard shall be determined for each functional area of the special facility, the attendant degree of risk established, and the possibility of cross-contaminatation considered. Radioactive and hazardous materials (chemicals, feed wastes, etc.) shall be segregated from each other to minimize the generation of mixed waste. Wherever possible, areas for work with radioactive or other hazardous contaminants shall be located together to simplify solutions to problems of air supply and exhaust, waste disposal, decontamination, and cross-contamination. In addition, areas where radioactive materials are used shall be designed for ease of decontamination during building usage and also for decommissioning after the building life cycle.

Energy conservtion shall be given particular attention in the planning and design of special facilities. See Section 0110-12, Energy Conservation. For many special facilities, HVAC loadings and other special ventilation requirements are of sufficient magnitude to require particular attention to the potentials for energy conservation; however, air-to-air heat exchangers are not recommended for energy conservation with untreated air between, for example, laboratory hood exhausts or other local exhaust systems for hazardous materials and the comfort air systems. Cascading air from low contamination potential zones (such as comfort zones) as a supply to higher contamination potential zones may be considered providing backflow protection is incorporated. Recirculation of air within a single zone with appropriate filtering and conditioning is also acceptable. Significant energy savings for heating and cooling may be realized, based on LCC effectiveness of energy conservation features; however, any such features shall only be incorporated where they do not compromise the safety and health of personnel.

Commonalities among similar DOE special facilities' requirements offer an opportunity for improved design of new special facilities or major alterations or additions to existing ones. Where similar types of special facilities exist or are being planned, maximum use shall be made of the design and construction approaches taken, construction and operating economies achieved to take advantage of new or innovative techniques and to avoid repeating less than successful experiences. Efforts shall be made during the planning phase to obtain information about recently constructed special facilities experiences at other DOE sites.

0110-99.0.2 Building Services and Distribution

Special facilities services and building utilities shall be planned to achieve maximum flexibility and ease of access. Vertical and horizontal headers shall be specifically located as planning and preliminary design progresses.

Priority shall be given to gravity-flow piped services and utilities and large air distribution and exhaust duct headers when analyzing the following

- Establishment of zones (space) in vertical and horizontal service chases
- Determination of service header sizes
- Assignment of spaces

Vertical chases shall be provided with fire cutoffs, preferably at each floor level and at the enclosing partitions, consistent with the building construction code classification. Suitable access doors or removable panels shall be provided in service chases for access to valves, dampers, and so forth. To maintain the necessary degree of protection required by the particular building code classification, equipment selections shall be made from products listed by UL or other approved testing organization.

To ensure both the safety of personnel and the effective administration and control of special facilities, access to hazardous areas (e.g., hazardous gas storage locations and electrical power and distribution panels) shall be controlled by locked gates, doors, power panels, or other physical barriers. Compressed gas cylinders shall be isolated outside of the special facilities building or housed in a special hazardous materials storage room, exhausted gas cabinets, or similar types of containment.

Where continuous services are required, service headers shall be looped and appropriately valved to maintain such services during routine maintenance or system alterations.

Special facilities services shall extend from horizontal service headers. Services shall be located to avoid penetration of adjacent facility walls and floors in those cases where routine maintenance or alterations of these services would result in undesirable curtailment or interruption of operations in the adjacent special or other facilities. All piping shall be located outside hazardous areas whenever possible to reduce personnel exposure during maintenance.

0110-99.0.3 Utilization Schedule

A special facilities utilization schedule shall be developed to show the intended schedule of operations of energy-using systems and equipment. These schedules shall be used in performing computerized or other energy-use analyses to develop energy-efficient special facility design. Particular care shall be taken to identify the use requirements of such large energy consumers as secondary confinement ventilation systems and other high volume air-using equipment to ensure that such equipment is properly designed. Operating control features shall allow reduced equipment air flows during periods of nonuse, if personnel health and safety and environmental protection will not be adversely affected.

0110-99.0.4 Building Layout

The design of the facility shall include controlled access to areas of potential hazards within the facility. The facility layout shall provide for the segregation of administrative and other support personnel from operations and process activities and areas. The arrangement and location of process equipment and its maintenance provisions shall ensure that exposure to radiation and other hazardous materials is within the requirements of DOE 5480.11 and DOE 5480.10, respectively. In addition, exposures shall be maintained ALARA. The design shall protect workers sufficiently from hazards to ensure that workers can perform actions required during normal operations, anticipated operational occurrences, and postulated DBAs. The design shall ensure prompt, safe shutdown in emergencies, and allow ready access to areas where manual corrective actions are required and to areas that contain radiation monitoring equipment.

A minimum number of entrances shall be provided for security areas. However, exits shall comply with NFPA 101. Some exits shall be provided for emergency use only, and equipped with alarm devices and seals. At least two ants shall be provided in rooms where hazardous materials are handled. (Exceptions for explosives facilities appear in Chapter II, Section 2.2 of DOE/EV 06194.)

In those areas where an accidental breach of a primary confinement system could expose personnel to radioactive material, a distance of 75 feet as measured by the method in the NFPA 101 shall be the maximum travel distance to ensure that personnel can exit through the next confinement barrier. This barrier is the partition separating two different air zones, the area of refuge being on the upstream side of the barrier. The assured airflow through the barrier shall be in the direction opposite of exit travel.

The facility design shall provide space to accommodate all planned activities, operations, and maintenance (e.g., processing, research and development, scrap and waste handling, sample analysis, shipping and receiving, and material staging required for equipment installation and modifications). The design shall minimize the hazard of handling flammable and other hazardous materials. In addition to the usual industrial safety features required in a nuclear-facility, the design shall also include the following safety features as appropriate:

- Layout of the facility shall provide specific control and isolation, if possible, of quantities of flammable, toxic, and explosive gases, chemicals, and other hazardous materials admitted to the facility.

- The provision of additional space shall be considered for temporary shielding or for additional shielding in the event radiation levels are higher than anticipated.

Auxiliary space allotments shall be held to a minimum consistent with operational efficiency. For office space, space allowances for planning purposes shall comply with Section 0110-11, Work Space Management Standards. Storage areas (or vaults) shall be located in light of the hazards of materials stored (e.g., radiation and criticality of nuclear materials), fire-fighting capabilities, and contamination control. Storage areas having heavy floor loadings shall be placed on grade or compacted fill.

Where practical, storage buildings shall be rectangular and windowless. The layout shall provide for efficient cleaning, maintenance, and ease of inspection. The storage building shall be designed to receive, ship, expedite identification of, inventory, place, store, and retrieve unirradiated and/or irradiated fissile material or other material capable of sustaining a chain reaction. Storage buildings shall be designed as dry and/or wet storage facilities as required.

Storage facilities shall be physically separated from process operations, areas for the storage of nonnuclear materials or equipment, and functions not directly required for storage operations. Where floor storage is operationally required, layout of floor areas and access areas shall take into consideration the requirements for secure location of storage containers, traffic control, and segregation. Physical protection of stored SNM shall comply with the DOE 5632 series.

Suitable physical compartmentalization shall be provided, as determined from the safety analysis, to limit the quantities of stored materials in each compartment to safe levels; ensure the necessary access features and controls; and satisfy the loss limitation criteria in Section 0110-99.0.7, Loss Limitations.

Story height shall be held to a minimum consistent with the structural framing system, required equipment height, and building utility systems. Generally, a clear height of 9 feet shall be adequate, with floor-to-floor height not exceeding 12 feet except where specific functions require special ventilation systems or where high-bay space is required for engineering development, semiworks, other equipment, or similar functional use.

Where economical, suspended ceilings shall be used to reduce HVAC loads and energy costs, to provide required acoustical properties, and to facilitate the maintenance of acceptable levels of cleanliness. Where the use of suspended ceilings is justified, floor-to-floor heights and space above the suspended ceilings shall be held to the minimum required to accommodate concealed piping, ducts, structural framing, and so forth.

Where an acceptable working environment can be provided by careful layout of exposed framing, piping, and ducts, the roof or overhead floor construction shall be designed to eliminate the need for ceiling finish (other than painting) or applied or integral acoustical treatment.

Corridor width(s) can be a controlling factor in the overall building size, and corridors shall be no wider then required for facility functions. All corridors and door openings shall meet NFPA 101 or more stringent requirements based on the hazards of materials to be handled or operations to be performed, as established by the cognizant DOE health and safety authority. The size and arrangement of interior corridors shall accommodate the following:

- Personnel traffic flow patterns
- Safety of building occupants
- Movement of equipment (including initial equipment installation, facility operations, and future replacement or removal)
- Ultimate decontamination and decommissioning of the facility, including equipment required during decontamination

Where room doors open into corridors, frames shall be recessed to prevent the open doors from encroaching on clear corridor spaces.

Equipment recessed in corridors, such as firehose racks or cabinets, drinking fountains, and pay telephones, shall be grouped together to the maximum extent possible.

0110-99.0.5 Interior Walls and Partitions

Fixed partitions shall be provided for corridors and office space unless movable partitions are functionally and economically justified and satisfy fire safety and other health and safety requirements. Where movable partitions are used, module dimensions shall be selected from commercial stock sizes. Where appropriate, the use of partial-height partitions extending from the top of mutual-use pipe chases to the ceiling or slab above shall be considered to maximize consolidation of pipe runs, and flexibility in operations, and construction economies.

0110-99.0.6 Fire Resistance

Development of the DBF shall include consideration of conditions that may exist during normal operations and special situations (e,g., during periods of decontamination, renovation, modification, repair, and maintenance). The structural shell surrounding the critical areas and their supporting members shall remain standing and continue to act as a confinement structure during the DBF under conditions of failure of any fire suppression system not designed as a safety class item. Fire resistance of this shell shall be attained by an integral part of the structure (concrete slabs, walls, beams, and columns) and not by a composite assembly (membrane fireproofing). In no event shall the fire resistance rating be less than two hours under conditions of failure of any fire suppression system not designed as a safety class item. Penetrations in this shell shall incorporate, as a minimum, protection against DBF exposures unless greater protection is required by other sections of these criteria.

0110-99.0.7 Loss Limitations

The design shall provide sufficient structural integrity, fire resistance, compartmentalization, detection, and extinguishing systems and alarms (plus other engineered safety systems where required) to generally limit property loss from any single DBA (excluding earthquake and tornados) to less than $1 million for those special facilities in which safety systems are provided and function properly, and to less than $25 million where safety systems do not function properly. See Section 0110-6.3, Fire Resistance Ratings, and DOE 5480.7 for maximum possible fire loss criteria.

0110-99.0.8 Personnel and Public Safety

The design of special facilities shall reduce the consequences of normal and DBA events by incorporating ARLA design concepts. Occupancy time, spacing, remote handling equipment, and shielding shall be considered. Automatic monitoring and alarm devies shall be provided (where required by the form and potential hazard of the material being handled or stored) to detect the presence of significant levels or increases of radioactivity and, if feasible, any other hazardous materials, either released in the special facility or escaping from it. (Where monitoring devices are not available for specific contaminants, sampling devices shall be substituted and be evaluated on a frequency sufficient to detect release levels of interest.) Cautionary systems or interlocks shall prevent inadvertent entry into hazardous areas. All safety alarm systems shall annunciate inside of the special facility so as to identify hazardous areas. The need for visual alarm devices within the special facility, in addition to audible alarm devices, shall be considered. Where alarms can preclude or minimize exposures outside of the facility, they shall be provided (such as criticality alarms or evacuation alarms).

DOE 5480.5 contains requirements for safety of nuclear facilities. In addition to its requirements, personnel exposure levels shall comply with Section 1300-6.2, Shielding Design, and exposure of the public shall comply with Section 1300-1.4, Guidance on Limiting Exposure of the Public.

Proper consideration shall also be given to chemical toxicity protection, as well as radiation protection. As an example, for unirradiated enriched uranium, under postulated accident conditions, chemical toxicity exposure will often be the controlling factor.

0110-99.2 Emergency Preparedness Facilities

0110-99.2.1 General

Emergency Preparedness Facilities shall be planned and their layout developed on the basis of repetitive modules with offices back-to-back and side-by-side, grouped according to office services, HVAC requirements, and functional disciplines. Arrangement of furniture, lighting, electrical receptacles, and other office features shall also be repetitive for offices requiring similar use, with special and movable equipment restricted to specific locations.

0110-99.2.2 Building Layout

The building plan shall group areas of like physical characteristics and requirements. Exits whose sole function is for emergency use shall be equipped with seals. These doors shall be equipped with hardware that will allow personnel to leave but that will not enable entry or reentry to the facility.

0110-99.2.3 Access by the Physically Handicapped

ECCs and EOCs shall be designed to accommodate the physically handicapped unless such physical handicap would prevent rapid response and evacuation.

If by necessity, ECSs are located in areas where evacuation probability is high and the facility or field office emergency plan excludes non-ambulatory personnel from ECS assignments,

then it is not necessary to adhere to the criteria of Section 0110-8, Accommodations for the Physically Handicapped.

0110-99.7 Occupational Health Facility

0110-99.7.1 General

In the planning of a new Occupational Health Facility, the estimated case load shall be developed in collaboration with the facility operating group. In addition, the available nearby community medical facilities shall be considered and the requirements of DOE 5480.8 shall be followed.

Where radiological hazards are a factor and an adequate community facility is not available, provisions shall also be made for emergency minor surgical, decontamination, and lifesaving medical care for casualties or injuries resulting from radioactive contamination.

The size and location of the facility shall depend on:

- The number and needs of employees to be served
- Extent of treatment and other activities included within the scope of the occupational health program
- The number of doctors and nurses required in accordance with DOE 5480.8
- Reasonably anticipated expansion
- The distance from hazardous operations
- The radiological conditions to be encountered

0110-99.7.2 Location

The location of the Occupational Health Facility in an immediate plant area will be influenced by the following factors:

- Noise level of nearby plant components
- Accessibility of the main occupational health facility to the greatest number of employees. Under certain conditions, a location near the main entrance to the plant to facilitate examination of employment applicants may be advantageous.
- Auxiliary Facilities. It may be necessary to place dispensaries or first aid field stations as auxiliary medical units in outlying or hazardous areas. These stations may occupy space in buildings provided primarily for other functions.

0110-99.7.3 Space Requirements

Space shall be provided to fulfill the current and foreseeable feature requirements for the following functions:

- Physical examinations, including preplacement, periodic, and termination examinations
- Diagnosis and pertinent treatment for immediate relief of injured and sick employees
- Preventive care and counseling, immunizations, and health education

0110-99.8 Telecommunications, Alarm, and ADP Centers and Radio Repeater Stations

0110-99.8.1 Centers and Repeater Stations

Architectural

Operating and equipment areas of centers and repeater stations that contain relays, switches, electronic devices, and other dust-sensitive equipment shall be designed to be relatively dust-free. To minimize the intrusion of dirt and dust into these operating and equipment areas, these areas shall be windowless and without skylights or roof windows. All exterior doors shall be weatherstripped. Access to the equipment and operating areas shall be through vestibules, foyers, corridors, or other buffer areas.

Operating areas shall be located and constructed to minimize outside noise interference and treated acoustically to maintain a low internal sound level commensurate with operating requirements.

Internal columns shall be avoided in areas of telecommunications, alarm, and ADP centers that require shielded enclosures.

Shielding against the electromagnetic or electrostatic effects of nuclear weapons shall be provided, as required, for those facilities that are located in structures specifically designed to withstand 5 psi or greater overpressure effects of nuclear weapons. Protective measures shall generally be in accordance with FEMA CPG2-17.

Flexible conduit connections for communications cables serving hardened centers shall incorporate sufficient slack to withstand potential displacement but shall not impair the installation or replacement of cables. Floor inserts shall be provided to secure the equipment to the floor through shock mounts designed to withstand anticipated blast effects. Ceiling inserts shall be provided to brace equipment racks and cabinets and to support overhead cable racks or trays.

Where radio communications or control equipment requires one or more exposed antennas having no significant blast resistance, provisions shall be made to replace the antennas from within the shelter. Normally retracted "pop-up" antennas, operable from within the hardened area, shall be provided.

The criteria of DOE/EP 0108 shall apply.

Fire Protection

Noncombustible or fire-resistant construction shall be used, with specific attention given to areas or compartments used for storage of significant amounts of paper, stock, forms, cards, and other combustible material. Emergency engine-generators shall be isolated from operating and equipment areas and separated from other occupancies with two-hour fire-rated construction. Asociated fuel tanks shall be buried outside in accordance with RCRA requirements or located away from buildings and protected in accordance with NFPA 30.

Physical Security

For protected areas, all detection and alarm devices, including transmission lines to annunciators, shall be failure- and tamper-indicating in both the access and service modes. Such devices shall be connected to monitor or display panels in the hardened security force communications center. An alternative alarm annunciation point (or a comparable alternative capability) shall be provided in a location that is continuously manned by cleared personnel. This alternative alarm annunciation point shall provide a second indication of an alarm such that a response can be initiated in the event the primary station is compromised.

The headquarters locations of a central station alarm system shall be protected as follows:

- Commercial central alarm stations should be UL Class AA installations. The cognizant DOE authority should ensure that the selection of central station alarm systems equipment is based to the extent possible on available test data.

- Local law enforcement agencies' central stations are usually constantly attended. If response by local law enforcement agencies to an alarm device is required for facility approval, the connection to the local law enforcement agency's central station should comply with UL Class A of UL 365.

- Secure conference facilities and secure offices handling, processing, and/or discussing classified information must meet IDS standards as outlined in DOE 5636.3A and in the DOE TSCM Procedural Guide.

- Where transmissions of classified data outside security areas are involved, NSA-approved encryption shall be used or the signal lines shall be installed in accordance with DOE 5300.4B.

- Data processing, amplifying, telecommunications, and other systems that emit electromagnetic emanations, and communications lines to remote interrogation points used to process classified data processing information, shall be protected against compromise of such data in accordance with DOE 5300.2B, DOE 5300.4B, and DOE 5637.1.

- A primary and auxiliary power source shall be provided for protective alarm systems. See Division 16, Electrical, for power supply criteria.

- For the protection of classified matter, line supervision limits and/or line tamper alarm capability shall comply with UL Class AA.

- A DOE facility, contractor, or subcontractor possessing classified information under the protection of a central station alarm system shall have its alarm connected by direct, continuously supervised, leased line or by such other means so as to distinguish its alarms from all other customers of that central station.

- The line shall be continuously supervised so as to detect any attempts to bypass the alarm system surreptitiously by shorting, opening, or substituting a bogus signal for the legitimate "no alarm" signal.

ADP systems shall be protected as follows:

- All elements of an ADP system, including remote terminals, printouts, and memory, shall be afforded physical security protection commensurate with the most highly classified material processed by the system. Security controls to safeguard the physical equipment apply not only to the computer equipment itself and to its terminals, but also to all removable input or output media such as magnetic tapes and magnetic disk packs. Physical protection shall comply with the DOE 5632 series.

- An ADP facility shall be located in a security area to provide adequate physical protection. It shall be secured to a level commensurate with the most highly classified material handled by the system. It shall be securely locked and alarmed when no authorized personnel are in attendance.

- Remote terminal access to ADP systems shall be limited to authorized users by methods prescribed by the CSSO.

Requirements for ADP centers and, remote interrogation points processing classified information are as follows:

- ADP centers and remote interrogation points used for classified information shall be established as limited areas or be located within larger limited areas such that access is controlled as required by DOE 5637.1.

- When contained within a larger limited area, ADP centers and remote interrogation points used to process classified information shall have separate access controls and barriers to restrict access to classified information to those persons who require it in the. performance of official duties and with the need-to-know.

- Where transmissions of classified data outside limited areas are involved, NSA-approved encryption shall be used or the signal lines shall be installed in accordance with DOE 5300.4B.

Requirements for secure communications centers are as follows:

- Communications centers handling classified messages shall be established as limited areas or be located within larger limited areas.

- When contained within a larger limited area, a communications center shall have separate access controls and barriers to restrict admittance to persons who require it in the performance of official duties.

011O-99.8.2 Telephone Switching Centers

Layout

Preliminary plans for telephone switching centers shall include preliminary design of all telecommunication requirements including telephone stations, switching centers, lines, cables, and wiring layouts.

Centers and their utility systems shall be sized to meet anticipated requirements five years after start of service.

Architectural

The design of the switching equipment room shall facilitate expansion. For most efficient operation and maintenance, adequate space shall be provided for test equipment, maintenance records, parts storage, tools, and work areas.

Vaults shall be:

- Readily accessible from within the center
- Adequately lighted, ventilated, and drained
- Arranged to enable installation of cable-pressurizing facilities

011O-99.8.3 Teletype, Data, and Facsimile Centers

Layout

The configuration of operating, storage, and maintenance areas, the initial and ultimate space and utility requirements, and arrangements for effective control of access shall be determined in accordance with DOE 5300.lB and guidance from Headquarters Office of Computer Services and Telecommunications Management.

Architectural

Centers that are electromagnetically shielded shall be windowless and without skylights or roof windows, shall have column-free operating areas; and shall have clear ceiling heights of not less than 8 feet.

Acoustic treatment shall be installed as required to maintain acceptable internal sound levels.

011O-99.8.4 Computer and Automatic Data Processing Centers

Planning and Layout

Layout, space, and utility needs of computer and ADP centers shall comply with:

- DOE 5637.1

DOE/EP 0108

Planning and design of ADP centers shall comply with:

- OMB Circular A-130
- 41 CFR 101-35.3
- 41 CFR 101-36.7

Operations shall be located in the same or adjoining rooms. Supporting activities (storage, maintenance, power, and environmental control and scheduling, and administrative offices) shall be housed in separate rooms adjacent to the central operations area.

Storage areas for combustible material shall be physically isolated from equipment areas by fire-resistant walls and provided with adequate fire-extinguishing means.

Provisions shall be made for preservation of duplicate vital records. See NFPA 75, Chapter 6, and NFPA 232.

Architectural

All areas of an ADP center shall be designed and finished to facilitate cleaning and to provide an environment essentially free from dust and the buildup of static electricity. Vinyl floor covering shall be provided in areas subject to lubricants and cleaners used in equipment operations, servicing, and maintenance.

Requirements for floor or raised floor wireways, equipment coding ducts, and piping shall be considered in the design of the floor to minimize shock and vibration of computers and other ADP equipment. Only rated noncombustible floor systems shall be installed in ureters where raised floors are to be provided .

Shielding shall be provided to protect magnetic recording equipment, magnetic tapes, and disk packs where electromagnetic fields of 10 microvolt per meter or 50 oersteds or greater can be expected.

Walls around secure ADP centers shall be constructed of concrete masonry units or other materials that are not easily penetrated.

Fire Protection

ADP facilities shall comply with DOE/EP 0108 and NFPA 75.

Physical Security

Each communications link that leaves an ADP facility shall be protected commmensurate with the most highly classified material that it carries and in accordance with DOE 5.300.3B. If all communications links are not protected at the highest level of mat trial carried by any one of

them, other security measures shall be installed to preclude transmission of classified material over unprotected links.

Only NSA-approved cryptographic devices or protected distribution systems shall be used to protect classified communication lines that pass outside the security area of an ADP system or facility. The specific security area of a facility will be defined in the ADP protection plan.

Each user of the system shall have the proper credentials and be authenticated before access is allowed. Acceptable methods of making sure the user is authorized are visual review by a guard or person in charge of the terminal or facility, an automated-type card access system, or a password system. The CSSO specifies the authentication method for the facility.

Measures shall be implemental to control compromising emanations from crypto-equipment and telecommunications systems in accordance with DOE 5300.2B, as determined by the Director of Computer Services and Telecommunications Management.

Measures shall be implemented on all new ADP equipment that processes classified material in DOE or DOE contractor facilities to prevent compromising emanations from such equipment and systems from being exploitable beyond the limits of effective physical control. The CSSO and CSOM have the responsibility for implementing and approving emanations security measures after a consideration of the risks. The measures applied should be commensurate with the sensitivity and amount of classified information processed and the vulnerability of the information or data processing installation to successful intercept attack. Listed below are methods for controlling compromising emanations. One or more of the first three methods shall be used in conjunction with the fourth to prevent compromising emanations beyond the limits of the effective physical control zone.

1. Shielded Enclosures. This may be a shielded room within which the equipment is contained or just an enclosure around the emanating equipment.

2. Equipment Design. ADP equipment maybe designed or modified to limit the strength of compromising signals to acceptable limits considering the control zone available Radiation limit requirements shall be considered on a cost-effective basis for certain types of ADP equipment (input/output devices and CRTs) when being purchased or leased to process classified information.

3. Control Zone. A control zone of 50 feet is usually sufficient for most installations to preclude a successful hostile intercept action with the exception of input/output devices and CRTs. These devices shall be considered independently. A control zone of several hundred feet or more may be required.

   A “control zone” as used in the preceding criterion is defined as the contiguous space above, below, and around equipment and distribution systems that is under sufficient physical and technical control to preclude interception of compromising emanations. The phrase "sufficient physical and technical control" in this definition means the degree of control such that security forces responsible for protecting a controlled space have the authority to investigate and remove any person or device of a suspicious nature that is detected therein.

4. Installation Criteria. The installation of ADP equipment and cabling shall comply with NSA NACSIM 5203 or other means approved by the CSOM to preclude compromising emanations from radiating beyond the control zone.

0110-99.8.5 Radio Control Centers

Layout

The space and utility requirements of radio control centers shall comply with DOE 5300.1B and guidance from Headquarters Office of Computer Services and Telecommunications Management.

Transmitters and receivers shall be located as close as possible to their antennas and, where practicable, under the surveillance and access control of the console equipment operator.

Provision shall be made for installation of map boards, network charts, station call signs, station authorizations, and other materials required to be displayed. These displays shall be located within easy view of the control equipment operator.

Architectural

Centers essential to DOE or DOE operating contractor functions shall be windowless and without skylights or roof windows.

Requirements for the following shall be determined, taking any protected expansion of the facility into account:

- Microwave waveguide and RF transmission line supports
- Ceiling, wall, or floor penetrations
- Special heat exhaust ducts
- Floor cable trenches
- Channels and inserts for cable racks and equipment supports

0110-99.8.6 Fire Alarm Control Centers

Layout

Alarm, supervising, and control equipment in fire alarm control centers shall be arranged to facilitate continuous surveillance and ease of access by the operator. All equipment, with the exception of storage battery plants and emergency engine generators, shall be located in the same or in immediately adjacent areas to facilitate testing, maintenance, and surveillance. Radio antennas shall be located as close as practicable to transmitters and receivers.

Architectural

Where the center is located within a fire station and adjacent to the vehicle area, a structural barrier shall be provided to protect the alarm room from impact damage from fire trucks. Protection of relay and annunciating equipment from vibration due to vehicle door operations may require that sensitive equipment be shock-mounted and that large overhead doors be cushioned.

0110-99.8.7 Security Alarm Control Centers

Planning

Planning and design of security alarm control centers shall be determined in consultation with the cognizant DOE security authority and shall comply with the DOE 5632 series.

Layout

Security alarm control centers shall be arranged so that all alarm, communications, and auxiliary power equipment necessary for continuous operation of the system is contained within the center or within contiguous areas having the same degree of physical security, including access control.

Space shall be provided within the center for maintenance and for storage of spare units of line supervisory and alarm equipment.

The initial and ultimate space and utility requirements of each center shall be determined in consultation with the cognizant DOE security authority.

Architectural

Exterior walls shall be windowless. Roofs shall be without skylights or roof windows. For those security alarm control centers where windows are required for visual surveillance of areas outside the center, the windows shall be bullet-resistant and of other characteristics as determined by the cogniant DOE security authority.

Personnel entryways shall include substantially constructed doors, equipped with locks operable from within the centers. Where viewing ports or windows are provided in entry doors, their size and other characteristics (e.g., reflective or wired glass) shall be as determined by the cognizant DOE security and fire protection authorities. Windows or other openings are not allowed in Class A fire doors.

See Division 8, Doors and Window, for additional security-related requirements for doors and windows that form a portion of the perimeter of a security area.

Structural protection shall be provided against unauthorized personnel intrusion. Structural openings shall be kept to a minimum. The cognizant DOE security authority shall be consulted to determine requirements for structural protection of air intake and exhaust systems and other special security features.

Central alarm stations shall have separate access controls and barriers to restrict admittance to persons employed therein or requiring access in the performance of official duties on a need-to-know basis.

A hardened central alarm station (and protective force communications center) shall be quipped with radio and telephone channels of communication with local law enforcement agencies. An emergency alternative communications capability from a secondary station shall be provided for use in the event the primary station is compromised. Radio communications equipment shall remain operable in the event of a loss of primary electric power.

Communications equipment shall allow rapid, reliable, and protected information exchange among on-site protective forces; between on-site protective forces and the central alarm stations and secondary communications station; and among the central alarm stations, secondary communications stations, and local law enforcement agencies.

0110-99.8.8 Radio Repeater Stations

Layout

Radio repeater stations shall be positioned on the site so as to ensure access by all-weather vehicular and personnel to the station building, the antenna(s), the standby generator plant, and fuel storage tank. The design shall minimize risk of damage to the antenna structure and supporting guy lines from vehicular traffic and provide for future expansion.

Architectural

Exterior walls shall be windowless. Roofs shall be without skylights or roof windows. Space shall be provided for maintenance activities and storage of spare parts and tools.

Where antenna towers, poles, or masts are to be located off the building, interconnecting cables shall be placed underground or adequately supported by a messenger wire (or cable). The building end of the messenger wire shall not be secured to the bulkhead panel unless the panel and appurtenances are designed to support the load.

0110-99.9 Vaults and Vault-Type Rooms for Storage of Classified Matter

0110-99.9.1 General

Vaults and vault-type rooms for storage of classified material shall comply with the DOE 5632 series. Minimum delay time expectations shall be used as standard.

A vault shall meet the definition of an SNM vault (see Glossary). In addition, a vault shall include an intrusion alarm system activated by an opening of the door.

A vault-type room is one having a combination-locked door and protected by an intrusion alarm system activated by any penetration of walls, floors, ceilings, or openings, or by motion within the room.

0110-99.9.2 Architectural

Vaults and vault-type rooms shall be windowless and without skylights or roof windows.

Vault-type rooms shall be penetration-resistant, with enclosures of fire-resistant construction and fire suppression detection systems appropriate to the hazards involved.

Vaults located outside of a secure and guarded area shall meet the criteria for substantial construction. Vaults located within a secure and guarded area shall meet the criteria for substantial construction or, if approved by the cognizant DOE security personnel, shall be a fire-resistant windowless enclosure with approved door locks and alarms, fire suppression and detection systems, and interior motion-detection devices.

Doors, hardware, locks, and, where necessary, windows shall meet the security-related criteria listed in Division 8, Doors and Windows. In addition, doors shall comply with UL 155 and UL 1OA. For a vault not containing SNM, the type of door and frame complying with Class 5 Standards of FS AA-D-600B shall be the required level of physical protection. For a vault containing SNM, a type of door and frame complying with GSA-approved Class 5 vault door(s) shall be the required level of physical protection.

0110-99.9.3 Substantial Construction

Where substantial construction is required, the vault enclosure (walls, floors, and roofs) shall provide, as a minimum, a penetration delay time equivalent to that provided by monolithic concrete at least 8 inches thick reinforced vertically and horizontally with not less than 5/8-inch-diameter steel reinforcing bars at not more than 6 inches on center. Pre-engineered metal buildings or other similar building systems shall not be used for substantial construction unless designed, constructed, and tested for the specific purpose.

0110-99.9.4 Alarm Systems

When electronic alarm systems are used to protect classified matter, they shall be designed to meet site-specific protection needs; as a minimum, they shall meet FS W-A-450B or be approved by the cognizant DOE security authority. See Division 16, Electrical, for additional criteria for security alarm systems.

Exterior sensors that serve as the primary means of detection at a security area perimeter shall be designed to assure that a person crossing the perimeter will be detected whether walking, running, jumping, crawling, rolling, or climbing the fence at any point in the detection zone.

Intrusion alarm systems shall have a primary and auxiliary power source. Switch-over to the auxiliary power source shall be automatic. An alarm condition shall be indicated at the monitor on failure of power sources.

Alarm lines shall be continuously supervised so as to detect any attempt to bypass the alarm system surreptitiously by shorting, opening, or substituting a bogus signal for the legitimate “no alarm” signal.

0110-99.10 Secure Conference Rooms

0110-99.10.1 General

Conference rooms where classified information is discussed on a recurring or routine basis shall provide acoustical security commmensurate with guidelines outlined in the DOE TSCM Procedural Guide.

The installation of telephones and other communication systems in conference rooms is highly discouraged. However, if their presence is deemed operationally essential, all such instruments should be equipped with jacks or other disconnecting devices to allow for disconnection during classified discussions.

0110-99.10.2 Room Envelope

The secure conference room envelope, consisting of walls, floors, ceilings, doors, door frames, and windows, and penetrations such as hardware, ducts and grilles, transfer grilles, pipes, electrical conduits, luminaires, and electrical devices and equipment shall be constructed and/or installed in accordance with guidelines established in the DOE TSCM Procedural Guide.

For design, the maximum expected sound levels to be generated within a secure room shall be used.

For design, the minimum expected sound levels to be generated outside the secure room shall be used.

The secure room envelope shall have an STC of not less than 45 in accordance with ASTM E413. Envelope materials, components, and assemblies shall be tested by a recognized testing agency to determine their acoustical performance.

See also Section 0950-99.10, Secure Conference Rooms.

0110-99.11 Secure Offices

0110-99.11.1 General

Offices where classified information is discussed on a recurring or routine basis shall provide acoustical security commensurate with guidelines outlined in the DOE TSCM Procedural Guide.

Telephones and other communication systems in offices in which classified discussions occur should be equipped with jack or other disconnecting devices to allow for disconnection during classified discussions.

0110-99.11.2 Room Envelope

The secure office room envelope, consisting of walls, floors, ceilings, doors, door frames, and windows, and penetrations such as hardware, ducts and grilles, transfer grilles, pipes, electrical conduits, luminaires, and electrical devices and equipment shall individually and

together provide a sound transmission loss that leaves the sound from the secure office always 15 db less than the background sound outside the room.

For design, the maximum expected sound levels to be generated within a secure room shall be used.

For design, the minimum expected sound levels to be generated outside the secure room shall be used.

The secure room envelope shall have an STc of not less than 45 in accordance with ASTM E413. Envelope materials, components, and assemblies shall be tested by a recognized testing agency to determine their acoustical performance.

See also Section 0950-99.11, Secure Offices.

0111 STRUCTURAL DESIGN REQUIREMENTS

0111-1 GENERAL

This section applies to the structural elements of buildings, bridges, other structures and facilities. The structural elements include, but are not limited to, the following

- All floor, roof, and wall framing members and slabs
- All piers, walls, columns, footings, piles, and similar elements of the substructure
- All other substructure and superstructure elements that are proportioned on the basis of stress, strength, and deflection requirements

Materials, framing systems, and details shall be compatible with the following:

- Clear space and span requirements
- Serviceability requirements
- Applicable fire protection classification
- Security requirements
- Foundation conditions
- Future expansion requirements
- Architectural treatment
- Climatic conditions

- Structural design loads for the specific facility and location

Local availability of construction materials and labor force shall be considered in the selection of the structural system.

The structural design drawings shall indicate the design criteria, the structural materials and their strengths with applicable materials standards, the design loads including loads that can occur during construction, and the allowable foundation loads that were used in the design.

Where earthquake resistance is required, the cognizant DOE authority should consult LBL-9143 for practical guidelines for engineering earthquake safety and management planning and technical procedures for design of new facilitis or evaluation of existing ones. This document provides a process for a cost-effective plan check or third-party review of the design approach. (See Section 0111-2.7.1, Buildings and Other Structures.)

0111-2 LOADS

0111-2.1 General Requirements

Structures and their elements shall be designed for the loads prescribed in these criteria.

0111-2.2 Dead Loads

0111.2.2.1 General

Dead loads are loads that remain permanently in place. They shall include the weights of all permanent materials and equipment, including the structure's own weight, supported in, or on, a structure Load calculations shall include an allowance for any loadings anticipated to be added at a later date. Initially assumed loads shall be revised so that the final design reflects the configuration shown on the drawings.

0111 -2.2.2 Unit Weights

The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ANSI A58.1. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturers' drawings or catalogs.

The unit weights of materials for highway structures shall be those given by AASHTO standards. The unit weights for railway structures shall be those given in AREA Manual for Railway Engineering (Fixed Properties).

0111-2.2.3 Service Equipment

Design dead loads shall include the weight of all permanent service equipment. Service equipment shall include plumbing stacks, piping, heating and air-conditioning equipment, electrical equipment, flues, fire sprinkler piping and valves, and similar fried furnishings. The weight of service equipment that may be removed with change of occupancy of a given area shall be considered as live load.

0111.2.2.4 Allowance for Partition Loads

The minimum allowance for the weights of partitions, where partitions are likely to be rearranged or relocated, shall be as follows:

- For partition weights of 150 plf or less, an equivalent uniform dead load of 20 psf shall be used.
- For partition weights above 150 plf, the actual linear loads shall be used.
- Partitions that are likely to be rearranged or relocated should be calculated as live loads for load factor design.

0111-2.3 Live Loads

0111 -2.3.1 General

Live loads shall include all loads resulting from the occupancy and use of the structure, whether acting vertically down, vertically up, or laterally. Operating, moving, stopping, and impact forces shall be considered part of the live loads. Live loads shall include neither dead loads nor loads from the environment, such as wind, tornado, earthquake, thermal forces, earth pressure, and fluid pressure.

0111.2.3.2 Buildings and Other Structures

Live loads for buildings and other structures shall be those produced by the intended use or occupancy. In no case shall they be less than the minimum uniform load or concentrated load stipulated in ANSI A58.1.

Live loads on roofs shall be as stipulated in ANSI A58.1. They shall include the minimum roof live loads or the snow loads and snow drifts or possible rain loads stipulated therein, whichever produces the more severe efffect.

In continuous framing and cantilever construction, the design shall consider live load on all spans and arrangements of partial live load that will produce maximum stresses in the supporting members.

0111-2.3.3 Highway and Railway Structures

Live loads for highway structures shall be as stipulated in AASHTO HB-13. Unless specified otherwise, an HS 20-44 loading shall be used. Live loads for railway structures shall be as stipulated in AREA Manual for Railway Engineering (Fixed Properties). Unless specified otherwise, a Cooper E-80 loading shall be used.

0111-2.4 Wind Loads

0111-2.4.1 General

The structural frame and exterior components of all buildings, signs, tanksd, towers, and other exposed structures shall be designed to resist pressures due to wind assumed to act from any direction. Partial wind loading shall be considered if it produces a more severe effect

0111-2.4.2 Buildings and Other Structures

Wind load design for buildings and other structures shall be determined in accordance with procedures in ANSI A58.1 with the basic wind speed being obtained from UCRL 15910.

The basic wind speed shall be derived from DOE site-specific hazard model studies summarized in UCRL 53526, Rev. 1 (available at DOE Field Offices or from the Office of Nuclear Safety, DOE Headquarters). If site-specific hazard model studies are not available, a hazard model shall be developed that is consistent with the approach used in UCRL 53526, Rev. 1.

The basic wind speeds for any specific site shall be determined following the procedures in UCRL 15910, except that Exposure "C" should be used for ail construction unless it can be shown that the necessary permanent shielding will be provided by natural terrain (not including shielding from trees or adjacent buildings).

UCRL 53526, Rev. 1, provides accepted tornado and straight wind data. Site-specific studies may also be used.

To determine the design wind loads, all factors and coefficients stipulated in ANSI A58.1 shall be applied to the site-specific basic wind speeds.

Building additions shall be designed as parts of a totally new building without regard to shielding from the original building and without regard to lesser wind resistance for which the original building may have been designed. The possibility that the original portion of the building may require strengthening due to an increase in the wind loads acting on it shall be considered

0111-2.4.3 Highway and Railway Structures

The wind loads for highway structures shall be as stipulated in AASHTO HB-13.

The wind loads for railway structures shall be as stipulated in AREA Manual for Railway Engineering (Fixed Properties).

0111-2.5 Tornado Loads

The basic wind speed and missile parameters shall be derived from DOE site-specific hazard models studies summarized in UCRL 53526, Rev. 1. If site-specific hazards model studies are not available, a hazard model shall be developed consistent with the approach used in UCRL 53526, Rev. 1.

Structures other than critical facilities need not be designed for tornado loading.

When directed by the cognizant DOE authority, tornado protection such as occupant shelters and safe areas shall be provided within facilities.

FEMA TR-83A and FEMA TR-83B can be used as guidelines for selecting and designing safe areas for the protection of building occupants for tornadoes.

Facilities for radioactive material handling, processing, or storage, and other facilities having high value or vital importance to DOE programs that are classified as critical facilities, shall require special tornado loading criteria as stipulated in Section 0111-99.0, Nonreator Nuclear Facilities-General.

0111-2.6 Internal Shock and Blast Loads

Building structures (excluding explosive facilities) that house operations that may release energy from rupture of equipment or explosions, either inadvertently or purposely (such as testing), shall be designed to control the resulting internal shock pressure loads per applicable criteria.

0111-2.7 Earthquake Loads

0111-2.7.1 Buildings and Other Structures

The basic seismic parameters shall be derived from DOE site-specific hazard model studies summarized in UCRL 53582. If site-specific hazard model studies are not available, a hazard model shall be developed that is consistent with the approach used in UCRL 53582. In applying UCRL 53582, specific guidance on relating frequency of occurrence to facility hazard levels shall be obtained from URCL 15910.

Earthquake load design for buildings and other structures shall be determined in accordance with the procedures contained in the UBC and UCRL 15910. The provisions and design procedures of TM 5-809-10 for the application of seismic loadings to conventional buildings shall also apply. For critical facilities, the provisions and design procedures of TM 5-809-10.1 shall be used.

Facilities for radioactive material handling, processing, or storage, and other facilities having high value or vital importance to DOE programs that are classified as critical facilities, shall require application of dynamic analysis in determining structural requirements for earthquake loading as stipulated in Section 0111-99.0, Nonreactor Nucler Facilities-General.

An independent review of the seismic design shall be made for facilities and buildings where a seismic event can have a potential risk to operator lives, to public safety, or of large economic loss. The review shall be made in two stages, the first at the end of preliminary design and the second before final design is complete. For additional guidance on independent reviews, see LBL-9143 and UCRL 15910.

0111-2.7.2 Highway and Railway Structures

The earthquake loads for highway structures shall be as stipulated in AASHTO HB-13 and AASHTO GSDB.

The earthquake loads for railway structures shall be as stipulated in AREA Manual for Railway Engineering (Fixed Properties).

0111-2.8 Other Loads for Buildings and Other Structures

0111-2.8.1 Vibratory Loadings

Equipment supports shall be designed to avoid resonance resulting from the harmony between the natural frequency of the structure and the operating frequency of reciprocating or rotating equipment supported on the structure. The operating frequency of supported equipment shall be determined from manufacturer's data prior to completion of structural design. Resonance shall be prevented by designing equipment isolation supports to reduce the dynamic transmission of the applied load to as low a level as can be economically achieved in the design.

0111-2.8.2 Earth and Groundwater Pressures

Every foundation wall or other wall serving as a retaining structure shall be designed to resist, in addition to the vertical loads acting on it, the incident lateral earth pressures and surcharges, plus hydrostatic pressures corresponding to the maximum probable groundwater level.

Retaining walls shall be designed for earth pressures and potential groundwater levels producing the highest stresses and overturning moments. When a water-pressure-relief system is incorporated into the design, only earth pressures need be considered. In cohesive soils, the long-term consolidation efffects on the stability of the walls shall be considered. Lateral earth pressures shall be determined in accordance with accepted structural and geotechnical engineering practice.

0111-2.8.3 Fluid and Gas Pressures

The design of components of buildings and other structures shall include the effects of fluid and gas pressures, both internal and external.

0111-2.8.4 Thermal Forces

The design of structures shall include the effects of stresses and movements resulting from variations in temperature. The rise and fall in the temperature shall be determined for the localities in which the structures are to be built. Structures shall be designed for movements resulting from the maximum seasonal temperature change. The design shall provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. In cable-supported structures, changes in cable sag and tension shall be considered.

0111-2.8.5 Creep and Shrinkage Forces

Concrete and masonry structures shall be investigated for stresses and deformations induced by creep and shrinkage.

For concrete and masonry structures, the minimum linear coefficient of shrinkage shall be assumed to be 0.0002 inch/inch, unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

0111-2.9 Other Loads for Highway and Railway Structures

Other loads for highway structures shall be as stipulated in AASHTO HB-13.

Other loads for railway structures shall be as stipulated in AREA Manual for Railway Engineering (Fixed Properties).

0111.2.10 Combination of Loads and Design Requirements for Buildings and Other Structures

Combination of loads, allowable stresses, and strength requirements for buildings and other structures shall be as stipulated in the UBC, except as otherwise indicated in 0111-99, Special Facilities.

0111-2.11 Combination of Loads and Design Requirements for Highway and Railway structures

Combination of loads and design requirements for highway structures shall be as stipulated in AASHTO HB-13. Combination of loads and design requirements for railway structures shall be as stipulated in AREA Manual for Railway Engineering (Fixed Properties).

0111-3 STRUCTURAL SYSTEMS FOR BUILDINGS AND OTHER STRUCTURES

0111-3.1 Framing

Buildings shall be framed to allow for simple formwork, fabrication, and construction procedures.

Structural systems shall be designed for ductile modes of failure to the extent feasible.

In the selection of a particular framing system, consideration shall be given to the structure's fictional requirements, including

- Column-free areas
- Floor-to-ceiling heights
- Number of stories

- Elevator, crane, or hoist installations
- Heavy loads
- Other particular requirements pertaining to the specific facility

0111-3.2 Floors

Where the first first uses concret-slab-on-grade construction, the slab shall be placed on a free-draining aggregate base overlying a compacted subgrade. A plastic vapor barrier shall be used under the slab where moisture conditions warrant. Excessive loads or equipment subject to vibration shall be supported by separate pads isolated from the rest of the floor slab with flexible joints.

For framed floors, the economy of prefabricated systems shall be considered, especially systems that simplify the installation of mechanical, electrical, and communications services. Where concrete floors are used, the economy of fiat plate slabs shall be considered, with the objective of using their undersurface for ceilings.

0111-3.3 Control Joints

Control joints shall be designed and placed in such a manner as to avoid structural distress and uncontrolled cracking from thermal expansion and contraction, concrete shrinkage, and movements due to wind and earthquake forces.

0111.3.4 Foundations

0111-3.4.1 General Requirements

The provisions of the UBC shall be the minimum requirements for foundations design. The potential adverse effects of frost heave and movements due to expansive soils shall also be considered in the design.

For all structures, Section 0201, Subsurface Investigations, shall be complied with to determine subsurface conditions, recommended foundation type, allowable design soil bearing pressure, seismic potential, and differential settlement.

0111-3.4.2 Foundation Vibrations

Analysis of foundation vibrations, design to avoid resonance, and vibration and shock isolation, where required, shall be in accordance with Chapter 1 of DM-7.03.

0111-4 STRUCTURAL SYSTEMS FOR HIGHWAY AND RAILWAY STRUCTURES

Structural systems for highway structures shall be consistent with the requirements of AASHTO HB-13.

Structural systems for railway structures shall be consistent with the requirements of AREA Manual for Railway Engineering (Fixed Properties).

011149 SPECIAL FACILITIES

0111-99.0 Nonreactor Nuclear Facilities-General

0111-99.0.1 General

Safety class structures are sometimes required in special facilities for the following reasons:

- For nuclear criticality safety
- To prevent or mitigate the release of quantities and concentrations of radioactive materials that have the potential to exceed the release guidelines contained in Section 1300-1.4, Guidance on Limiting Exposure of the Public
- To achieve and maintain the facility in a safe shutdown condition

Section 1300-3, Safety Class Criteria, addresses the safety classification and required criteria for safety class structures.

Special facility structures that need not be designed to withstand severe natural phenomena or man-made events shall be designed to the requirements in Section 0111-2, Loads. A case-by-case written evaluation shall be performed to determine which structures or components may be excluded from these criteria.

Safety class items required to function during or following severe natural phenomena shall not be prevented from performing their required safety functions by the failure of components, systems, or structures that are not designed to the severe natural phenomena criteria.

Safety class structures shall be protected against dynamic efffects, including effects of wind-driven missiles and discharging fluids, that may result from natural phenomena, accidents at nearby facilities, including military installations and transportation facilities, equipment failure, and similar events and conditions inside and outside the facility. The design bases for such events shall take into account their historic frequency and severity in the region of the site and the potential risk to the environment or the health and safety of the public. The type of severe events to be considered will vary among sites. However, earthquakes, tornados, straight winds and floods shall be addressed.

Facilities containing plutonium, other radioactive material, or other material that would be likely to produce significant health or safety hazards shall be evaluated as to the degree of risk, and more stringent criteria applied in structural design, as necessary.

Many buildings are subject to future additional ceiling-roof equipment loadings. In planning and designing buildings for special facilities, consideration shall be given to providing for a future 10 to 20 psf additional structural loading.

Where floor-mounted special facilities equipment will have a commonality of use, it shall be centrally located with respect to special facilities operations. Floor loadings and location of equipment and projections of future additional equipment requirements and their floor loadings shall be considered and provided for in structural planning and design.

Design criteria for enclosures of radioactive and other hazardous materials are provided in Section 1161, Enclosures.

The design of structures, including their supports, that are confinement system barriers shall ensure satisfaction of the fictional requirements for the specific confinement system they are part of. In addition, safety class confinement barriers (barriers whose continued integrity is shown by a safety analysis to be required following severe natural phenomena, including the DBE, and man-made events) shall be designed to withstand secondary events as well as primary events. Potential secondary events might be fire, explosion, or nuclear criticality caused by the DBE.

In no case shall the total combustible loading located in a fire area exceed the fire resistance rating of the area enclosure. This shall be documented in a fire risk analysis.

0111-99.0.2 Tornado and Extreme Wind

Determination of Design Basis Tornado

DOE site-specific hazard model studies summarized in UCRL 53526, Rev. 1 (available at DOE Field Offices or from the Office of Nuclear Safety, DOE Headquarters), shall be used to select the DBT and extreme wind characteristics for the design of structures. If site-specific hazard model studies are not available, a hazard model shall be developed consistent with the approach used in UCRL 15910.

In applying UCRL 53526, Rev. 1, specific guidance on relating frequency of occurrence to facility hazard levels shall be obtained from UCRL 15910.

Tornado Analysis

In designing for tornado or extreme wind resistance:

- The tornado rotational speed shall be appropriately combined with the translational speed.
- Resulting loads from the rate of pressure drop, taking into consideration any pressure equalization due to permissible venting, shall be combined with velocity-induced pressure loads as stipulated in UCRL 15910.
- UCRL 53526, Rev. 1, provides the characteristics of typical potential tornado-generated missiles. Additional missiles may be identified from review of on-site sources and possible missiles that could be borne to the site by a tornado. Both small high-velocity missiles and massive low-velocity missiles shall be considered separately in terms of penetration, perforation, or crushing effects. The horizontal and vertical velocities of the missiles shall be combined in the design.

- The minimum wind speed used shall be 70 mph.

Loads resulting from the DBT shall be assumed capable of occuring at any time. However, for design purposes, DBT loads need not be assumed to occur simultaneously with other severe site-related events such as an earthquake, fire, or flood, except where the simultaneous occurrence is related (e.g., fire from lightning or other wind-related causes).

0111-99.0.3 Floods

The design loads from flooding shall comply with UCRL 15910. In calculating design loads from flooding, a conservative approach shall be taken to ensure that the loads used in the design are as follows:

- Greater than the maximum historic levels recorded for the site
- No less than the probable maximum flood (PMFL)

0111-99.0.4 Earthquakes

General

The systems, components, and structures that shall be designed to meet these special facility criteria shall be identified through a written evaluation (see Section 0111-99.0.1, General). Such systems, components, and structures shall be designed to provide their passive or active functions as required by the SAR in accord with their designated safety classes.

Site-specific seismic parameters shall be determined for a DBE. The SSE shall be equivalent to the DBE.

New seismic design, including additions or modifications to existing structures, shall be reviewed by a qualified, independent organization. This review must include evaluation of the design approach, the lateral force resisting system, and the design detailing, per UCRL-15910. TM-5-809-10 can be used for design detail guidance.

Earthquake Occurrence

The DBE shall be assumed capable of occurring at any time, accept that the simultaneous occurrence with any other limiting site-related event such as a tornado, fire, or flood need not be considered for design purposes, except where the joint occurrence is causally related (e.g., fire or flood).

Determination of DBE

Generally, a DBE shall have a ground acceleration of 0.1g or greater. To determine the DBE, site-specific earthquake hazard models and response spectra given in UCRL 53582, Rev. 1, shall be used to select the appropriate seismic ground acceleration. Design guidance in UCRL 15910 shall be used in applying UCRL 53582, Rev. 1. Site-specific studies can be substituted for the UCRL 53582, Rev. 1, data where no data exist or where a higher level of detail is required. The DBE shall be defined by design response spectra, appropriate for the site, or by acceleration time histories, representative of the anticipated ground motions.

Seismic Analysis

The adequacy of systems, components, and structures to withstand a seismic event shall be verified by a dynamic analysis, except where it can be demonstrated that the use of a simplified approach, such as a static load method, component testing, or a combination of testing and analysis provides assurance of adequate seismic design. The ratio of vertical-to-horizontal acceleration shall be two-thirds, unless site-specific data justify the use of a different ratio.

The use of earthquake experience data is an acceptable approach to the seismic qualification of safety class items. If experience data are used for seismic qualification, the following shall be considered:

- Safety class equipment shall be essentially identical to the equipment that has data in the experience data base (i.e., this comparison should take into account the manufacturer, vintage, and general configuration of such equipment).

- Equipment shall be mounted and anchored in essentially an identical fashion as that for the experience data base equipment.

Consideration of the above and an independent review of this consideration must be adequately documented.

0111-99.0.5 Aircraft

Unless the safety analysis can demonstrate that the risk from an aircraft crashing into the facility is acceptable, potential aircraft crashes shall be considered among the spectrum of man-made missiles that confinement structures shall be designed to withstand or against which they shall be protected.

0111-99.0.6 Nearby Explosions and Externally Generated Missiles

The potential effects of a major explosion at a nearby facility or transportation route shall be considered among the spectrum of external blast effects and missiles that confinement structures shall be designed to withstand or against which they shall be protected.

0111-99.0.7 Explosion, Internal Pressurization, Criticality, and Other DBA Causes

The probable consequence of DBAs involving internally generated missiles or blast effects shall be considered. Such DBAs typically involve failure of high-speed rotating machinery, cranes, experimental facilities, high-energy fluid system components, or explosives. Structures required to function following such accidents shall be designed to withstand these DBAs.

0111-99.0.8 Load Combinations

Safety class structures and structural members shall be designed to resist the appropriate load combinations provided in UCRL 15910.

Concrete Structures

Concrete structures and structural members for safety class concretc structures shall meet the design and construction requirements of ACI 349 for new construction or original (or equivalent) codes for existing construction providing the margin of safety of the overall facility is maintained.

Steel Structures

Safety class steel structures shall meet the design, fabrication, and erection requirements of AISC N690 for new construction or original (or equivalent) codes for existing construction providing the margin of safety of the overall facility is maintained.

0111-99.4 Explosives Facilities

Explosive facilities shall comply with TM 5-1300 and DOE/TIC 11268.

0140 QUALITY ASSURANCE

Facility design shall be conducted under QA requirements to ensure that the established program and project quality objectives are satisfied. A QA program shall be developed and implemented in compliance with DOE 5700.6B and using the elements of DOE 4700.1 and ANS ANSI/ASME NQA-1.

Control mechanisms shall be established to ensure that: (1) design inputs are correctly translated into design documents in a timely manner, (2) organizational and physical interfaces are identified and controlled; (3) changes to design are controlled in a manner commensurate with the original design; (4) the design is independently verified to be adequate; (5) documentation and records of the design and design verification processes are maintained in accordance with the QA program.

QA encompasses all those planned and systematic actions and controls necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. QA includes *quality control,* which includes actions needed to ensure that the physical characteristics of a material, structure, component, or system meet predetermined requirements.

An adequate QA program provides the following assurances

- Organizational interfaces are identified and controlled.
- The design is independently verified to be adequate.
- A document control system is in place
- A change control system is in place.

The QA program shall include quality control functions in the following areas:

- The design will satisfy program and project requirements.
- The prepared drawings and construction specifications adequately incorporate QA, design, and codes and standards requirements and are available in a timely manner.
- Construction can be performed in accordance with design.
- Tests, reviews, or inspections confirm the adequacy of design and quality of construction and manufactured components, where appropriate
- Lock and tag systems are provided for turnover acceptance, maintenance, and system outages.

As a part of the QA program, architectural and engineering portions of design should be closely coordinated and *functionally analyzed* during the conceptual, preliminary (Title I), and detailed (Title 11) design phases to avoid conflicts that could result in costly changes during construction. Prior to initiating Title I and Title II design, QA requirements shall be established for the project systems, subsystems, and components. The following shall be determined:

- What the facility is to accomplish
- The range of operating conditions
- The required degree of reliability
- The intended useful life
- How it can be maintained, repaired, or replaced

Wherever possible, design shall reflect experience gained on similar projects or similar types of construction.

Provisions shall be made for review and checking design calculations, drawings, and construction specifications by qualified personnel other than those responsible for the original design.

Deviations from specified standards shall be identified and procedures established to ensure their control.

To the extent practicable, and particularly in the case of innovative design, the design should be independently reviewed by competent consultants in construction or manufacturing techniques to confirm the practicability of construction or manufacture.

0150 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

0150-1 SITE DEVELOPMENT

During site development construction activities:

- The area beyond the construction limits shall not be unnecessarily disturbed.
- The impact of construction activities on the environment and existing facilities shall be minimized through the use of silt fencing, dust palliative, soil waterproofers, etc., in accordance with TM 5-830-3.
- Site resources such as soil, timber, and water shall be effectively used.
- Potential effects on existing safeguards and security shall be assessed and necessary precautionary measures implemented.
- Construction materials and installed work shall be protected from damage.
- Construction materials and installed work that have been damaged during construction activities shall be replaced.
- Existing utilities and other structures that are to remain in place shall be located by survey, staked, and protected from disturbance.

Where feasible, the following temporary and permanent facilities shall coincide to minimize the area of disturbance within the construction limits:

- Drainage and erosion control measures
- Horizontal and vertical access road alignments
- Parking and storage areas

See Section 0250-3, Roads, and Section 0250-4, Parking Areas, for further criteria.

Where construction will affect off-site activities, local government and law enforcement agencies shall be notified.

Traffic control measures shall be implemented to minimize interference between construction activities and local vehicular and pedestrian traffic. Work zone traffic control plans shall be implemented and shall include necessary barricades, detours and signage. Such plans shall comply with ANSI D6.1.

Disturbance of the natural terrain shall be minimized during site grading. Where feasible, natural flora on or adjacent to the construction site shall be preserved and protected from vehicular and pedestrian traffic with temporary fencing.

In locations where topsoil is not readily available, all topsoil within the area of disturbance shall be scalped and stockpiled in a designated location, for later use in landscaping and revegetation efforts.

Excess topsoil, if any, shall be preserved and stockpiled in a designated location for future use at other construction sites.

Natural flora in unlandscaped areas shall be reestablished where disturbed by construction activities.

Revegetation operations shall coincide with other landscaping activities.

Where revegetation is not feasible due to adverse climatic conditions (i.e., desert climate) other methods of soil stabilization shall be implemented (e.g., terraces, benches, dikes, chemical soil stabilizers, mulches and mulch tacks).

Cultural resource sites of archaeologic and historic significance that lie within the boundaries of DOE installations shall be identified within the site EIA.

Archaeologic and historic sites shall be reconsidered during preparation of CDRs and ADMs for new construction. New construction shall comply with each site's historical preservation plan. Archaeologic and historic site clearances for new construction shall be obtained prior to Title I Preliminary Design. The evaluation and mitigation process associated with archaeologic and historic site clearances shall include testing, documentation, site stabilization (preservation measures), and consultation with the State Historical Preservation Office. Where feasible, archaeologic and historic sites shall be protected and preserved in accordance with Executive Order 11593, Section 106 of the NPHA of 1966, and 36 CFR 800.

Construction materials and installed work at the construction site shall be protected from damage. Temporary security fencing shall be installed, as required, at unsecured construction sites to prevent vandalism or theft. See Section 0150-5, Temporary Security Fencing.

0150-2 TEMPORARY UTILITIES

The conditions and requirements for the following temporary utilities shall be considered on a project-by-project basis:

- Water service
- Sanitary wastewater disposal
- Stormwater drainage
- Refuse collection
- Electrical power

Where feasible, temporary utility service shall be taken from existing utility distribution or collection systems. All temporary utility service connections shall be coordinated, as

appropriate, with franchised utilities or with the cognizant DOE Facilities Engineering Group. Routes selected for temporary utility services shall mitigate interference with constrction activities. As required, temporary utility services shall be removed after installation of permanent utility services.

0150-3 TEMPORARY AND SPECIAL WIRING FOR TELEPHONE FACILITIES

The need for temporary telephone facilities shall be assessed on a project-by-project basis. Overhead or buried cable shall be used to provide interim service to telephone facilities during construction activities. Routes selected for temporary telephone cable shall mitigate interference with construction activities. Temporary and special wiring (including utility poles and buried cable) shall be removed after installation of permanent telephone wiring systems. See Section 1075, Telephone Facilities.

0150-4 POLLUTION AND SOIL EROSION CONTROL

0150-4.1 General

Pollution and soil erosion controls shall be implemented during construction activities to mitigate impacts on air, water, and other environmental resources and to assure compliance with Federal, State, and local laws and regulations.

Site-specific industrial waste problems shall be considered prior to construction. Special construction permit and environmental protection requirements shall be addressed at a pre-bid conference and shall be clearly stated within the contract documents.

0150-4.2 Solid Waste

Precautions shall be taken to prevent conveyance of wind-borne refuse beyond the construction limits. Such material shall be collected on a regular basis and consolidated on-site. Construction site refuse and other solid waste shall be hauled to an approved landfill on a regular basis.

Provisions shall be taken to prevent accumulation of mud and soil on adjoining paved roadways during construction activities.

0150-4.3 Air Pollution

Construction refuse and other solid waste shall not be disposed of on-site by open burning without prior approval of the cognizant DOE Facilities Engineering Group. Precautions shall also be taken to minimize the release of gases, vapors and exhaust emissions during site development construction activities.

Dust palliative and soil waterproofers shall be used to mitigate air quality impacts. Generation of airborne particulate matter by vehicle movement shall be minimized in accordance with TM 5-830-3 by limiting the area of disturbance at the construction site, by frequent roadway spraying with water or surfactants, or by other methods that adequately control dust. To mitigate dust generation during construction activities, placement of

permanent roadway and parking area pavements shall be scheduled during early stages of construction. Where pavement damage by construction equipment precludes early placement of permanent roadway and parking area pavements, base course material shall be among other dust control measures considered as alternatives.

0150-4.4 Water Pollution and Soil Erosion

Effective temporary measures shall be implemented to minimize water pollution and soil erosion during construction activities. Where feasible, placement of permanent site improvements (e.g., drainage, erosion control, landscape, roadway base course and pavement) shall be scheduled during early stages of construction to minimize the duration of exposure of erodible soils. Temporary stormwater diversion and detention facilities shall be provided where early placement of permanent improvements is impractical. During construction, temporary bridges or culverts shall be provided at all access road drainage crossings. Where feasible, construction activities shall be scheduled to avoid the rainy season.

Precautions shall also be taken to prevent discharge of liquid contaminants (such as fuels, lubricants and other toxic substances) to the environment. Temporary facilities for disposal of sanitary wastewater shall be provided.

0150-4.5 Noise Pollution

The impact of noise pollution on site personnel, adjacent activities and existing facilities shall be assessed prior to site development construction activities. Precautionary measures shall be implemented to mitigate such impacts where they are significant.

0150-4.6 Demolition and Decommissioning

See Section 0205, Demolition, Decontamination, and Decommissioning.

0150-5 TEMPORARY SECURITY FENCING

Prior to construction the following conditions and requirements for temporary security fencing shall be implemented:

- Exclusion of unauthorized vehicular and pedestrian traffic from the construction site
- Restriction of authorized vehicular traffic to designated access roads
- Protection of construction materials and installed work

Temporary security fencing shall be installed, as required, at unsecured construction sites to prevent vandalism or theft.

Temporary security fencing shall provide a level of integrity and a clear zone to suit site-specific conditions.

Temporary security fencing shall be consistent with site-specific security and protection goals and operational requirements.

See Section 0283-3, Permanent Security Fencing.

0170 CONSTRUCTION CONTRACT CLOSEOUT

0170-1 MATERIAL TO BE PROVIDED

Prior to final acceptance of a completed contract, the construction contractor shall provide the Contracting Officer various data needed for the successful operation of the facility and material assuring compliance with the construction documents. Contract documents shall ensure that the contractor is responsible for delivering these items.

The following *noninclusive* listings indicate the basic information to be submitted. The design professional shall *delete* from the listing inapplicable items and *add* project-specific requirements.

Project documentation:

- Record drawings
- As-built drawings
- Welder IDs, welder qualification records, inspection reports, original radiographic films, weld maps
- Action response to inspection reports
- Bonds
- Weekly certified payrolls
- Insurance certificates
- Names of contractors, subcontractors and suppliers
- Minutes of progress meetings
- Measurement and calculation for pay items
- Original and revised construction schedules
- Accident reports
- Photos
- Reports of progress and problems

- Names of the responsible parties, addresses and telephone numbers

Final survey locations and physical features including:

- Building comers
- Roads
- Parking lots and sidewalks
- Qualily assurance records
- Above- and below-ground utilities, valves, and utility structures

Data to be furnished shall be tied into horizontal control system using established coordinates or baselines and property lines. Vertical control system shall use USGS or other recognized bench marks. See Section 0202, Surveying.

Field test reports:

- Construction components test (to demonstrate conformance to design documents)
- System operational test (to demonstrate conformance to design documents)
- HVAC testing and balancing
- Pressurization/vacuum and leakage tests of piping, tanks and equipment
- Sterilization of potable water systems
- Filtration
- Acoustical
- Vibration
- Backfill (material type, proctor tests, compaction)
- Concrete (slump, air entrainment, cylinder and beam strength)
- Smoke evacuation
- Fire suppression
- Fire and smoke detection
- Grounding
- End-to-end function for electrical, instrumentation, and communications

- Security system performance/demonstration
- Wire continuity and hi-pot/megger
- Communications
- Energy management systems and devices
- Emergency generation/UPS
- Blockage tests and flow tests for sewer lines
- Cathodic protection
- Lightning protection
- Asphalt (classification, gradation, thickness, compaction)
- Base material (material type, thickness)
- Excavation (soil type, elevation of rock, elevation of water table)
- Pile driving data sheets including hammer size and energy, blows per foot and final tip elevation
- Pile load test results
- Timber test reports

Manufacturers' and supplier's data including contractor-designed items:

- Warranties
- Manufacturing inspection certificates
- Manufacturing performance certificates
- Standards certification documentation
- Listing of local service companies
- Listing of emergency "Hot Lines"
- Wire lists
- Operating and maintenance manuals (normal and emergency)
- Spare parts lists
- Concrete mix designs, asphalt mix design

- Shop drawings as approved
- Laboratory, shop and mill tests' results of materials and equipment
- Samples
- Pre-engineered building calculations and certification
- Truss design calculations
- Material fire testing documentation
- Schematic and one-line electrical system diagrams
- Normal voltage levels
- Switching arrangements
- Equipment descriptions
- Load capacities
- Short-circuit interrupting ratings
- Plant material watering, fertilizing, pruning, spraying mulching, mowing, aerating, dethatching schedules
- Material Safety Data Sheets

0170-2 CLOSEOUT PROCEDURES

The Contracting Officer shall initiate contract closeout procedures. Construction completion and closeout procedures shall be as required by DOE 4700.1.

Division 2
Site and Civil Engineering

0200 SITE DEVELOPMENT

0200-1 FACILITY SITING

0200-1.1 General

The selection of sites for new facilities shall comply with DOE 4300.1B. Site development and facility utilization planning shall comply with DOE 4300.1B. Site development planning for energy management shall comply with DOE/MA 0129. A site development plan shall be used to locate new facilities on existing or new sites to assure effective site utilization and to preclude future conflicts between existing and new facilities.

During site selection for new facilities the following conditions and requirements shall be considered:

- Programmatic and operating efficiency
- Natural topographic and geologic conditions
- Existing cultural, historic, and archeological resources
- Endemic plant and animal species
- Existence of known RCRA and/or CERCLA sites
- Special siting requirements for facilities containing, using, or processing hazardous materials
- Health, safety and environmental protection requirements
- Indoor air quality impacts (e.g., presence of radon in foundation soils, building materials that off-gas ‘irritating-chemical vapors and the need to "bake out" new buildings prior to occupancy)
- Hazardous operations and consequences of potential accidents in adjacent facilities

- Natural hazards including seismic activity, wind, hurricane, tornado, flood, hail, volcanic ash, lightning and snow
- Wave action within any natural or man-made body of water (in accordance with CERC Shore Protection Manual)
- Physical protection requirements
- Security and safeguard requirements
- Adequacy of existing or planned support and service facilities, including utilities, roads, and parking areas
- Interrelationships between facilities and aesthetic compatibility
- Energy conservation requirements
- Impact of site selection

Location analyses performed during the preparation of CDRs shall consider but not be limited to these same criteria. The NEPA/DOE 5440.1C require the preparation of an environmental assessment prior to the initiation of a government action that may significantly affect the environment. These requirements shall be considered during facility siting.

To the extent possible, facility siting shall preclude the use of floodplains or areas subject to flash floods and shall minimize destruction, loss, or degradation of wetlands. See Section 0276, Construction in Floodplains or on Wetlands.

0200-1.2 Radiological Siting Requirements

Radiological siting requirements shall be considered during site selection and facility planning efforts.

For those facilities in which radioactive materials are processed, used, or stored, or those facilities that incorporate radiation-producing machines, the acceptability of the site shall be evaluated in terms of potential radiological consequences. The accidents to be considered are those attributable to both operational events (determined by using a deterministic and/or a probabilistic approach) and natural phenomena as applicable to the facility and the site.

For a deterministic analysis, events to be analyzed are those judged to have maximum consequences based on technical review of the specific facility design and related radiological processes. For a probabilistic analysis, events to be considered are those events whose annual probability of occurrence exceeds 10^{-6}. These analyses provide the basis of judgment for selection of one site over alternative sites and for overall risk of operation of the facility.

Radiation dose to an off-site individual receiving maximum exposure shall be evaluated. For both on-site and off-site individuals, emergency response planning shall be an important criterion in determining the acceptability of a site. Dose refers to dose equivalent in rem from exposure to radiation directly received by the body from an external source and/or from

radioactive materials taken into the body by inhalation or ingestion. Dose shall be calculated and compared to the dose guidelines established below. Comparisons shall be based on a 50-year committed effective dose-equivalent.

The off-site individual receiving the maximum dose shall be assumed to be located at the point of highest concentration (or highest exposure rate) outside the boundary controlled by the site. Meteorological conditions used in dose calculations shall be representative of unfavorable dispersion, determined by comparing the 0.5 percent dispersion factors (X/Q) for each sector to the 5-percent overall site X/Q and selecting the highest value. The dose assessment shall consider both the duration of the event and, consistent with emergency response capability to control or evacuate individuals, the duration of exposure. The duration of exposure should not exceed two hours. The dose calculated shall be compared to the numerical guidelines within 0200-1.2, Radiological Siting Guidelines.

Consideration shall be given to on-site individuals. Prudent measures associated with the radiological protection of on-site personnel and in conjunction with the on-site emergency response planning, as required through implementation of DOE 5500.3, shall be incorporated into the design and siting of a new facility.

Information on the siting evaluation, including the models, parameters, and assumptions used in the dose calculations shall be documented for use in the facility's SAR and emergency response plans. See DOE 5440.1C and DOE 5481.1B.

0200-1.3 Radiological Siting Guidelines

The following siting guidelines apply to off-site individuals receiving maximum dose from exposure to internally-deposited radioactive materials and/or to radiation from external sources. Guidelines are based on a 50-year committed dose equivalent.

The maximum calculated dose shall not exceed 25 rem to the whole body, 300 rem to the thyroid, 300 rem to the bone surface, 75 rem to the lung, or 150 rem to any other organ. If multiple organs receive doses from the same exposure, the effective dose equivalent from all sources shall not exceed 25 rem when calculated by using the ICRP Report No. 26 weighting factors.

These siting guidelines apply to nonreactor nuclear facilities. Siting and design criteria for nuclear reactors appear in DOE 5480.6.

The use of doses as set forth in these guides is not intended to imply that these doses constitute acceptable limits for emergency doses to the public under accident conditions. Rather, these are reference values that can be used in the evaluation of facility design in combination with the suitability of the site with respect to accidents having a low probability of occurrence and low risk of public exposure to radiation.

When calculating these doses, degraded performance of ESF and administrative controls shall be assumed unless they can be clearly shown to be unaffected by the accident (capable of performing their safety function) by proper design, installation, testing, and maintenance according to prescribed standards.

Guidance for implementing the criteria of Section 0200-1.2, Radiological Siting Requirements, is available in LANL LA-10294-MS. However, this guidance does not apply to high-level waste repositories with respect to earthquake siting and design.

0200-2 BUILDING LOCATION

New buildings and building additions shall be located in accordance with the site development plan. During site selection for new buildings the following conditions and requirements shall be considered:

- Architectural and functional compatibility with the environment
- Operation and service functional relationships
- Natural topographic and geologic conditions
- Existing cultural and archeological resources
- Historical sites
- Abandoned mines or wells and potential for subsidence
- Endemic plant and animal species
- Availability of existing utility services
- Building setback requirements
- Availability of existing road systems
- Traffic volume
- Refuse handling and loading zone requirements
- Adequacy for parking, future expansion, and other land use requirements
- Health, safety, and environmental protection requirements
- Indoor air quality impacts (e.g., presence of radon in foundation soils, building materials that off-gas irritating chemical vapors and the need to "bake out" new buildings prior to occupancy)
- Physical protection requirements
- Security and safeguard requirements
- Energy conservation requirements
- Impact of site selection

- Minimum fire separation between buildings (in accordance with NFTA 80A)

Open space shall be provided between structures (to accommodate site security, landscaping and other environmental considerations).

Sufficient access shall be provided around building exteriors (to accommodate emergency vehicles, maintenance vehicles and snow removal equipment).

In cold climates, building entrances, stairs and other pedestrian circulation features should not be placed along the north side of buildings or within shaded areas.

Sites selected for new buildings shall comply with DOE 4330.2C.

Location analyses performed during the preparation of CDRs shall consider but not be limited to the above criteria.

0200.99 SPECIAL FACILITIES

0200.99.0 Nonreactor Nuclear Facilities-General

0200-99.0.1 General

Site evaluation and studies necessary to provide the technical basis for location, design, and operation (under normal conditions, severe and extreme environmental conditions, and DBA conditions) of the facility shall include but not be limited to the items indicated below. In addition, appropriate consideration shall be given to the long-term and immediate consequences of releases of radioactive or other hazardous materials to the environment. New site selection requirements and procedures are also prescribed in DOE 4300.1B.

0200.99.0.2 Other Facilities and Operations

The potential hazards from other on-site facilities and off-site sources of hazards that could affect the safe operation of the special facility shall be considered. Typical on-site hazards are fire, explosion, radioactive materials, gas mains, large quantities of explosives, flammable gases, and other hazardous materials. Off-site hazards can be due to the facility's proximity to airports, transportation routes (highways, railways, and waterways), private industrial facilities, and military facilities.

0200-99.0.3 Services

The proximity of the facility to utilities, the fire department, and other services shall be considered.

The design of utility services shall provide reliability consistent with operational requirements, the value of in-process product, and the potential hazard for identifiable probable conditions. Utility systems essential to the support of safety class items shall be designed as safety class items.

0200-99.0.4 Meteorology

Available meteorological data shall be considered to identify conditions that may influence the design and operation of the facility. Meteorological data to be considered shall include expected annual ranges and distributions of the following variables:

- Wind direction and speed
- Atmospheric stability
- Temperature
- Atmospheric water vapor
- Mean joint temperature and specific humidity

As a minimum, at least one year of valid meteorological data shall be used to properly develop estimated joint frequency distributions of wind speed and stability conditions. These data shall be used to estimate the dispersal of effluents under normal and accident conditions.

0200-99.0.5 Hydrology

Site studies shall be performed to determine ground water levels, flood runoff, drainage, and other hydrological characteristics that could influence the design or operation of the facility. The hydrological studies shall include the following:

- Flooding (probable maximum flood, 100-year flood, 25-year flood, flash flooding, flood due to tsunamis, flooding due to dam failures, flooding due to ice jams)
- Ground water levels
- Tsunamis
- Dam failures and breaches (including seismically induced dam failures)
- Ice loadings from water bodies
- Potential transport of radioactive and chemical contaminants in surface water and in groundwater

0200-99.0.6 Seismology

Studies shall be performed to determine site features such as ground failure under dynamic loading, surface faulting, liquefaction, vibratory ground motion, and site amplification that could influence the design or operation of the facility.

0200-99.8 Telecommunications, Alarm, and ADP Centers and Radio Repeater Stations

0200-99.8.1 General

Telecommunications, alarm, and ADP centers shall be centralized and consolidated to:

- Maximize the range of electrical and communication systems coverage
- Reduce on-site distribution service cable and duct lengths
- Maximize the efficiency and effectiveness of physical protection systems
- Minimize operation and maintenance costs

Five-year growth forecasts shall be performed during site evaluations for telecommunications, alarm, and ADP centers.

Telecommunications, alarm, and ADP centers and radio repeater stations shall be housed in fire-resistant structures and located outside areas subject to explosion, fire, flood, chemical fumes, excessive dust, vibration, dampness, high noise levels, and high electrical interference. Protective measures shall be implemented in all instances where these facilities cannot be located outside such areas. Facility fire and physical protection designs shall comply with DOE 1360.2A, DOE 5300.2B, DOE 5300.3B, DOE 5300.4B, the DOE 5632 series, DOE 5637.1, NFPA 75 and DOE/EP 0108.

ADP centers that process classified or sensitive unclassified information shall be located in secured areas with effective access control.

When ADP centers must be located in multiple-use facilities, special protective measures shall be implemented to safeguard ADP equipment and to ensure uninterrupted operation. ADP centers shall not be located above or below the following facilities unless they are separated by fire-resistant floors or are otherwise properly isolated:

- Cafeterias and kitchens
- Photographic film processing areas
- Chemical laboratory areas
- High-voltage electrical distribution centers
- Public areas
- Hazardous areas
- Uncontrolled areas

The configuration of maintenance, operating, storage and utility areas and equipment within telecommunications, alarm, and ADP centers and radio repeater stations shall:

- Provide optimal functional efficiency to operations and maintenance personnel
- Provide adequate maintenance service access to maintain all equipment. The minimum aisle space between cabinets or rack-mounted equipment and adjacent walls shall be 3 feet. Additional clearance shall be provided for high-voltage equipment and to allow for equipment change out.
- Consolidate related equipment and operations areas
- Provide adequate fire-resistant wall separations between storage and maintenance areas and equipment and operations areas
- Provide physical protection for equipment, operations, and storage areas
- Provide structural, architectural, environmental, mechanical, and electrical features and ystems that will mitigate the degree of renovation necessary to accommodate future expansion need for five years after facilities are occupied

0200-99.8.2 Teletype, Data, and Facsimile Centers

Teletype, data, and facsimile centers shall be centralized and consolidated within a secured area located in close proximity to the principal users. Site and facility planning efforts for such centers shall be coordinated with the cognizant DOE security office and the user groups.

0200-99.8.3 Radio Control Centers

Land area requirements, air space restrictions, and topographic limitations shall be considered during site selection for radio communications control centers.

Radio communications control centers shall be located outside areas subject to high electrical noise levels.

0200-99.8.4 Fire Alarm Control Centers

Fire alarm control centers shall be located within the central fire station, the Emergency Communication Center or within another alarm center in each emergency service area. Where feasible, secondary fire alarm control centers shall be located within other fire stations in the immediate vicinity.

0200-99.8.5 Security Alarm Control Centers

Security alarm control centers shall be located in close proximity to the tactical response force when possible and practical.

0200-99.8.6 Radio Repeater Stations

Sites selected for radio repeater stations shall comply with DOE 5300.1B. Approval for a radio repeater station shall be obtained from DOE Headquarters, Office of Computer Services and Telecommunications Management.

0201 SUBSURFACE INVESTIGATIONS

0201-1 GENERAL

For permanent strictures, subsurface conditions shall be determined by means of borings or other methods that adequately disclose soil and groundwater conditions. Data and other information obtained from prior subsurface investigations shall be used, supplemental by additional investigations at the specific location as deemed necessary by the design professional. Subsurface investigations shall be made for critical facilities.

Subsurface investigations shall be performed under the direction of a qualified soils engineer. In earthquake-prone areas, appropriate geological investigations shall be made to determine the contribution of the foundation (subsurface) to the earthquake loads imposed on the structure and shall include, but not be limited to, a recommendation of foundation type, determinations of allowable soil bearing design capacity, and the possible effects of seismic activity on the soil mass. A settlement analysis under differential design loads shall be performed where differential settlement may cause structural or architectural damage.

0201-2 DRILLING AND SAMPLING METHODS

Drilling and sampling shall comply with ASTM standards, including ASTM D1586, ASTM D1587, and ASTM D2113. Soil samples shall be taken below existing grade and at each change in soil stratification or soil consistency. The depth of soil samples shall be determined by the soils engineer after consulting with the project engineer on site-specific design requirements.

Soil samples shall be preserved until the subsurface investigation has been approved by the cognizant DOE authority.

0201-3 FIELD AND LABORATORY REPORTS

All data required to be recorded according to the ASTM or other standard test methods used shall be obtained, recorded in the field, and referenced to boring numbers. Soil shall be visually classified in the field logs in accordance with ASTM D2488, but the classification for final logs shall be based on the field information, the results of tests, and further inspection of samples in the laboratory by the soils engineer preparing the report. As a minimum the report shall:

- Include a chart illustrating the soil classification criteria and the terminology and symbols used on the boring logs
- Identify the ASTM or other recognized standard sampling and test methods used
- Provide a plot plan giving dimensioned locations of test borings
- Provide vertical sections for each boring plotted and graphically presented showing number of borings, date of start and finish, surface elevations, description of soil and thickness of each layer, depth to loss or gain of drilling fluid, hydraulic pressure required or number of blows per foot (N value), and, where applicable, depth to wet cave-in, depth to artesian head, groundwater elevation and time when water reading was made and presence of gases
- Note the location of strata containing organic materials, weak materials or other inconsistencies that might affect engineering conclusions
- Describe the existing surface renditions
- Summarize the subsurface conditions present
- Provide pavement structural design data including California Bearing Ratio tests or modulus of subgrade reaction tests
- Provide a profile and/or topographic map of rock or other bearing stratum
- Analyze the probable variations in elevations and movements of subsurface water due to seasonal influences
- Report all laboratory determinations of soil properties including shrinkage and expansion properties

0201-4 FOUNDATION ENGINEERING EVALUATION AND RECOMMENDATIONS

The soils engineer shall analyze the information developed by investigation or otherwise available, including any aspect of the soil conditions that might affect design and construction of proposed structures, and shall consult with the engineer on the design requirements of the project. The soils engineer shall submit a professional evaluation, recommended construction specifications, and recommendations including the following where applicable:

- Foundation support of the structure and slabs, including soil bearing pressures, bearing elevations, foundation design recommendations and anticipated settlement
- Anticipation of, and management of, groundwater

- Lateral earth pressures and pressure coefficients (active, passive, and at rest) and internal friction angles for design of walk below grade, including backfill, compaction and subdrainage, and their requirements
- Soil material and compaction requirements for site fill, construction backfill, and for the support of structures and pavement
- Recommendations and design criteria for shoring and underpinning systems
- Design criteria for temporary excavation, temporary protection such as sheet piling, underpinning and temporary dewatering systems
- Stability of slopes
- Seismic activity
- Frost penetration depth and effect
- Analysis of the effect of weather and construction equipment on soil during construction
- Analysis of soils to ascertain presence of dispersive potentially expansive, deleterious, chemically active or corrosive materials or conditions, or presence of gas
- Recommendation of the most proper foundation system and other alternative workable systems
- Specific recommendations and design and construction criteria for ponds, reservoirs, slurry cut-off walls, drainage systems, etc.

0202 SURVEYING

0202-1 GENERAL

Construction, control, property and topographic surveys shall be coordinated with the cognizant DOE authority. Where feasible, surveying support available from DOE contractors shall be used. Survey field notes shall be legibly recorded on standardized (8-1/2 inch x 11 inch) field note forms. Field notes and final plots of surveys shall be furnished to the cognizant DOE authority. Any boundary surveys and recorded maps shall be forwarded to the DOE Operations Office.

The degree of accuracy for construction, control, property, and topographic surveys shall be consistent with the nature and importance of each survey. Where required by law (i.e., applicable State statutes) all control and property surveys at DOE sites shall be performed by, or under the supervision of, a professional land surveyor registered in the State in which the subject site is situated.

0202-2 HORIZONTAL AND VERTICAL CONTROL

Each DOE Facilities Engineering Group shall be responsible for establishing, recording, and perpetuating primary on-site horizontal and vertical control monumentation. Each DOE Operations Office shall also be responsible for correlating primary site-specific horizontal and vertical control monumentation with that of other agencies such as the National Geodetic Survey (formerly the U.S. Coast and Geodetic Survey [C&GS]). Primary horizontal control monumentation shall comply with NOAA NGS Special Publication 247. Primary vertical control monumentation shall comply with NOAA Manual NOS NGS 1 and NOAA Manual NOS NGS 3. All geodetic control networks and surveys shall comply with FGCC Standards and Specifications for Geodetic Control Networks.

Temporary on-site horizontal and vertical control monumentation shall comply with ACSM Horizontal Control as Applied to Local Surveying Needs and with NOAA Manual NOS NGS 3.

0202-3 MONUMENTATION

0202-3.1 Temporary Control Monuments

Where the scope and complexity of the project warrants, the placement, number and location of temporary horizontal and vertical control monuments in new development areas shall be coordinated with and approved by the cognizant DOE Facilities Engineering Group. See Section 0202-6, Construction Staking.

A minimum of two inter-visible control monuments shall be placed along or adjacent to right-of-way lines. These temporary control monuments shall be tied by a Grid Bearing, ground distance and elevation to a third permanent survey monument or temporary control monument. The surveyor setting such monumentation shall submit legible notes, drawings, and reproducible documentation to the DOE Facilities Engineering Group. The location and description of all temporary control monuments in the immediate vicinity of new construction shall be provided on construction drawings.

Temporary control monuments shall be 5/8-inch diameter mild steel bars or 3/4-in diameter iron pipe with a minimum length of 2 feet. In loose sand or unstable soil, such temporary control monuments shall have a minimum length of 3 feet. With written approval from the cognizant DOE Facilities Engineering Group, manhole rims, markings chiseled in concrete, PK nails in asphalt, and lead and tack in bedrock or concrete shall be suitable alternative temporary control monuments.

Temporary control monuments shall be set flush or within 0.2 feet of the ground surface. All temporary control monuments shall have a cap or permanent tag bearing the assigned monument identification numbers as identified in the survey field notes and as shown on the design drawings or other related documents.

Three guard posts with reflective paint striping shall be installed adjacent to temporary control monuments in high traffic areas to preclude vehicular damage.

Temporary control monuments shall be set in conformance with the accuracy standards and specifications for Class 3 surveys or more accurately (see Table 0202-3.1).

Table 0202-3.1 Suggested Standards and Specifications for Local Surveys ***

	Class 1	Class 2	Class 3
Position Closure	1:15,000	1:10,000	1:5,000
Angles Accurate to	5 sec.	7 sec.	14 sec.
Distances Accurate to	0.002 ft.	0.004 ft.	0.007 ft.
(per 100 feet)	(1:50,000)	(1:25,000)	(1:15,000)
Rejection limit or spreads between D & R and sets	5 sec.	5 sec.	10 sec.
Number of positions or sets			
1" Instrument	4 Pos.	4 Pos.	2 Pos.
10" Instrument	1 Set 6DR	1 Set 6DR	1 Set 2DR
20" Instrument	2 Sets 6DR	2 Sets 6DR	1 Set 4DR
30" Instrument	3 Sets 6DR	3 Sets 6DR	1 Set 6DR
1' Instrument			1 Set 8DR
Azimuth Closure	$8'' N^{1/2}$	$10'' N^{1/2}$	$30'' N^{1/2}$
Azimuth Closure per angle point	3 Sec.	5 Sec.	10 Sec.
Number of Repetitions (distance measurements)	1	1	1
Taping Criteria			
Temperature	Accurate to ±2°F	Accurate to ±3°F	Accurate to ±6°F
Tension	Accurate to ±1# of standard	Accurate to ±2# of standard	Accurate to ±3# of standard
Calibration	**	**	**
Type of Target	Fixed	Fixed	Plumb Bob String or Fixed

1. It is recommended that 30" transits not be used for Class 1 and 2 surveys.
2. *N = Number of angle stations carrying azimuth. The smallest value for the azimuth closure criteria will apply.
3. Fractions of a full tape length must be checked.
4. Properly calibrated electronic distance measuring equipment may be used in place of metal tapes.
5. Side points observed from primary traverses shall conform within reason to the required accuracy for the primary traverse. The accuracy of the observations wll depend on the type of point observed. Whenever indefinite points, such as fence corners, tree stumps, etc., are involved, the best approximation of the center or specific point previously described should be observed. Each angle should be observed 2DR, and the spread between the D and R observations should not exceed ±20".
6. Tension applied should be same used to standardize or calibrate tape.

** Standardized tape or one calibrated with a standardized tape.

*** *Horizontal Control as Applied to Local Surveying Needs,* American Congress on Surveying and Mapping S200. Permanent survey monuments shall be considered to have zero positional error when used as reference for the placement of control monuments for construction, but should be checked with at least one other monument at the time construction control is set.

Table 0202-3.1 is taken from ASCM Horizontal Control as Applied to Local Surveying Needs. These standards and specifications apply to surveys in areas where control is closely spaced (one or two miles, or less); however, these standards and specifications may be applied to surveys where control is more widely spaced with precision field operations.

0202-3.2 Permanent Survey Monuments

The placement, number and location of permanent survey monuments for horizontal and vertical control shall be coordinated with and approved by the cognizant DOE authority. The location and description of the nearest permanent survey monument shall be provided on construction drawings. These monuments shall be tied by Grid Bearing, ground distance and elevation to the applicable State Plane Coordinate System and referenced to NAD of 1983 and the NGVD of 1929.

Any surveyor that sets a permanent survey monument shall submit legible notes, sketches, or other reproducible documentation that show the location of the new monument relative to the on-site horizontal and vertical control network, to the applicable State Plane Coordinate System, to the NAD of 1983 and to the NGVD of 1929. The convergence, scale factor, and elevation at the monument shall also be provided.

A description of the surveying equipment and procedures used to establish the new monument shall accompany copies of all field notes, calculations, reductions, and closures. Similar information shall be submitted for any found monuments. Permanent survey monuments shall be considered properly positioned and represented only after the DOE Operations Office has approved all survey procedures and calculations and has verified conformance to standards and specifications for Class 2 surveys (see Table 0202-3.1) or greater.

Table 0202-3.1 shall apply to surveys in areas where control is closely spaced (one or two miles or less); however, these standards and specifications may be applied to surveys where control is more widely spaced with precision field operations. Permanent survey monuments shall be identified with a metal cap or disk set in a 24-inch diameter pipe with flared ends at bottom. Identification numbers, as approved by the DOE Operations Office, shall be permanently stamped into the metal cap or disk.

These identification numbers shall be documented within the survey field notes and shown on the design drawings and within related documents.

Tentative point identification for permanent survey monuments may be assigned by the surveyor; however, permanent point identification shall only be assigned to such monuments by the DOE Operations Office.

Permanent survey monuments shall not be removed without prior authorization from the cognizant DOE Operations Office.

0202.3.3 Bench Marks

A minimum of one permanent bench mark for vertical control shall be established in each new development area. A minimum of three bench marks shall be established if there are no existing bench marks within a 3-mile radius of each new development area. Additional bench

marks may be established, as necessary, with prior approval of the cognizant DOE Facilities Engineering Group. Bench marks may coincide with permanent survey monuments or temporary control monuments.

Bench mark elevations shall be referenced to the NGVD of 1929.

Level section misclosures between fixed bench mark elevations shall equal or exceed Third Order Accuracy, as defined in FGCC Standards and Specifications for Geodetic Control Networks (Table 0202-3.3).

Table 0202-3.3 Accuracy Standards for Level Closures

First Order*	Second Order*	Third Order*
0.017 ft $M^{1/2}$	0.035 ft $M^{1/2}$	0.05 ft $M^{1/2}$

* M is the distance in miles of the total level route running forward and back between fixed elevations or along a level loop.

Source: *Standards and Specifications for Geodetic Control Networks,* Federal Geodetic Control Committee, 1984.

Legible level notes and calculations shall be submitted to the cognizant DOE Facilities Engineering Group for approval.

Permanent bench marks shall be identified with a metal cap or disk as specified in Section 0202-3.2, Permanent Survey Monuments

Permanent bench marks shall not be removed without prior authorization of the cognizant DOE Operations Office. The location and description of all bench marks in the immediate vicinity of new construction shall be provided on construction drawings.

0202-4 SURVEYS FOR UTILITIES, ROADS, AND PARKING AREAS

Coordinates and elevations shall be determined for utilities, roads and parking areas at their principal points of definition. This information shall be provided on the construction drawings. The principal points of definition for utility systems shall include utility poles, obstructions, manholes, valve boxes and other appurtenances for heating and cooling lines, sewers, and overhead and underground power and telephone systems. Principal points of definition for potable water and natural gas distribution systems shall be valve boxes, main line intersects and fire hydrants.

The principal points of definition for roads shall be roadway centerline intersects. Road alignment surveys shall include stationing, bearings and curve information tied to these

principal points of definition. Where applicable, the following information shall also be provided on the construction drawings:

- Stations and deflection angles for each point of intersection
- Right-of-way lines and markers
- Spot elevations (centerline, edge of pavement, and at intersects) at minimum intervals of 100 feet
- Pavement width
- Other improvements (e.g., drainage inlets, wheelchair ramps, fire hydrants, sidewalk, curb and gutter)
- Topographic features within the project limits
- Elevation contours
- Overhead and underground utility crossings (plan and profile)
- Roadway drainage crossings
- Location and description of underground utility witness markers

0202-5 SURVEYS FOR EXISTING UNDERGROUND UTILITIES

Where exact routes of underground utilities are not defined within record drawings and such information is essential to subsequent design efforts, the cognizant DOE Facilities Engineering Group shall coordinate necessary electronic line detection and exploratory excavation activities. Such utilities shall be located by survey and documented on the construction drawings.

0202-6 CONSTRUCTION STAKING

Construction staking for new DOE facilities shall comply with local standards and with practices approved by the cognizant DOE Facilities Engineering Group.

0203 UTILITIES WITHIN EASEMENTS OR CORRIDORS

0203-1 UTILITY LOCATIONS

0203-1.1 General

Utility locations shall take into consideration the following:

- Location, size, and elevation of sanitary sewers, storm drains or open drainage channels, drain inlets and manholes
- Location, size, and elevation of water, gas, heat transmission mains and underground electrical service
- Location and size of overhead electric service, street lighting, and telephone lines, including pole and manhole locations
- Location of fire alarm call boxes

0203-1.2 Underground Utilities

Underground utility lines such as sanitary sewer, water, and gas shall not be placed under existing or proposed pavements, except when crossing such pavements or when adequate space is not available. Utility lines shall be placed between backslope of road ditch and building, or back of curb.

Water mains shall not be installed in the same trench with sewer lines. Where water mains and sewer lines are installed parallel to roadways, they shall, if practicable, be located on opposite sides of roadways.

See Section 0270, Sanitary Wastewater Collection and Stormwater Management Systems, for underground pipeline separation requirements.

Underground lines shall be located so that minimum effort and cost will be required to excavate the lines when required for maintenance.

0203-13 Aboveground Utilities

Above-ground utility features shall not be located in front of, or in such a manner as to detract from the facility. They shall not make landscaping more difficult or restrict or negate close-in recreational areas.

0203-1.4 Security Areas

Separation of utilities from security-related equipment must be considered when planning utility installations. A special emphasis should be given to maintaining clear ground around security fences and in security areas. Utilities that penetrate or pass under a security barrier through an opening of more than 96 square inches in smallest dimension shall provide the same degree of penetration delay as is required for the security barrier.

Overhead utilities generally cannot pass between secure and nonsecure areas without special security features. Utility equipment and supports should not be located so as to provide rover in clear zones or security areas equivalent to or more restrictive than Protected Areas or to aid illegal crossing of security boundaries. The DOE 5632 series provides security area definitions and regulations for these issues.

0203-13 Record Drawings

Underground utilities including piping and wiring and including both temporary and permanent services shall be accurately defined on as-built drawings in both plan and depth.

0205 DEMOLITION, DECONTAMINATION, AND DECOMMISSIONING

0205-1 DEMOLITION

Demolition plans shall ensure that remaining buildings, trees, and environmental resources are protected.

The design professional shall determine whether the use of explosives will be allowed and whether prior approval of such decision must be obtained from DOE.

Demolition plans shall define:

- The extent of demolition, abandonment, and removal of existing facilities and utilities
- Methods for handling and disposing of hazardous waste materials (asbestos, PCB-filled equipment, and other hazardous waste materials)
- Materials to be salvaged
- Backfilling of removed materials and cleanup

0205-2 DECONTAMINATION AND DECOMMISSIONING

Facilities where radioactive or other hazardous contaminating materials will be used or will result from facility operation shall be designed to limit dispersion and simplify periodic decontamination and ultimate facility decommissioning and disposal or reuse. Requirements are provided in Section 1300-11, Decontamination and Decommissioning.

0210 SITE PREPARATION

Local topography shall be considered during project and facility design efforts. New facilities shall be planned to fit with the local topography and require a minimum amount of grading.

Design shall include provisions for erosion control and soil stabilization in ditches, fill slopes, embankments, and denuded areas, and restoration of areas disturbed by the project to original or improved conditions.

Site preparation design shall comply with the following criteria:

- Site drainage design shall comply with Section 0270, Sanitary Wastewater Collection and Stormwater Management Systems.
- Vehicle parking, sidewalks, and road requirements shall comply with Section 0250, Paving and Surfacing.
- Landscaping shall comply with Section 0290, Landscaping.
- Site grading design shall comply with Section 0250, Paving and Surfacing, and Section 0270, Sanitary Wastewater Collection and Stormwater Management Systems.
- Site power and lighting shall comply with Section 0278, Power and Lighting.
- Site security requirements shall be taken into account and provided for in accordance with the retirements set forth in the DOE 5632 series. See Section 0283, Physical Protection, for additional requirements.

0214 DEWATERING

0214-1 GENERAL

The design, installation, and operation of dewatering systems for groundwater control shall be the responsibility of the construction contractor, unless stipulated otherwise in the contract. A groundwater investigation and the selection and design of a dewatering control system shall comply with TM 5-818-5. The design engineer shall determine if the assistance of a qualified groundwater hydrologist shall be required.

0214-2 GROUNDWATER INVESTIGATION

A groundwater investigation shall be made before selection of a dewatering control system. The investigation shall examine the character of subsurface soils, groundwater conditions and quality, and the availability of an electric power source. The source of seepage shall be determined and the boundaries and seepage flow characteristics of geologic and soil formations at and adjacent to the site shall be analyzed in accordance with the mathematical, graphic, and electroanalogous methods discussed in TM 5-818-5.

Field reports identifying groundwater elevations, etc., should be provided to construction contractor responsible for dewatering and groundwater investigation.

0215 SHORING AND UNDERPINNING

0215-1 GENERAL

All shoring and underpinning shall comply with the safety requirements of 29 CFR 1926, Subpart P.

0215-2 SHORING SYSTEMS

Tiebacks analysis of plastic yielding in strutted excavations, analysis of the stability of the bottom of excavations, and shoring for deep exudations shall comply with SSFI SH 300.

0215-3 UNDERPINNING

Remedial underpinning shall be performed where existing foundations are inadequate. Precautionary underpinning shall be performed where new construction adjacent to an existing structure requires deeper excavation.

The services of a structural engineer specializing in underpinning shall be used to perform any underpinning design, which shall comply with the principles in Winterkorn and Fang, Foundation Engineering Handbook.

0220 EARTHWORK

0220-1 GENERAL

Earthwork includes excavating, filling, stabilizing, and compacting earth at the site. Earthwork includes the addition of borrow and disposal of excavated material.

0220-2 SUBSURFACE DATA

Prior to earthwork design, the design engineer shall confer with the soils engineer to define subsurface investigation recommendations required in accordance with Section 0201, Subsurface Investigations.

0220-3 DESIGN

The earthwork design and specification shall comply with the recommendations in the project subsurface investigation.

0235 BUILDING FOUNDATIONS

0235-1 GENERAL

Building foundations shall be designed in accordance with the requirements of the UBC and ACI 318.

0235-2 FOUNDATION DESIGN CRITERIA

0235-2.1 General

Based on preliminary information concerning the purpose of the structure, foundation loads, and subsurface soil conditions, the design professional shall consider alternative types of foundations for the bearing capacity and total and differential settlements.

0235-2.2 Adverse Subsurface Conditions

One of the following procedures shall be used to ensure satisfactory foundation performance where poor soil conditions are encountered:

- Bypass the poor soil by means of deep foundations extending to or into a suitable bearing material
- Design structure foundations to accommodate anticipated differential settlements
- Remove the poor material, and either treat and replace it or substitute good compacted fill material
- Treat the soil in place before construction to improve its properties

Where reasonable alternative design foundation types are possible, preliminary designs shall be prepared for the purpose of detailed cost comparisons. These preliminary designs shall be sufficiently complete to determine the approximate size of footings, length and number of piles required, etc. The behavior of existing foundation types in the immediate vicinity to those proposed shall be ascertained during preliminary design. The long-term effects of subsurface conditions (bearing capacity and settlement) on each foundation type shall be considered. See Section 0201, Subsurface Investigations.

0235-2.3 Cost Estimates and Final Selection

Final foundation design shall not be initiated until the evaluation and cost comparison of the proposed alternatives have been completed. On the basis of tentative designs, the cost of each promising alternative shall be estimated. Estimate sheets shall include items, dimensions, quantities, unit material and labor costs.

0235-3 CONCRETE

Concrete for building foundations shall be designed in accordance with Section 0330, Cast-In-Place Concrete.

0235-4 PIER-AND-BEAM FOUNDATIONS

Grade beams shall comply with ACI 318.

Piers shall comply with ACI 336.3R.

0235-5 PILE FOUNDATIONS

Pile foundations shall comply with the UBC and ACI 543R.

0235-6 RIBBED-MAT SLAB FOUNDATIONS

Ribbed-mat slabs shall comply with ACI 336.2R.

0235-7 EXPANSIVE SOILS

Where expansive soils are encountered, the magnitude of swell or settlement shall be determined in accordance with ASTM D4546 or AASHTO T 258. Based on the results of these tests, the foundation design shall consider one of the following options:

- Mechanically or chemically altering the soil characteristics
- Controlling moisture conditions
- Designing the foundation to tolerate the estimated volume change

0235-8 EQUIPMENT FOUNDATIONS

Heavy, vibration-producing equipment, such as high-pressure air compressors, chillers, fire pumps and engine/generator sets, shall have separate, isolated foundations. A structural vibration analysis and design shall be provided for vibration equipment, where appropriate.

0245 RAILROAD DESIGN

0245-1 GENERAL

The bases for railroad facilities design shall be the criteria in AREA Manual for Railway Engineering (Fixed Properties). Designs shall also comply with regulations and criteria set forth by State commissions and other regulatory bodies regarding railway crossings at public highways.

Special requirements such as derailers are required where railroads cross some security boundaries. The security administrator or his or her designee and the DOE 5632 series shall be consulted for design requirements.

0245-2 TRACK LAYOUT

Track layouts shall allow rail movement to be continuous from the interchange yard through the classification yard to the delivery tracks. Each interchange or receiving track shall be designed to accommodate the maximum single delivery. The average number of cars in each classification shall determine the length of classification tracks.

0245-3 DRAINAGE

Track-side drainage swales, drainage ditches, intercepting ditches, culverts, lateral drains, pipe drains, and other drainage facilities shall comply with AREA Manual for Railway Engineering (Fixed Properties).

0245-4 STRUCTURES

The design strength of railroad structures shall be not less than Cooper E-80 loading.

Structures associated with the railroad operation (buildings, signal standards) shall not be located adjacent to or within security areas equivalent to or more restrictive than Protected Areas as directed in the DOE 5632 series.

0245-5 RAIL

Rail to be used in new construction or for minor alignment and modifications shall be new or relayer rail. New rail is preferred for new construction. The types of rail to be used shall be based on economic considerations.

0245-6 TIES

The use of nonwooden ties shall be allowed, provided the alternative material is acceptable to the cognizant DOE authority. Concrete ties shall be used in areas where tie inspection and maintenance entails pavement removal, or in locations where track maintenance interferes with other site operations and activities (e.g., railroad highway crossings, paved streets, and paved industrial areas). AU tics shall be treated with decay-retardant compounds conforming to the requirements of AREA Manual for Railway Engineering (Fixed Properties). Hardwood ties shall be provided with antisplitting devices in each end.

0245-7 JOINT BARS

0245-7.1 General

Joint bars shall be of the size, shape, and punching pattern to fit the rail.

0245-7.2 Compromise Joint Bars

Where new or relayer rail joins rail of lighter weight, compromise joint bars shall be used. Each pair of compromise joint bars shall be of the proper design and dimensions for the rail on which it is applied.

0245-8 TIE PLATES

0245-8.1 New Rail

Tie plates shall be new, with or without ribs. Insulating tie plates shall be used in the vicinity of lighted crossings.

0245-8.2 Relayer Rail

Used tie plates in good condition and of the proper size and punching can be used with relayer rail. The size of the used tie plates shall not be smaller than 7-1/2 inches by 10 inches for 85-pound relayer rail, and 7-1/2 inches by 11 inches for 110-pound relayer rail. Tie plates with or without ribs can be used.

0245-9 RAIL ANCHORS

Rail anchors shall be spaced to comply with AREA Manual “for Railway Engineering (Fixed Properties).

0245-10 SPIKES

Six-by-5/8-inch spikes shall be used for all ties. New track spikes shall be used for both new and relayer rail.

0245.11 GUARDRAILS

Two inner guardrails shall be installed on all single-track bridges and trestles. Each guardrail shall be 11 inches from the traffic rail and shall extend at least 30 feet beyond each end of the bridge or trestle. One guardrail shall be placed on each track of double-track bridges or trestles.

0245-12 HIGHWAY-RAILWAY GRADE CROSSING

All grade highway crossings shall comply with AREA Manual for Railway Engineering (Fixed Properties) and local State highway standards.

0245-13 BALLAST

The minimum depth of ballast under the ties shall be 8 inches. Prepared ballast (stone, gravel, or slag) is preferred, and prepared stone ballast is most preferred.

0245-14 TURNOUTS

Turnouts shall comply with AREA Manual for Railway Engineering (Fixed Properties).

0245-15 SUPERELEVATION

Superelevation shall not be used on cures where the speed is less than 20 miles per hour except when required by the serving railroad Superelevation shall be provided on access or main running tracks where the speed is equal to or greater than 20 mph.

0245-16 GRADES

The maximum grade on access lines shall be determined by the tonnage handled in one train unit. An analysis shall be made to design grades below 3 percent. Grades shall not exceed 3 percent without approval by the cognizant DOE authority. The design professional shall coordinate the requirements of the serving railroad.

0245-17 CLEARANCES

Clearances for tangent track shall comply with AREA Manual for Railway Engineering (Fixed Properties). Side clearances shall be measured horizontally from the center line of tracks. Side clearances on the outside of curves shall be increased 1 inch for each degree of track curvature over that shown for tangent track. Side clearances on the inside of curves shall be increased 1 inch for each degree of track curvature, and also 3-1/2 times the amount of superelevation of the high rail.

0245-18 ELECTRICAL GROUNDING

Electrical grounding shall be provided at intervals to preclude development of electrical potentials. Electrical grounding shall include bonding between rail sections, installation of ground electrodes, and connection of spur track with building grounding systems where they are within 25 feet of each other.

Electrical grounding shall comply with the NEC.

0250 PAVING AND SURFACING

0250-1 COVERAGE

This section covers walks, roads, streets, parking areas, pavements, curbs, and gutters.

0250-2 WALKS

A functional system of walks connecting structures, operational areas, parking areas, streets and other walks shall be provided to meet pedestrian traffic demands. The location and width shall be determined in accordance with the site development plan. Walks subject to use by the physically handicapped shall comply with UFAS.

The following design factors shall be considered

- Adequate drainage off walk
- Subgrade and base preparation

- Commercial driveways
- Safety
- Skid resistance

0250-3 ROADS

Geometric design of all roads, streets, access drives, and parking areas shall comply with AASHTO GDHS-84.

Gradients for roads, streets, and access drives shall comply with AASHTO GDHS-84. Road and street grade changes in excess of 1 percent shall be accomplished by means of vertical curves. The length of vertical curves shall be determined in accordance with AASHTO GDHS-84. Roadway centerline gradient profiles shall be shown for vertical control.

0250-4 PARKING AREAS

Parking areas should not be located in front of buildings or at prominent visual points of approach. Landscaping, grading, and location shall give prominence to attractive features and de-emphasize or obscure undesirable features. Parking lots shall meet local governmental standards for circulation, layout, and safety.

Handicap parking allocations shall comply with UFAS. Perimeter concrete curbs and gutters shall be considered for all parking areas and access drives in built-up areas. In remote or little-used areas, concrete curbs and gutters shall be used only when required to control drainage. Removable prefabricated concrete wheel stops may be used where appropriate. Railroad ties are acceptable for use as wheel stops.

Parking areas shall not be located within 15 feet of DOE security area equivalent to or more restrictive than Protected Areas as specified by the DOE 5632 series. Location of parking areas near security areas must take into account the possible interference with intrusion detection sensor fields and tactical response team activities.

Positive drainage shall be provided for parking area pavements. They shall:

- Provide positive surface drainage with a 1 percent minimum slope in the direction of drainage
- Limit slope in direction of parking to 4 percent maximum
- Limit slope perpendicular to direction of parking and slope of parking lot drives to 6 percent maximum for bituminous or concrete surfaces and 3 percent for other surfaces

0250-5 PAVEMENTS

0250-5.1 Flexible Pavements

Design and details of construction of flexible pavements shall comply with the local State highway department standards. Concrete valley drains can be provided if swales are necessary within flexible pavements.

0250-5.2 Rigid Pavements

Design and details of construction of rigid pavements shall comply with the local State highway department standards. Joint patterns shall be provided for all rigid pavements. The edge of rigid pavements where future construction will occur shall be a thickened edge. The joint pattern shall provide vertical control information for the layout of paving forms.

0250-6 TRAFFIC CONTROL

Signs, pavement markings, and channelization shall comply with ANSI D6.1.

0256 AIRPORTS AND HELIPORTS

0256-1 GENERAL

Planning and design of aviation facilities and the airspace clearances shall comply with FAA AC 150/5050-5.

Planning and design of aviation facilities shall emphasize safety for all modes of aircraft operations. Aircraft installations require permanent unobstructed airspace and facilities and equipment constructed to facilitate maintenance, ground handling, and flight operations.

Planning studies of aviation facilities shall be based on consideration of existing facilities and conditions. Principles and criteria of airfield general site plans are contained in FAA AC 150/5300-2D and FAA AC 150/5390-2.

Landing and takeoff paths (traffic patterns) shall be oriented in such a manner as to preclude requiring critical facility overflights. Traffic pattern altitudes shall be established and published to provide for aircraft operations on approaches that are away from critical facilities.

Heliports shall be sited and traffic patterns shall be established to provide for normal operation that does not require overflights of critical facilities. Heliports shall not be located closer to critical facilities than 2 times the dimension of the landing pad or 3 times the rotor diameter of the largest helicopter authorized to land at the heliport.

0256-2 SITE CONDITIONS

The following site conditions shall be considered to determine the adequacy of the aviation facility:

- Topography
- Vegetative cover and existing construction
- Weather elements
- Prevailing wind direction for both summer and winter conditions
- Soil conditions
- Flood hazards
- Natural and man-made obstructions
- Adjacent land uses
- Availability of usable airspace
- Accessibility of roads
- Location of site utilities
- Capability for future expansion
- Aboveground utilities

Site selection for a new airfield or heliport or plans for expansions of existing facilities shall comply with FAA AC 150/5300-2D and FAA AC 150/5390-2

0256-3 AIRCRAFT CHARACTERISTICS

The design of aviation facilities shall be based on consideration of relevant aircraft characteristics contained in FAA AC 150/5325-5B.

0256-4 AIRCRAFT NOISE

Aircraft noise shall be considered in conformance with FAA AC 1S0/5020-1.

0256-5 AIRFIELD LAYOUT

The layout of airfield facilities shall support operational efficiency and provide safe conditions for takeoff and landing operations and ground handling of aircraft. Airfield layout shall also include:

- Wind direction and velocity analyzed in accordance with FAA AC 150/5070-6A
- A taxiway system
- Parking aprons
- Supporting facilities

0256-6 AIRFIELD SAFETY CLEARANCES

Airfield safely clearances shall comply with clearance criteria and the criteria for determining obstructions to air navigation in FAA AC 150/5300-4B and FAA AC 150/5300-12.

The critical decision point and emergency landing areas for the various aircraft using a facility shall be determined from the respective aircraft performance charts.

0256-7 FIRE AND RESCUE FACILITIES

Fire station facilities shall comply with FAA AC 150/5210-6C and NFPA 403.

0256-8 DRAINAGE

Airport drainage systems shall comply with FAA AC 15/5320-5B.

0256-9 PAVEMENTS

Airfield pavements shall be designed in accordance with FAA AC 150/5320-6(2

0256-10 PAVEMENT MARKINGS

The marking of paved areas at airport and heliports shall comply with FAA AC 150/5340-1E.

0256-11 STORAGE FACILITIES FOR PETROLEUM OIL AND LUBRICANTS

Storage of petroleum, oil, and lubricants shall comply with NFPA 407. See Section 0275-4, Control of Pollution from Other Sources.

0260 PIPED UTILITY MATERIALS

0260-1 COVERAGE

This section covers exterior utilities such as water mains, water storage facilities, and gas piping.

0260-2 EXTERIOR UTILITIES

Exterior utilities are defined as those that are more than 5 feet from any building exterior.

The design of exterior utilities shall consider possible future extensions of the utility. Any site development plans for the area shall be consulted. In general, if expansion is planned, utilities should be extended to the edge of the site or to a point where connection can be made without damage or disruption to existing facilities. Utility corridors shall be established that give each utility a defined location within the corridor.

All water mains, supplying fire protection systems, fire hydrants, etc., shall be treated as fire mains and installed in accordance with NFPA 24.

Water storage facilities shall comply with NFPA 22

Gas distribution shall comply with local codes and requirements. Fuel gas shall comply with NFPA 54. Liquified petroleum gas shall comply with NFPA 58.

Exterior utilities shall be adequately protected against corrosion, either by using resistant materials or by other protective measures. In general, it is better to use materials that are naturally resistant to corrosion in that environment. See Section 0262, Corrosion Control.

Separation of utilities from security-related equipment must be considered when planning utility installations. Special emphasis should be given to security fences and in security areas. Utilities that penetrate or pass under a security barrier through an opening of more than 96 square inches in smallest dimension shall provide the same degree of penetration delay as is required for the security barrier.

Overhead utilities must not pass between secure and nonsecure areas. Utility equipment and supports must not be located so as to conceal or aid an adversary in penetrating a security boundary. Sanitary and drain sewers that penetrate security areas must be provided with special security features if openings exceed the size limit set forth in the DOE 5632 series.

Domestic water supply lines shall comply with 40 CFR 141 and 40 CFR 142.

0262 CORROSION CONTROL

0262-1 GENERAL

This section shall apply to corrosion control design for underground steel structures and pipe, storage facilities, and other facilities where corrosive conditions can occur. Types of corrosion control are protective coatings and cathodic protection. See Section 0260, Piped Utility Materials. The design engineer shall determine whether the service of a corrosion control specialist shall be used in corrosion control design.

0262-2 CORROSION CONTROL TESTS

Water supplies shall be considered as to chemical content. Based on such analysis, protective devices and measures shall be used to prevent corrosion on the interior surfaces of ferrous water lines and other appurtenances.

Prior to construction, soil and ground-water conditions shall be considered to determine the necessity for protecting surfaces of buried pipe from external chemical and electrolytic attack.

0262-3 CATHODIC PROTECTION SYSTEMS

If buried pipelines require cathodic protection, the systems shall be installed at the same time as the piping system.

Connections at joints shall ensure electrical continuity except where insulating joints are installed. Insulating joints shall be used to electrically isolate protected sections from nonprotected sections and from neighboring metallic structures. Test stations shall be provided at sufficient intervals along the piping system to evaluate the performance of the cathodic protection system after installation. Test leads shall be terminated in test blocks housed in above-ground cast metal boxes with removable covers. These test stations shall be located in areas not exposed to traffic or grass mowers and properly identified.

The interior of steel water tanks shall be protected by cathodic protection system when the calcium content of the water is less than 18 ppm or when the calcium content is between 18 ppm and 55 ppm and the sulfate content is greater than 25 ppm.

Cathodic protection for underground flammable/combustible liquid storage tanks and piping shall comply with NFPA 30.

0266 WATER DISTRIBUTION SYSTEMS

0266-1 GENERAL

This section applies to water distribution systems for domestic (potable) and industrial (non-potable) applications. The use of dual water systems (i.e., domestic and industrial or irrigation) is subject to the approval of the cognizant DOE Facilities Engineering Group. Where dual water systems are approved for use, the location and alignment of such systems must be clearly identified by location markers placed throughout the site at intervals specified by the cognizant DOE Facilities Engineering Group. Both systems must also be clearly identified on the record drawings.

Cross-connections between domestic and industrial or irrigation distribution systems are prohibited. See Section 0260-2, Exterior Utilities, and Section 0270-1.3, System Design Considerations, for further criteria on horizontal and vertical separation of domestic water mains from other utilities.

0266-2 REGULATORY OVERVIEW

Domestic water conveyed within distribution systems that serve DOE facilities shall comply with the applicable SDWA, 40 CFR 141, 40 CFR 142 requirements and with all other State, regional and local requirements. The radionuclide content of these drinking water systems shall comply with the requirements of the directive on Radiation Protection of the Public and the Environment in the DOE 5400 series. The quality of domestic water within such distribution systems shall be protected from degradation by installation of backflow prevention assemblies, as necessary, to preclude backflow of contaminants or pollutants into the system.

0266-3 PLANNING FOR WATER DISTRIBUTION SYSTEMS

During route selection and initial planning efforts for water distribution systems, the following conditions and requirements shall be considered:

- Future population and development projections
- Anticipated demands for fully developed. conditions
- Anticipated peak domestic, industrial, fire and special water demands
- Unique conditions (e.g., research and production facility demands and operating schedules)
- Hydraulic design criteria
- Health and safety requirements
- Physical constraints (e.g., utility corridors, geologic formations and topographic features)

- Energy conservation requirements
- Environmental constraints
- Security and safeguards requirements

Distribution system layouts shall be simple and direct as possible. Where feasible, initial planning efforts shall optimize system layouts (e.g., system loop lines) to:

- Facilitate future system expansions
- Strengthen fire protection capabilities
- Minimize conflicts with other utilities
- Reduce maintenance requirements

Water distribution systems shall be included within utility master planning efforts.

0266-4 SYSTEM DESIGN CONSIDERATIONS

Domestic water distribution system mains shall be sized based on the greatest demand to be satisfied (i.e., fire demand, special requirements or the peak domestic demand). Domestic water distribution systems shall be designed to deliver the peak domestic flow of 2-1/2 times the average daily demand, plus any special demands, at a minimum residual pressure of 30 psi at ground elevation (or higher if special conditions require).

Domestic water distribution systems that also serve fire protection requirements shall be designed to satisfy fire flow requirements plus 50 percent of the average domestic requirements plus any industrial or process demands that cannot be reduced during a fire.

Each fire hydrant within the distribution system must be capable of delivering 1000 gpm at a residual pressure of not less than 10 psi. Where domestic water distribution systems are to serve internal fire protection systems (i.e., sprinklers or foamite systems), adequate residual pressures shall be maintained for proper operation of such fire protection systems.

Fire hydrant branches (from main to hydrant) shall be not less than 6 inches in diameter and no longer than 300 feet. A gate valve shall be installed within each fire hydrant branch to facilitate maintenance.

Water distribution system mains shall be located in accordance with Section 0260, Piped Utility Materials. Water mains shall have a minimum pressure rating of 150 psi. Water distribution systems shall be designed to maintain a normal operating pressure range of 40 psi to 100 psi (at ground level) in distribution mains and building service lines.

Where the gradient across the service area is such that multiple pressure zones are necessary to maintain normal operating pressures, pressure reducing valves shall be used to separate each pressure zone.

Use of pressure relief and surge relief valves shall be considered, as necessary, to preclude system damage from water hammer.

Gate valves shall be installed at maximum intervals of 5000 feet on long supply lines and at maximum intervals of 1,200 feet on main distribution loops, feeders, and all primary branches connected to these lines. Gate valves shall also be installed at selected points throughout the distribution system to provide system control over each service area. At intersections of distribution mains, one less gate valve than the total number of intersecting mains shall be provided.

Fire hydrants shall be installed at a maximum spacing of 400 feet. Fire hydrants shall not be located more than 300 feet from the buildings to be protected. Each building shall be protected by a minimum of two hydrants.

Air release and vacuum valves shall be installed, as necessary, at high points within the distribution system and in long supply mains.

Distribution system mains shall have a minimum depth of cover of 2-1/2 feet. Additional cover shall be provided to prevent freezing in cold climates, at roadway crossings in high traffic areas, and at railroad crossings.

Building service lines shall be a minimum of l-inch in diameter. Service lines less than 2 inches in diameter shall be connected to the distribution main by a corporation stop and a copper gooseneck, with a service stop below frostline. Service lines larger than 2 inches in diameter shall be connected to the distribution main by a rigid connection and shall have a gate valve located below frostline. Risers from frostline to floorlines of buildings shall be adequately insulated.

Site soil and groundwater conditions (e.g., soil corrosivity) shall be considered during the selection of distribution system pipe and pipe joint materials. Where ferrous pipe is installed within the distribution system, insulating couplings shall be installed to preclude galvanic corrosion. See Section 0262, Corrosion Control, for further criteria.

0267 INDUSTRIAL WATER TREATMENT

0267-1 GENERAL

This section applies to treatment of water to be used in industrial processes. Complete chemical analyses of potential water sources shall be acquired prior to selection of industrial water treatment processes. The applicability of internal (introduction of chemical additives) or external (physical and chemical systems) industrial water treatment processes shall be considered. The recommended process shall be capable of consistently providing the minimum degree of treatment for the particular industrial application at minimal costs over the life of the system. Operational reliability, capital cost, and annual operation and maintenance costs shall be considered.

The following conditions and requirements shall be considered during the selection of industrial water treatment processes:

- Industrial use process requirements
- Water supply characteristics
- Water quality requirements
- Volume and rate of water use
- Volume, rate and character of treatment process waste products
- Energy conservation requirements
- Special siting requirements

0267-2 WASTE PRODUCTS

Waste products such as sludges and brine solutions generated by external water treatment processes shall not be disposed of in a manner that will adversely impact surface water, groundwater, or other environmental resources. See Section 0275, Industrial Wastewater Treatment, and Section 0285, Solid Waste Systems.

0267-3 REFERENCES

The selection and design of industrial water treatment processes should reflect practices as applicable in one or more of the following references:

- Drew Chemical, Principles of Industrial Water Treatment
- AWWA Water Treatment Plant Design
- Nordell, Water Treatment for Industrial and Other Uses
- Powell, Water Conditioning for Industry
- Drew Chemical, Ameroid Engineer's Manual of Marine Boiler and Feed Water Treatment
- NASA NHB 7320.1B

0270 SANITARY WASTEWATER COLLECTION AND STORMWATER MANAGEMENT SYSTEMS

0270-1 SANITARY WASTEWATER COLLECTION SYSTEMS

0270-1.1 General

This section applies to sanitary wastewater collection systems (i.e., liftstations, force mains, collector sewers and interceptor sewers) and building sewers (5 feet beyond the building foundation).

0270-1.2 System Layout

Wastewater collection system layouts shall be as simple and direct as possible. Where feasible, initial planning efforts shall optimize system layouts to facilitate future system expansions, to mitigate conflicts with other utility systems, and to reduce maintenance requirements.

Wastewater collection systems shall be included within utility master planning efforts.

The following conditions and requirements shall be considered during route selection for new collection systems:

- Future population and development projections
- Anticipated flowrates for fully developed conditions
- Physical constraints (e.g., utility corridors, geologic formations and topographic features)
- Hydraulic design criteria
- Unique conditions (e.g., research and production facility operating schedules)
- Security boundaries and requirements

0270-1.3 System Design Considerations

Industrial wastewater and pollutants above EPA minimal concentrations shall be excluded from sanitary wastewater collection systems except where pretreatment systems suitably remove pollutant constituents cost effectively.

Hydraulic design of wastewater collection systems shall comply with TM 5-814-1, TM 5-814-2, and ASCE 37. All wastewater collection systems shall be designed for gravity flow unless such systems are not economically feasible. Sewage liftstations and force mains shall not be used unless approved by the cognizant DOE authority. Feasibility analyses and economic evaluations of liftstation and force main costs for construction, operation, and maintenance shall be prepared and submitted to the cognizant DOE authority for approval. Sewers and force mains shall be sized to accommodate the estimated daily minimum and maximum

discharges for the initial and final years of the design period specified by the cognizant DOE Facilities Engineering Group.

In accordance with ASCE 37:

- Velocities in gravity sewers and force mains shall not exceed 10 feet per second.
- Gravity sewers shall be designed for a minimum velocity of 2 feet per second.
- Force mains shall be designed for a minimum velocity of 3.5 feet per second.

For preliminary design, domestic water consumption rates shall be used to approximate wastewater flowrates. Where possible, actual flow data from an adjacent service area typical of the service area under consideration shall be used to estimate wastewater flowrates for final design. In the absence of such data, metered water use less the estimated consumptive use (i.e., water withdrawal rate) can be used.

Sewers and force mains shall have a minimum depth of cover of 2 feet. Additional cover shall be provided to prevent freezing in cold climates and at roadway crossings in high traffic areas.

Sewer or force main trench widths shall be minimized; however, excavations, trenching, and shoring shall comply with 29 CFR 1926, Subpart P. Pipe bedding specified by the pipe manufacturer shall be in place prior to installation of sewers and force mains.

Sewers or force mains shall not be routed within 50 feet (75 feet in pervious soils) of any well or reservoir that serves as a potable water supply. The sewer or force main shall be ductile iron pipe in all instances where such horizontal separation cannot be maintained. Where there is a shallow depth to groundwater, special precautions shall be taken to preclude sewer infiltration or exfiltration.

Where feasible, sewers or force mains shall not be routed within 10 feet of potable waterlines or firelines.

Where potable waterlines must cross sewers or force mains, waterlines shall pass 2 feet above the sewer or force main. Where insufficient cover precludes such vertical separation, the sewer or force main shall be ductile iron pipe or shall be fully encased in concrete for a minimum distance of 10 feet to each side of the waterline crossing. Where feasible, sewer or force main pipe joints shall not be located within 3 feet of such crossings, unless the joint is encased in concrete.

Where feasible, sewers and force mains shall not be routed under buildings or other permanent structures. Sewers and force mains shall be adjacent and parallel to paved roadways. Sewers and force mains shall not pass beneath paved roadways except at roadway crossings. Where feasible, utility cuts within existing roadway pavements shall be perpendicular to the roadway centerline to minimize trench length. Diagonal roadway cuts shall be avoided where possible.

Sewers or force mains that penetrate or pass under a security barrier through an opening of more than 96 square inches in area and over 6 inches in smallest dimension shall provide the same degree of penetration delay as is required for the security barrier.

0270-1.4 Pipe Materials and Pine Joints

The selection of sewer and force main pipe material shall be based on wastewater characteristics and soil conditions. PVC shall be considered where treeroot and infiltration are a problem. Ductile iron pipe shall be used for force main and gravity sewer stream crossings. Ductile iron pipe shall also be used for inverted siphons and for sewers located in parking lots or other high traffic areas.

Pipe joints shall have a permanent watertight seal. Maximum infiltration-exfiltration allowances and infiltration-exfiltration test requirements shall be specified within the contract documents.

0270-2 STORMWATER MANAGEMENT SYSTEMS

0270-2.1 General

Stormwater management Systems shall be cost effective and shall provide flood protection commensurate with the value and operational requirements of the facilities to be protected.

The following conditions and requirements shall be considered prior to stormwater management system design:

- Local regulations
- Site topography
- Ultimate development within the drainage area
- Requirements for future expansion
- Outfall locations
- Existing drainage systems
- Location of other utilities
- Security boundary and safeguard requirements

In accordance with the CWA as amended by the WQA of 1987, the NPDES Permit Regulations require control of point source stormwater discharge.

Stormwater management systems shall be designed for not less than the 25-year, 6-hour storm. The potential effect of larger storms (up to the 100-year, 6-hour storm) shall also be considered. With the approval of the cognizant DOE authority, lesser design storms may be used where a large expenditures for flood protection cannot be economically justified.

Within fully developed watersheds, where the downstream capacity of existing flood control structures has been exceeded, stormwater runoff that results from developed conditions shall be detained on site (ponded) and gradually released such that the capacities of the downstream channels and other control structures are not exceeded and soil erosion is mitigated.

Storm drains that penetrate or pass under a security barrier through an opening of more than 96 square inches in area and over 6 inches in smallest dimension shall provide the same degree of penetration delay as is required for the security barrier. See Section 0280-1, Fencing, for requirements for ditches or culverts that pass beneath permanent security fence.

0270-2.2 Hydrology

0270-2.2.1 General

The following criteria shall be assessed during the performance of hydrologic analyses:

- The character and applicability of available stream gauge data
- The cost (in dollars) of drainage improvements in comparison to the value (in dollars) of facilities to be protected

The following site-specific information shall be assembled for use in hydrologic computations:

- Geographic location
- Precipitation frequency data
- Drainage area
- Soil and cover
- Runoff distribution

Rainfall intensity-duration curves based on historic record should be developed and used for each locale.

Peak discharge and runoff volume estimates shall be based on available information. Peak discharge flood formulae shall only be used for preliminary analyses. Inflow flood hydrography shall be derived for use in design.

The design flood shall be based on a study of precipitation frquency, runoff potential, and runoff distribution relative to physical characteristics of the watershed.

Where available, stream gauge data shall be used to estimate design flows in major channels. Where stream gauge data is inadequate or unavailable, rainfall information shall be taken from documented sources, such as NOAA/U.S. Weather Bureau Technical Paper No. 40. In

all instances, design storm precipitation values taken from documented sources or derived by published standard engineering methods shall be used to estimate design flood discharges.

In accordance with ASCE 37, use of the Rational Method, Q = CiA, shall be restricted to estimation of runoff from small urban and developed areas. The Rational Method shall not be used for drainage areas in excess of 160 acres.

For large drainage areas, criteria presented within SCS National Engineering Handbook, Section 4, Hydrology, shall be used to determine runoff rates. Regional frquency analyses shall be used on large catchments where the period of record is long and the basins are closely related.

0270-2.2.2 Geologic, Geographic, and Topographic Factors

Design flood discharge estimates shall be based on the following:

- Variation in flood potential due to differences in geology, topography, and moisture sources
- Surface runoff originating from rainfall, snowmelt, or both
- Topographic features that influence precipitation amounts
- Geologic formations that induce high flood discharges
- Geologic features that reduce flood potential

0270-2.2.3 Precipitation Frequency

For further guidance on precipitation frequency data, the design professional should consult the following references:

- NOAA Atlas 2 (applicable to the mountainous regions of the 11 contiguous states west of approximately long. 103°W)
- NOAA/National Weather Service Technical Paper No. 40 (applicable to those states not covered within the preceding reference)

Where available, local precipitation data shall be used in lieu of regional data for site-specific hydrologic computations.

0270-2.2.4 Soil and Cover

The effects of watershed soil type and vegetative cover on runoff potential shall be considered where precipitation and runoff data are available. If such data are not available, comparisons with similar watersheds shall be made. The methods used for estimating runoff from soil and cover data shall comply with SCS National Engineering Handbook, Section 4, Hydrology.

0270-2.2.5 Runoff Distribution

Unit-hydrography shall be used to derive flood estimates.

0270-2.3 Flood Routing

Flood routing methods shall be used to derive design flood discharge rates at locations where drainage structures are proposed within the watershed. Reservoir, channel, or unit-hydrograph routing methods shall be used where appropriate. The use of computer programs to expedite computations is encouraged.

0270-2.4 Hydraulics

0270-2.4.1 Storm Sewers

Subsurface drainage systems shall be sized to accommodate runoff from the 25-year, 6-hour storm. Subsurface drainage systems shall be sized for a greater storm in locations where there is substantial risk to critical facilities and operations. Sediment transport requirements shall be incorporated within subsurface drainage system designs. Storm sewers shall be designed to maintain adequate scour velocities. New storm sewers shall be sized for open channel flow. The minimum storm sewer size shall be 12 inches. The minimum culvert size shall be 15 inches. For roof drain systems, the minimum pipe size for laterals and collectors shall be 4 inches.

0270-2.4.2 Open Channels

Open-channel stormwater conveyance systems shall be sized to accommodate the 25-year, 6-hour design flow with a minimum freeboard. Open-channel drainage systems shall be sized for a greater storm in locations where there is substantial risk to critical facilities and operations.

Open-channel stormwater conveyance systems shall be designed for minimal maintenance. The potential for scour or deposition within earth-lined channels shall be considered prior to approval by the cognizant DOE authority. Preference for earth-lined or hard-lined channels shall be based on a comparison of capital, maintenance and operation costs.

Inlets to open-channel stormwater conveyance systems shall be placed at locations where erosion potential is minimal.

0270-2.5 Street Drainage

Street drainage in developed areas shall be conveyed within the roadway cross section. Curb inlets shall be used to divert stormflows to surface and subsurface stormwater conveyance systems. Curb inlets shall not be located within curb returns or in areas of heavy pedestrian traffic. Pedestrian and cyclist safety shall be considered during selection of storm inlet grates. Curb gaps shall be used where roadside drainage swales exist.

In loations where uninterrupted vehicular access is essential to critical operational activities, roadway cross sections shall be designed to convey runoff from the 25-year, 6-hour storm such that one driving lane width (12 feet) is free of flowing or standing water. Stormwater

management systems shall have sufficient capacity to ensure that runoff from the 100-year, 6-hour design storm will not exceed a depth of 0.87 feet at any point within the street right-of-way or extend more than 0.2 feet above the top of curb in urban streets. Inverted crown roadway cross sections shall not be used unless approved by the cognizant DOE authority.

0273 WATER POLLUTION CONTROLS

0273-1 GENERAL

Treatment and disposal of sanitary wastewater and wastewater sludges shall comply with the CWA, the FWPCA, the SDWA, and other applicable Federal, State, regional, and local laws and regulations. Treatment and disposal of sanitary wastewater sludges shall also comply with the Executive Directives (Executive Orders and Office of Management and Budget Circulars) identified within:

- DOE 5440.1C
- DOE 5480.1B

0273-2 REGULATORY OVERVIEW

For an overview of the laws and regulations applicable to water pollution control see DOE 5400.1.

0273-3 PLANNING FOR SANITARY WASTEWATER TREATMENT AND DISPOSAL SYSTEMS

During initial planning efforts, the feasibility of discharging sanitary wastewater to other POTWs shall be considered and shall be coordinated with the operator of the POTW.

During site selection for on-site wastewater treatment and disposal facilities the following conditions and requirements shall be considered.

- Proximity to other facilities
- Natural topographic and geologic conditions
- Location of the outfall sewer relative to the receiving stream
- Adequacy for future expansion
- Health and safety requirements
- Environmental constraints

- Prevailing wind direction
- Security and safeguard requirements

To mitigate aesthetic impacts on adjacent activities and operations, wastewater treatment facilities shall be located as far as practicable from inhabited and high traffic areas; however, wastewater treatment facilities shall not be isolated to the degree that maintenance access is hindered.

Where feasible, wastewater treatment and disposal systems shall be located above the 100-year floodplain. Where topographic or other physical constraints preclude this, levees shall be provided for flood protection.

Treatment, storage and disposal facilities for hazardous and toxic wastes shall be located above the 500-year floodplain. See Section 0285-2, Site Selection, for further criteria.

0273-4 SELECTION OF SANITARY WASTEWATER TREATMENT AND DISPOSAL METHODS

New wastewater treatment and disposal facilities shall be cost effetive and energy efficient. Processes and systems shall be optimized to reduce maintenance requirements and to facilitate future modular expansions.

Industrial wastewater and toxic pollutants shall be excluded from sanitary wastewater treatment and disposal systems except where pretreatment systems suitably remove objectionable constituents cost effectively. Measures shall also be taken to exclude stormwater runoff, surface drainage and subsurface drainage from sanitary wastewater treatment and disposal systems. See Section 0275, Industrial Wastewater Treatment, for further criteria.

Treatment and disposal of radioactive wastes shall comply with DOE 5480.1B. See ANL/EES TM-264, Rev. 1, for further guidance on management of radioactive waste.

Where mandated by Federal or State regulatory agencies, seepage detection systems shall be implemented within new wastewater treatment facilities.

Conventional methods for treatment and disposal of domestic wastewater shall meet NPDES discharge limits for conventional and toxic pollutants or more stringent State, local or regional criteria. Pretreatment systems shall be implemented where non-conventional and toxic pollutants will be discharged to conventional wastewater treatment and disposal systems.

"Packaged" treatment processes shall not be used unless approved by the cognizant DOE authority. Feasibility analyses and economic evaluations of such processes shall be prepared and submitted to the cognizant DOE authority for review. These analyses shall include an assessment of operator skill level requirements, system reliability, availability of spare parts, service contract arrangements and LCC.

The potential for large-scale use of anaerobic sludge treatment processes (and associated volume reduction) for production of methane gas to be used as an energy source shall be considered.

Disposal of domestic wastewater effluent and sludge by land application methods shall be implemented where suitable site and soil conditions prevail; however, precautions shall be taken to protect water and other environmental resources where land application methods are used. Where feasible, effluent reuse applications such as landscape irrigation or groundwater recharge shall be implemented.

Groundwater and surface water monitoring programs shall be implemented to detect changes in water quality from land application methods. The initial (background) quality of surface water, and of groundwater within the saturated zone of underlying aquifers, shall be established prior to start-up of land application operations. Air quality monitoring shall also be provided where aerosols are created by land application processes.

On-site wastewater treatment and disposal systems (i.e., septic tanks and drain fields) shall be used in remote locations where wastewater characteristics, site constraints, soil conditions are such that NPDES discharge limits can be consistently met.

Approval of selected treatment and disposal methods shall be obtained from the cognizant DOE authority.

The selection of sanitary wastewater treatment and disposal systems shall be in accordance with the following:

- EPA 430/9-75-002
- EPA 625/1-77-009
- EPA Project #17090
- EPA 625/1-80-012
- EPA Project #17090
- WPCF MOP/8 CTG-77

0273-99 SPECIAL FACILITIES

0273-99.0 Nonreactor Nuclear Facilities-General

There shall be no interconnections among storm water systems, the sanitary waste system and radioactive or other hazardous material handling systems or areas. Maintaining separation such as accomplished by separate trenches is acceptable; however, all crossings, parallel runs, and separation distances shall comply with the UPC. Installations shall be in compliance with the UPC and ASCE 37. The sanitary waste system at each facility shall be monitored or sampled and analyzed (e.g., alpha emitters) for radioactivity unless the site

sanitary treatment system is monitored. In addition, there shall be no interconnections between the potable water system, the sanitary waste system, and process systems.

0275 INDUSTRIAL WASTEWATER TREATMENT

0275-1 GENERAL

Industrial wastewater and pollutants above EPA minimal concentrations shall be excluded from sanitary wastewater treatment and disposal systems except where pretreatment systems suitably remove pollution constituents cost effectively. See Section 0275-99, Special Facilities, and Section 1300-8, Waste Management, regarding treatment and disposal of radioactive wastes.

Treatment and disposal of industrial wastewater shall be in compliance with the CWA, the FWPCA, the SDWA, the RCRA, the TSCA, and other applicable Federal, State, regional, and local laws and regulations. Treatment and disposal of industrial wastewater shall also comply with the Executive Directives (Executive Orders and Office of Management and Budget Circulars) identified within:

- DOE 5400.1
- DOE 5440.1C
- DOE 5480.1B
- DOE 5820.2A

0275-2 REGULATORY OVERVIEW

For an overview of the laws and regulations applicable to industrial water pollution control see ANL/EES TM-264, Rev. 1.

0275-3 PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT AND DISPOSAL SYSTEMS

0275-3.1 General

Planning efforts shall consider cost-effective methods for protecting surface water, groundwater and environmental resources.

0275-3.2 Alternative Production Flow Control Methods

Where feasible, production flow methods that conserve water shall be implemented within new production and manufacturing facilities to reduce the volume of industrial wastewater. Planning and production method decisions shall be based on:

- Waste stream characteristic
- Waste treatment costs
- Manpower requirements

0275-3.4 Recycle/Recovery and Alternative Waste Treatment Techniques

Where feasible, recycle and recovery systems shall be implemented within industrial waste streams to conserve energy and resources. Alternative waste treatment techniques sh considered for potential cost and energy savings. During evaluations of alternative waste treatment techniques the following shall be considered:

- LCC
- Simplicity of facility operations
- Compatibility with other site operations
- Environment impacts
- Sludge generation and disposal methods

0275-3.4 Disposal of Solids

The need for additional treatment of solids generated during industrial wastewater treatment shall be considered where sludge toxicity and volubility preclude disposal at sanitary landfills.

Solids generated by industrial wastewater treatment processes shall be disposed of in a manner that will not adversely impact surface water, groundwater or other environmental resources.

0275-4 CONTROL OF POLLUTION FROM OTHER SOURCES

Precautions shall be taken to prevent contamination of surface water, groundwater, soil, or other environmental resources in the vicinity of storage or treatment tank systems for petrochemical, hazardous material and hazardous wastes. Hazardous waste tank systems shall comply with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR-264, 40 CFR 265, 40 CFR 270, and 40 CFR 271. Petrochemical and hazardous material tank systems shall comply with 40 CFR 280 and proposed 40 CFR 281.

Operational requirements for containment of spills and leaks are contained in:

- 40 CFR 122, which defines the requirement for each facility to develop and implement a SPCC plan that defines systematic methods for response to spills, leaks, or other releases and emergency situations and cleanup procedures

- 40 CFR 280.30 (draft), which requires personnel to be present during transfers of material

- 40 CFR 264.193 and 264.196, which address spill response, cleanup, and reporting requirements if a release occurs and closure requirements if migration to groundwater or surface water cannot be prevented

Structural requirements are found in:

- 40 CFR 280.30 (draft), which details requirements for spill or overfill prevention devices on new and existing tank systems

- 40 CFR 264.193, which details requirements for secondary containment on new and existing hazardous waste tank systems

- 40 CFR 264.194, which also requires use of spill prevention controls (check valves), overfill prevention controls (sensing devices, cutoffs and bypasses), and maintaining sufficient freeboard

In 40 CFR 280.20 (draft) it is required that all new tank systems (includes piping) for petrochemicals and hazardous chemicals be constructed of one of the following compositions:

- Fiberglass reinforced plastic

- Cahodically protected coated steel

- Steel and fiberglass reinforced plastic composite

- Other systems approved by the State permitting agency or the EPA

In 40 CFR 280.21 (draft) it is required that all existing tanks be upgraded to meet the same performance standards as new tanks and piping within 10 years from the effective date of the final regulations (i.e., either be constructed out of materials to prevent corrosion, install cathodic protection, or close the tank). In 40 CFR 264.192 it is required that, for new hazardous waste tank systems, the written assessment of proposed tank systems (to be performed by an independent registered engineer) shall include design standards by which the tanks and ancillary equipment are to be constructed, characteristics of the wastes, and other installation considerations. Where any external metal component comes in contact with water or soil, a list of factors affecting potential for corrosion and type and degree of required external corrosion protection is required.

For existing tanks, 40 CFR 264.191 addresses requirements for system integrity. An assessment of each tank system without secondary containment must be made by 1/12/88, including an evaluation of existing corrosion protection.

Other installation requirements for new petroleum and chemical tanks are addressed in 40 CFR 280.20 (draft) and include:

- Damage prevention during installation
- Provision of adequate space for the tank and ancillary equipment and placement and compaction of backfill during excavation
- Clean, washed, non-corrosive backfill material
- Proper support and anchorage of backfilled structures
- Minimization of pipeline and conduit alignment intersection
- Pipe joints cut and deburred to provide liquid tight seals
- Swing joints/flexible connectors installed at the beginning and end of each line as well as where the line changes direction
- Cathodic protection installed according to the manufacturer's instructions and specifications
- Tanks and piping tightness tests performed after backfill is installed and before the system is placed in operation
- Certifications of compliance with these requirements submitted on the notification form to the State permitting agency

Installation requirements for new hazardous waste tanks are addressed in 40 CFR 264.192. In addition to satisfying corrosion protection requirements, these installations must include:

- Design or operational measures to protect underground components that may be adversely affected by vehicular traffic
- Design measures to ensure tank foundations will maintain the load of a full tank, to provide seismic protection, and to withstand effects of frost heave
- Proper handling procedures
- Noncorrosive, porous, homogeneous backfill around the tank and components to ensure support
- Tank and ancillary equipment tested for tightness prior to backfill, enclosure or use

A variety of repair, inspection and reporting requirements for both categories of tanks must also be followed.

For hazardous waste tank systems, groundwater monitoring may be required in some instances when leaks have occurred, but will definitely be required under 40 CFR 264.197 and 40 CFR 265.197, which contain requirements for closure and post-closure care.

Groundwater monitoring is one method of implementing the monitoring and release detection requirement (40 CFR 280.41, draft) for petroleum and hazardous materials tanks. Groundwater monitoring is also a requirement for closure and post-closure care and corrective actions for petroleum and hazardous materials tanks per 40 CFR 280 Subparts F, G, and H.

Construction of tanks and tank systems must also meet DOE requirements and State or EPA permitting requirements.

0275-5 SELECTION OF INDUSTRIAL WASTEWATER TREATMENT AND DISPOSAL METHODS

Approval of treatment and disposal methods must be obtained from the State permitting agency and the EPA. Methods for treatment and disposal of industrial wastewater shall comply with HES Recommended Standards for Sewage Works (Ten States Standards).

0275-99 SPECIAL FACILITIES

0275-99.0 Nonreactor Nuclear Facilities-General

0275-99.0.1 Industrial Wastes

Industrial wastes such as discharge from mop sinks, overflow from positive pressure circulating waste systems, and process steam condensate shall be collected and transferred to a liquid waste treatment plant or similar treatment area. Provisions shall be made for the continuous monitoring and recording of radioactivity, flow volume, pH, and other parameters required for material control and proper waste treatment operations while each volume of waste is being received by the plant. The radioactivity monitor shall have an alarm that annunciates locally as well as in an occupied area where corrective action can be initiated. The use of retention systems shall be considered.

0275-99.0.2 Process wastes

Liquid process wastes containing radioactive or other hazardous material shall be collected and monitored near the source of generation before batch transfer through appropriate pipelines or tank transfer to a liquid waste treatment plant or area. These wastes shall be individually collected at that facility in storage tanks that are equipped with stirrers or other accepted means of mixing, sampling and volume measuring devices, and transfer systems. Waste storage tanks and transfer lines shall be designed and constructed so that any leakage shall be detected and contained before it reaches the environment. Radiation, liquid level, or conductivity detectors shall be provided in collection systems. Transfer lines shall have inspection and collection pits at practical intervals into which leakage can drain by gravity. Double-walled transfer pipelines or multi-pipe encasements shall be used for high-level radioactive liquid wastes and other equally hazardous nonradioactive liquid wastes as defined by safety analysis. Provisions shall be made for the collection, transfer, and disposal of infiltration into the annulus of double-walled pipelines and for the collection, transfer, and storage (as appropriate) of leakage from the pipe of double-walled transfer pipelines.

Nuclear criticality safety shall be considered in the design of liquid radioactive waste processing systems.

Radioactive waste collection, transfer, and storage systems shall be such as to avoid the dilution of radioactive waste by waste of lower level radioactivity or other waste. This may require the provision of multiple and parallel systems. Systems that involve the possible dilution of radioactive waste shall only be used with the concurrence of the sponsoring DOE program office.

0275-99.0.3 Nonradioactive Liquid Effluents

For nonradioactive effluents, the point of release shall be considered the point at which the effluent exits the pipe, etc.

0276 CONSTRUCTION IN FLOODPLAINS OR ON WETLANDS

Executive Order 11988 and Executive Order 11990 mandate that Federal agencies avoid development, modification or occupancy of floodplains and wetlands where practical alternatives exist.

DOE responsibilities with respect to compliance with Executive order 11988 and Executive Order 11990 are covered in 10 CFR 1022, which includes

- DOE policy regarding inclusion of floodplain and wetland factors within planning and decisionmaking
- DOE procedures for the identification of proposed actions located in floodplain and wetlands, providing for early public review of such actions, preparing floodplain and wetlands assessments, and issuing statements of finding for such actions in a floodplain

To the extent possible, DOE shall accommodate the requirements of Executive Order 11988 and Executive Order 11990 through applicable DOE 5440.1C procedures.

DOE shall exercise leadership and take action to:

- Avoid to the extent possible the long-term and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands, and avoid direct and indirect support of floodplain and wetlands development wherever there is a practicable alternative
- Incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision-making processes
- Undertake a careful consideration of the potential impacts of any DOE action taken in a floodplain and any new construction undertaken by DOE in wetlands not located in a floodplain

- Identify, consider, and, as appropriate, implement alternative actions to avoid or mitigate adverse floodplain and wetlands impacts
- Provide opportunity for early public review of any plans or proposals for actions in floodplains or new construction in wetlands

Construction in floodplains or on wetlands shall comply with the following:

- 10 CFR 1022
- NEPA and implementing regulations

0278 POWER AND LIGHTING

The design professional shall coordinate site power and lighting as follows:

- See Section 1605, Basic Electrical Materials and Methods, for cable trenches and power wiring requirements.
- See Section 1620, Power Generation, for emergency power requirements.
- See Section 1630, Exterior Electrical Utility Service, for substations and switching stations requirements.
- See Section 1640, Interior Electrical Systems, for underground duct and primary power requirements.
- See Section 1650, Exterior Lighting, for exterior lighting requirements.
- See Section 1660, Special Systems, for power supply and lightning protection requirements.
- Security lighting requirements shall comply with the DOE 5632 series.

0279 EXTERIOR COMMUNICATIONS AND ALARM SYSTEMS

The design professional shall coordinate exterior communications and alarm systems as follows:

- See Section 1595-10, Energy Management Systems
- Intrusion alarm and fire alarm systems shall comply with the DOE 5632 series, Section 1670, Exterior Communications and Alarm Systems, NFPA 72A, NFPA 72B, NFPA 72C, NFPA 72D, NFPA 72E, NFPA 72F, NFPA 72G, and NFPA 72H.

- Security alarm systems shall comply with Section 1671, Interior Communications and Alarm Systems, and the DOE 5632 series.

0280 SITE IMPROVEMENTS

0280-1 FENCING

Fencing shall be limited to that required for safety, physical security, and activity control. In each case the most economical type of fence that will satisfy the particular functional or security requirement shall be selected. Fencing shall be grounded around substations, fuel storage areas, and other hazardous areas.

Chain link fabric shall be used for the security of restricted areas. Wood fencing can be used when nonmagnetic requirements are established and to bar vision into limited personnel access areas. Fencing should be at least 8 feet high. Solid fencing, which can increase guard requirements, shall be used judiciously.

Woven wire fencing shall be at least 4'-6" high and should be limited to railway and highway rights-of-way where roaming animals must be kept out.

Barbed wire fencing can be used for boundaries of open, undeveloped areas only.

Snow fencing should be used to prevent snow from drifting in access areas. When extreme wind and snow conditions prevail, special designs can be used as required.

Areas under security fencing subject to water flow, such as bridges, culverts, ditches and swales, shall be blocked with wire or steel bars with adequate provision for the passage of flood flows, such that the area provides a penetration delay equal to that required for the security fence. Depressions where water flow is not a problem should be covered by additional fencing suspended from the lower rail of the main fencing. Weed control may justify paving the area beneath fences.

0280-2 OTHER SITE IMPROVEMENTS

Vehicular signage shall comply with ANSI D6.1.

0281 VEHICULAR AND PEDESTRIAN CIRCULATION

0281-1 GENERAL

Vehicular and pedestrian circulation facilities shall comply with the following:

- UFAS
- ANSI D6.1
- AASHT0 GU-2-73
- AASHTO GD-2-65
- AASHTO GDHS-84

Convenient and safe vehicular and pedestrian access shall be provided to all site facilities. Rapid access features shall be implemented to accommodate fire fighting equipment and emergency vehicles. See Section 0283, Physical Protection, for vehicular and pedestrian access control. See Section 0250, Paving and Surfacing, for sidewalk, roadway and parking area pavements.

0281-2 PEDESTRIAN CIRCULATION FACILITIES

0281-2.1 General

On-site pedestrian circulation facilities such as sidewalks, bus stops, loading zones, at-grade pedestrian crossings (crosswalks), and grade separation pedestrian crossings shall be provided. Features such as curb-cut and access ramps shall be provided for the physically handicapped. Curb-cut ramps shall be located adjacent to or within marked crosswalks. The specific location of curb cut ramps shall be adapted to site conditions. Curb-cut ramps shall have a minimum width of 4 feet.

Pedestrian circulation facility designs should be integrated with security and safeguard requirements at secured sites. Pedestrian circulation facilities should be located to minimize nuisance interference with IASs and other sensor fields.

O281-2.2 At-Grade Pedestrian Crossings

At-grade pedestrian crossings shall be located to minimize curb-to-curb walking distance at flared intersections. At intersections that are not flared or otherwise widened, crosswalks shall be placed in line with approach walks.

Use of traffic control and protective devices shall be considered in heavy pedestrian-vehicular traffic areas to facilitate pedestrian traffic movement. The types of traffic control and protective devices that shall be considered for such applications include the following:

- Crosswalk markings (visible by day and by night)

- Street lighting at crosswalks
- Pedestrian refuge islands
- Pedestrian signals with "Walk" and "Don't Walk" indicators
- Pedestrian-vehicular barriers between sidewalks and traffic lanes
- Median barriers, fences, or plantings along divided highways (to discourage pedestrians from crossing at uncontrolled locations)

The following alternatives to implementation of traffic control and protective devices shall also be considered:

- Pedestrian subways or overcrossings
- Conversion of two-way street operation to one-way operation
- Elimination of turns
- Elimination of some crosswalks

0281-2.3 Pedestrian Grade Separation Crossings

Implementation of pedestrian grade separation crossings shall be considered where heavy peak pedestrian movements coincide with moderate-to-heavy vehicular traffic volume, or where abnormal hazards or inconvenience to pedestrians would otherwise result. Pedestrian subways or overcrossing structures shall comply with AASHTO GDHS-84.

All pedestrian subways or overcrossings shall be designed to accommodate the physically handicapped.

0281-3 VEHICLE CIRCULATION FACILITIES

Vehicle circulation facilities shall comply with ANSI D6.l.

Vehicle circulation facility designs should be integrated with security and safeguard requirements at secured sites. Vehicle circulation facilities should be located to minimize nuisance interference with IASs and other sensor fields. Particular attention shall be given to sensors actuated by seismic or electrical field disturbances.

Vehicle circulation facilities shall be designed to provide safe and convenient access for deliveries, collections, fire protection, emergencies, maintenance, repair, and other essential services. Where feasible, internal street systems shall be designed to discourage use by through-traffic.

The following shall be considered prior to design of vehicle circulation facilities:

- Design capacity
- Design speeds
- Design vehicles
- Sight distance
- Topographic constraints
- Horizontal and vertical alignments
- Visual impacts
- Cross-section elements (e.g., pavement, cross-slope, lane widths, shoulder treatment, medians, frontage roads, sidewalks, and curb and gutter)
- Other geometric design elements (e.g., barriers, retaining walls, guardrails, traffic control devices, fencing, utilities, lighting, landscaping, drainage, erosion control, and noise and pollution control)

Speed bumps shall not be used in parking lots.

0283 PHYSICAL PROTECTION

0283-1 GENERAL

The physical protection requirements in this section are not all-inclusive. The applicability of any or all of the physical protection systems to site-specific safeguards and security requirements shall be identified within the threat analysis for each site. Application of physical protection systems to meet site safeguards and security requirements shall be documented and justified in Headquarters-approved MSSAs. Advice and technical assistance from the DOE Safeguards and Security Coordinator shall be sought. Consultant input may also be incorporated within site-specific physical protection systems.

Physical protection system designs should use a graduated approach, i.e., a greater degree of protection shall be provided for critical assets and operations.

0283-2 PHYSICAL PROTECTION PLANNING

Physical protection requirements shall be considered during site selection for new facilities. Operational reliability, capital cost, and annual operation and maintenance costs shall be considered during selection of physical protection systems. Physical protection system designs shall comply with the DOE 5632 series and shall be coordinated with the responsible security administrator or his designee. Approval of the recommended physical protection

system shall be obtained from the DOE Safeguards and Security Coordinator. These factors shall be documented in the SSSP or other corresponding planning documents.

Physical protection of critical assets and security interests shall be in accordance with the DOE 5632 series. The following reports will also be considered as guidance:

- SAND 87-1926
- SAND 87-1927
- SAND 87-1928
- NIJ Standard 0108.01
- NBS Technical Note 837

Permanent boundaries shall be used to enclose security areas except during construction or transient activities, when temporary barriers can be erected. Temporary barriers can be of any height and material that will effectively impede access to the area.

Physical protection features shall be implemented at all locations where storm sewers, drainage swales and site utilities intersect the perimeter of secured areas. Storm drainage improvements through security fences shall be designed to prevent debris from clogging stormwater inlet structures.

0283-3 PERMANENT SECURITY FENCING

0283-3.1 General

A security fence primarily serves as a legal and physical demarcation of a security area and also obstructs illegal entry Unless a security fence is regularly patrolled, under continuous observation, or equipped with an IAS supported by an assessment capability and a response force, the fence has limited additional utility.

Where continuous surveillance over the boundary of the security area is not required, a sturdy, multiple strand or chainlink fabric fence shall serve as the physical and legal barrier. A more substantial barrier shall be consideered for security areas adjacent to heavily populated civilian areas or public highways or where continuous surveillance is required over the boundary of a non-nuclear restricted area.

A double security fence shall be considered around areas that contain Category I and II special nuclear materials. The cognizant DOE Operations Office or Operating Contractor Security and Safeguards Division shall be consulted for further siting guidance.

The number of ECPs shall be limited so as to establish and maintain the level of integrity required by the cognizant DOE Operations Office for secured areas. ECPs shall be designed to provide positive security control over vehicular and pedestrian traffic that enters the secured area. ECPs shall be structurally hardened, as necessary, to meet site-specific criteria.

ECP designs shall also facilitate ingress and egress of emergency vehicles and fire protection equipment.

Where feasible, the ECP shall be placed between the IDA zone and the inner fence. This configuration provides a continuous IDA zone across the ECP during low traffic periods.

0283-3.2 Desire Considerations

0283-3.2.1 General

Where appropriate, the following requirements shall be shown on the drawings or specified within the contract documents:

- Materials (i.e., fence fabric, posts, concrete, fence anchor sills or bottom rails, tension wires, barbed wire, and outriggers)
- Grading (i.e., horizontal alignment, vertical alignment, clearance from obstructions, utility crossings, surface drainage and subsurface drainage)
- Soil stabilization (i.e., $\pm$ 3 inch maximum variation in planar surface for microwave or active infrared)
- Permanent vegetation control (i.e., herbicide along the base of fence and within a clear zone 20 feet to each side of fence or permanent pavement beneath a microwave or active infrared beam line)
- Electrical grounding
- Closures (i.e., gate sizes, types, clearances, hardware, motor operators, control systems and direction of swing)
- Barriers to impede unauthorized access to security areas (effective delay shall be documented within conceptual design report)
- IAS requirements (i.e. $\pm$ 3 inch maximum variation in planar surface for microwave or active infrared)

0283-3.2.2 Location

A clear zone shall be provided along each side of security fence perimeters to facilitate intrusion detection and assessment. Where a double fence is provided, a minimum clear zone of 20 feet shall be considered to the inside and to the outside of the inner and outer fence, respectively. Where minimum distances cannot be provided, supplementary protective measures shall be considered (i.e., greater fence height or other protective measures as required by the cognizant DOE Security Officer), Where feasible, wider clear zone shall be provided. See Section 0283-4, Patrol Roads and Walkways, for further criteria.

0283-3.2.3 Construction

Permanent security fencing for DOE sites, facilities, and security areas shall comply with the DOE 5632 series, Chapter II. However, protection programs shall be tailored to address site-specific characteristics. These shall be documented in the SSSPs and/or MSSAs.

Permanent security fencing for DOE sites, facilities, and security areas shall consist of a minimum of 11 gauge, galvanized steel fabric with mesh openings not larger than 2 inches. Fencing shall be topped by three or more strands of barbed wire on single or double outriggers. Double outriggers can be topped with coiled barbed wire (or with barbed tape coil where approved for use by the cognizant DOE Security Officer). When single barbed wire outriggers are used, they shall be angled outward, away from the security area.

Overall fence height, excluding barbed wire or barbed tape coil topping, shall be a minimum of 7 feet.

Wire-rope-type vehicle barriers shall be considered for installation outside the inner fence where the secured perimeter bounds heavy vehicular traffic areas. Guidance from SAND 87-1926 shall be considered.

Tension wires or top rail shall be considered for installation along the top edge of the fence fabric.

Posts, bracing, and other structural members shall be located on the inside of secured perimeters. Once in place, all fence hardware shall be peened or spot welded to prevent easy removal. Where the galvanized finish has been removed or damaged during installation it shall be coated with zinc-enriched paint.

0283-3.3 Fence Grounding

Electrical grounding shall be provided for all permanent security fencing in accordance with the NEC.

0283-4 PATROL ROADS AND WALKWAYS

All-weather patrol roads or walkways shall be provided along the inside of the perimeter security fence surrounding security areas in cases where the security fence will be patrolled by a security force. Turnouts shall be considered for use at frequent internals if roadway shoulders are not drivable.

One of the foIlowing materials shall be considered for use in the construction of patrol walkways:

- Compacted bank run gravel
- Stabilized soil with sand coating
- Bituminous or portland cement concrete
- Other suitable material as approved by the cognizant DOE Operations Office

In all instances, the cognizant DOE security officer shall be consulted prior to design of patrol roads and walkways. Roadway lighting shall comply with the ANSI C136 series and with the IES Lighting Handbook. See Section 1650, Exterior Lighting.

0283-5 GATES, ENTRY CONTROL POINTS, VEHICLE BARRIERS

0283-5.1 Gates

0283-5.1.1 General

Points of vehicle and pedestrian access to restricted areas shall provide the same level of physical protection as that provided at all other points along the secured perimeter. Gate hardware for security fencing shall be installed in a manner that will mitigate tampering.

Motorized gates shall be considered for primary access points. Motorized gate controls shall where practicable be located within guard stations at each access point. Motorized gates shall be designed to facilitate manual operation during power outages.

0283-5.1.2 Gate Grounding and Bonding

Electrical continuity shall be provided across all gate openings. Operating mechanisms for motorized gates shall be grounded in a similar manner.

0283-5.2 Entry Control Points

ECPs for surveillance and control of vehicle and pedestrian ingress and egress are required at each security boundary access point. The number of ECPs within each security boundary shall be minimized. ECP design features shall comply with the DOE 5632 series and NFPA 101. See Section 0283-5.3, Vehicle Barriers, for further criteria.

Primary and auxiliary alarm and communication systems shall be provided between ECPs and the tactical response force communications center.

Emergency power supplies to support ECP operation and communication systems shall comply with Section 1640-3.3, Standby or Emergency Power Systems.

A UPS shall be considered for loads that, if interrupted, would degrade the security of the associated area. The UPS system shall comply with Section 1660-3, Uninterruptible Power Systems. UL 752 or NIJ Standard 0108.01 should be considered for facilities housing UPS systems.

0283-5.3 Vehicle Barriers

Above-grade vehicle barriers shall be considered to preclude intruder concealment. Speed reducers shall be considered for use at entry control points to slow approaching adversary vehicles to within vehicle barrier design limits if needed to achieve site-specific threat/target system response requirements consistent with the operational and protection goals of the facility. SAND 87-1926 should be considered in designing vehicle barriers.

0283-6 SECURITY INSPECTOR POSTS AND GUARD TOWERS

0283-6.1 Security Inspector Posts

The location and manning of fixed and mobile posts shall be determined by considering the approved threat level, characteristics of the protected facility, terrain and environment, and the DOE 5632 series. The security inspector station shall when practicable be situated to provide the best available unobstructed view of the surrounding terrain. When planning for response times, the delay provided by physical barriers after the initial detection of the intrusion shall be considered.

Security inspector posts, both mobile and fixed for protected areas shall be equipped with duress systems.

Permanent security inspector posts constructed after the date of this Order for controlling access to areas containing weapons, nuclear test devices, complete nuclear assemblies, or Category I or Category II quantities of SNM shall meet the following requirements:

- All routine and emergency duty fixed posts shall be located so that the efficiency of routine duties is enhanced and likely routes of adversary ingress and egress are clearly observable.

- All routine and emergency duty fixed posts shall provide adequate human engineering so that protective personnel occupying the posts can perform their duties efficiently. All routine-duty fixed posts shall provide occupants with adequate protection from weather and temperature variations.

- Exterior walls, windows, and doors shall be constructed of or reinforced with materials which have a bullet penetration resistance equivalent to "high-powered rifle rating" as given in UL 752.

- Weapons, ammunition, and explosives shall be stored in accordance with the requirements of DOE 5632.7.

0283-6.2 Guard Towers

In guard towers that are intended to serve as fighting positions in alert conditions, consideration shall be given to protected firing ports, a minimum of 60 square feet of net floor area per person, and exterior walls conforming with NIJ Standard 0108.01

0283-7 LIGHTING

Protective lighting shall be coordinated with the cognizant DOE security personnel.

Adequate protective illumination shall be provided to detect adversaries, reveal unauthorized persons, and, at pedestrian and vehicular entrances, to allow examination of credentials and vehicles.

Protective lighting, as part of a security system, should be used as needed for proper physical protection of classified matter.

Lamps in which light is produced directly or indirectly by the use of gas, such as sodium vapor and other HID lamps, are highly efficient and economical in operation, and their use in protective lighting systems is encouraged. However, it should be recognized that gas lights require a relight period of approximately 3 minutes following any power interruption.

Where HID lamps are used and where continuous lighting is required, a standby lighting system shall be considered to ensure the maintenance of minimum protective lighting during HID lamp start-up and restrike periods. Fixtures adjacent to each other shall when practical and appropriate be placed on different circuits so that only a portion of the lighting is extinguished if one circuit becomes inoperative. (See Section 1650-2, Lighting Sources, for use of HID lamps near observatories.)

Lighting installed at security posts shall be capable of providing a minimum illumination of 2 footcandles at ground level for at least a 30-foot diameter circle around the security inspector post and 0.2 footcandle for 150 feet in all directions.

For facilities requiring protective lighting, consideration shall be given to having an emergency lighting capability of the type and size required in relation to the importance of the facility, reliability of regular power sources, and feasibility of using portable lighting equipment.

Where protective lighting at remote perimeters is not feasible, protective force patrols and freed stations may be equipped with night vision devices, although it should be recognized that adequate perimeter lighting provides better protection and deterrence to intrusion than do night vision devices. Night vision devices shall not be used in lieu of protective lighting at ingress and egress points.

Light glare shall be kept to a minimum where it would impede effective operations of protective force personnel.

Light sources on perimeters shall be so located that illumination is directed, whenever possible, outward. There should be relative darkness along patrol routes and at freed posts other than pedestrian and vehicular entrances.

0285 SOLID WASTE SYSTEMS

0285-1 REGULATORY OVERVIEW

0285-1.1 General

For an overview of the laws and regulations applicable to hazardous, nonhazardous, and radioactive solid waste see ANL/EES TM-264, Rev. 1. Management of nonhazardous solid waste shall comply with 40 CFR 256 and Subtitle D of the RCRA. Management of hazardous solid waste shall comply with 40 CFR 264 and Subtitle C of the RCRA.

0285-1.2 EPA Identification Number

In accordance with the EPA notification procedure (45 FR 12746), an application for an EPA identification number must be filed with EPA for all generating and all TSD facilities for hazardous, nonhazardous, and low-level radioactive solid wastes.

0285-2 SITE SELECTION

0285-2.1 General

Site selection is the most critical step in establishing TSD facilities for hazardous, nonhazardous, and low-level radioactive solid wastes. High-level radioactive wastes (as defined by 40 CFR 260) shall be placed in a permanent repository.

The following conditions and requirements shall be considered during the selection of solid waste TSD sites:

- Existing groundwater and surface water conditions
- Soils and geologic and topographic features
- Solid waste types and quantities
- Social, geographic, and economic factors
- Aesthetic and environmental impacts

0285-2.2 Recommended Practices

0285-2.2.1 Regional Systems

Consideration shall be given to possible incorporation of hazardous, nonhazardous, and radioactive solid waste systems within other existing regional solid waste facilities.

0285-2.2.2 Environmentally Sensitive Areas

The following environmentally sensitive areas shall be avoided or receive lowest siting priority for TSD of hazardous, nonhazardous, and radioactive solid waste:

- Wetlands
- Areas within the 500-year floodplain
- Permafrost areas
- Critical habitats of endangered species
- Recharge zones of sole-source aquifers

Watersheds for domestic water supply

0285-2.2.3 Fault Zones and Karst Terrain

When potential sites are screened for location of new solid waste TSD facilities, seismic zones and karst (limestone formation) terrain shall be avoided unless site-specific evaluations demonstrate minimum potential for contamination of surface water, groundwater, and other environmental resources.

0285-2.2.4 Cost Effectiveness

LCC analysis shall be performed during site selection for TSD facilities. LCC analysis shall include site reclamation costs.

0285-2.2.5 Sites Traversed by Utilities

Sites traversed by buried pipe utility trenches shall not be used for TSD facilities unless the relocation or protection of these utilities is economically feasible. Since buried pipe utility

trenches can serve as a pathway for migration of gas, leachate, and other contaminants, provisions shall be made for pipe maintenance and repair.

0285-2.2.6 Characteristics and Availability of Soil Cover

The characteristics and availability of on-site soil cover shall be considered with respect to site operation and performance requirements, including vehicle maneuverability.

0285-2.2.7 Site Access

Sites shall be accessible to service and refuse collection vehicles by all-weather road extensions from primary road systems.

0285-2.2.8 Effects on Other Facilities

Sites that would adversely affect operation of other facilities shall be avoided.

The effects on other facilities from the following conditions attributable to operation of TSD facilities shall be considered:

- Vehicular traffic
- Noise
- Litter
- Bird strike
- Vectors (i.e., insects or rodents)
- Other nuisance conditions

0285-2.2.9 Site Approval

Final site approval for TSD facilities for hazardous, nonhazardous, and low-level radioactive wastes shall be obtained from the cognizant DOE Operations Office.

0285-3 SITE DESIGN

0285-3.1 General

All site requirements and technological alternatives shall be considered prior to final design. Site suitability for TSD of specific solid waste material shall be considered.

0285-3.2 Recommended Practices

0285-3.2.1 General

TSD facilities for hazardous, nonhazardous, and low-level radioactive wastes shall be designed, constructed, maintained, and operated to minimize the possibility of any unplanned release of hazardous wastes or the potential for fire or explosion resulting from such wastes or waste management operations.

0285-3.2.2 Types and Quantities of Solid Wastes

The types and quantities of all solid waste to be handled by the solid waste system shall be determined by survey and analysis to serve as a basis for design.

0285-3.2.3 Groundwater Resources

The following shall be considered to determine potential impacts on groundwater resources:

- Initial (background) quality of water resources in the saturated zone
- Depth to groundwater and the direction and rate of flow (including current and projected withdrawal rates by local groundwater users)
- Potential interactions of the solid waste system and its hydrogeology with areal, groundwater, and surface water resources (based on historical records and other information sources)
- Site geology (with emphasis on hydraulic conductivity and the natural attenuative capacity of soils and subsurface geology)

0285-3.2.4 Surface Water Resources

Quality, quantity, source, and seasonal variations of surface waters in the vicinity of the solid waste system shall be determined. These data shall serve as the basis for design of surface water protection and monitoring systems.

0285-3.2.5 Flood Protection

Flood protection measures (defined by the 100-year flood level or, for a "critical action," the 500-year flood level) shall comply with procedures described in WRC Bulletin No. 17A. If all or part of the facility lies within the 100-year floodplain, a suitable levee shall be provided to prevent facility inundation.

0285-3.2.6 Plans

Plans for design, construction, operation, and maintenance of new sites or modifications to existing sites shall include:

- Evidence of compliance with applicable State and Federal regulations

- Demonstrated consistent with current recommended practices or suitable alternative technologies
- Details of all design and operational considerations necessary to bring site conditions to an acceptable level
- Discussion of any areas for disposal of wastes requiring special or separate handling
- Other pertinent information, such as:
  - Land use and zoning within one-quarter mile of the site, including the location of all residences, buildings, public and private wells, water courses, rock outcropping, and roads
  - Location of all airports within 2 miles of the site
  - Location of all utilities within 500 feet of the site
  - Temporary and permanent all-weather access roads
  - Screening and other nuisance control measures
  - Groundwater monitoring wells
  - Sedimentation control plans
  - Description of site development and operation procedures
  - Contingent plans
  - Projected use of reclaimed site
  - Long-term maintenance procedures

0285-3.3 Selection of Methods

Approval of selected TSD methods shall be obtained from the cognizant DOE Operations Office. The selected method of TSD of hazardous, nonhazardous or radioactive solid waste shall be in compliance with the following:

- 40 CFR 122, 40 CFR 192, 40 CFR 240, 40 CFR 241, 40 CFR 256, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 267
- DOE 5820.2A
- RCRA, Subtitles C and D

0285-99 SPECIAL FACILITIES

0285-99.0 Nonreactor Nuclear Facilities-General

Design of special facilities shall include adequate provisions for the safe collection, packaging, inventory, storage, and loading for transport of solid waste that is contaminated with radioactive material. These provisions shall include allocation of adequate space for sorting and safe temporary storage of solid waste, equipment for assay of the waste, and facilities for volume reduction appropriate to the types and quantities of solid waste to be produced. All packages containing contaminated solid waste shall be appropriately monitored, both before being moved to temporary storage locations and before being loaded for transport to a disposal site. Nuclear criticality safety shall be considered in the design of radioactive solid waste facilities.

0290 LANDSCAPING

0290-1 GENERAL

Plantings shall be simple, functional, and economical to maintain. Plant species proven to be hardy and tolerant of the site conditions shall be selected. The species of trees selected and their location shall preclude roots from damaging underground utility lines, foundations, and adjacent surface facilities. Landscaping shall be placed so as to not interfere with maintenance and repair activities. Tall trees should not be in locations that will interfere with effluents from exhaust systems.

Landscaping should be used as an element in energy conservation design solutions for buildings, including reduction of solar radiation during cooling season, heat loss from wind, and heat loss during the heating season.

The design professional shall determine whether the services of a landscape architect shall be used in the landscaping design.

0290-2 SITE ANALYSIS

The following site factors shall be taken into account in a site analysis

- Availability and accessibility of irrigation water
- Visual factors
- Climatic data, including extreme wind
- Existing vegetation
- Soils

- Microclimate
- Hydrology, including flood-flow frequency
- Geology and seismology
- Revegetation and restoration of disturbed areas
- Topography
- Vehicle and pedestrian circulation patterns
- Noise factors
- Utilities
- Security requirements
- Maintenance requirements
- Erosion and runoff control

0290-3 DESIGN CONSIDERATIONS

0290-3.1 General

Particular emphasis shall be placed on using plants that are indigenous or adaptable to the local area of the site. Plants selected shall minimize the need for irrigation while maximizing the cooling benefits (e.g., shading windows and condensing units). The use of pavers with voids that allow absorption into permeable soils shall be considered for minimizing the problems caused by the run-off of rainwater.

Erosion control and landscaping shall be coordinated with other site development elements. Turf areas shall allow the use of conventional lawn service equipment to maintain it. Consideration will be given to the use of ground cover in areas of slope exceeding 2:1.

0290.3.2 Preservation

The cost of replacing existing vegetation shall be compared with the cost of any measures taken for preservation.

0290.3.3 Trees, Shrubs, Ground Covers, and Vines

Consideration shall be given to plant transplanting methods, techniques for moving plants, planting methods, and adaptation of plants to new locations.

0290-3.4 Turf

Climate, microclimate, and soil renditions of the site shall be considered to identify the best suited variety of turf, the most appropriate site preparation, and optimal maintenance requirements.

0291 IRRIGATION SYSTEMS

0291-1 GENERAL

Irrigation includes the development and management of the water supply, the conveyance system, the method of application, and the waste water disposal for the irrigation system. The need for irrigation systems shall be determined based on climatological data.

Consideration shall be given to the use of nonpotable water sources if cost savings can be achieved.

0291-2 LANDSCAPE IRRIGATION

In designing a sprinkler system for landscape irrigation, the following shall be considered to determine sprinkler types, sprinkler spacing patterns, and sprinkler circuit selection, and system use:

- Water requirements of different types of grass, ground cover, shrubs, and trees
- The terrain and the ability of various types of soil to absorb and hold water
- Climatic conditions

0291-3 AGRICULTURAL IRRIGATION

Agricultural irrigation methods shall comply with state irrigation guides and the appropriate chapters of Section 15 of the SCS National Engineering Handbook.

Division 3
Concrete

0300 COVERAGE

This division covers the design and construction of plain, reinforced, or prestressed concrete structures, whether of cast-in-place or precast construction. The requirements of this division shall be used in conjunction with those of Section 0111, Structural Design Requirements.

0301 GENERAL REQUIREMENTs

0301-1 BUILDINGS AND OTHER STRUCTURES

Concrete materials, design, and construction for buildings and other structures shall comply with ACI 318 and 40 CFR 249.

0301-2 HIGHWAY AND RAILWAY STRUCTURES

Concrete materials, design, and construction for highway structures shall comply with the AASHTO HB-13.

Concrete materials, design, and construction for railway structures shall comply with the AREA Manual for Railway Engineering (Fixed Properties).

0301-3 SANITARY ENGINEERING STRUCTURES

Concrete materials, design, and construction for sanitary engineering structures shall comply with ACI 350R.

0310 CONCRETE FORMWORK

Formwork for concrete construction shall comply with ACl 347 and ACI SP-4.

0320 CONCRETE REINFORCEMENT

0320-1 MATERIALS FOR REINFORCEMENT

Reinforcement materials for buildings and other structures shall comply with ACI 318; for highway structures, with the AASHTO HB-13; for railway structures, with the AREA Manual for Railway Engineering (Fixed Properties); for special facilities, with ACI 349 (see Section 0111-99.0, Nonreactor Nuclear Facilities-General).

0320-2 DETAILING OF REINFORCEMENT

Reinforcement details shall comply with ACI 352R and ACI SP-66 in addition to ACI 318 for buildings and other structures, the AASHTO HB-13 for highway structures, the AREA Manual for Railway Engineering (Fixed Properties) for railway structures.

0330 CAST-IN-PLACE CONCRETE

0330-1 COVERAGE

This section covers the selection of materials, proportioning of mixes, mixing, placing, testing, and quality control of cast-in-place concrete.

0330-2 MATERIALS, TESTING, AND QUALITY CONTROL

Materials, testing, and quality control for cast-in-place concrete shall comply with ACI 318 for buildings and other structures, with the AASHTO HB-13 for highway structures, with the AREA Manual for Railway Engineering (Fixed Properties) for railway structures, and with ACI 349 (see Section 0111-99, Special Facilities) for special facilities.

Tolerances for formed concrete shall be as suggested in ACI 347.

0330-3 SELECTING PROPORTIONS FOR CONCRETE MIXES

0330-3.1 Normal, Heavyweight, and Mass Concrete

The selection of proportions for concrete mixes for normal, heavyweight, and mass concrete shall comply with ACI 211.1.

0330-3.2 Structural Lightweight Concrete

The selection of proportions for structural lightweight concrete shall comply with ACI 211.2.

0330-4 MIXING, TRANSPORTING, AND PLACING

The mixing, transporting, and placing of cast-in-place concrete shall comply with ACI 304.

0330-5 CLIMATIC CONSIDERATIONS

0330-5.1 Hot Weather Concreting

Hot weather concreting shall comply with ACI 305R.

0330-5.2 Cold Weather Concreting

Cold weather concreting shall comply with ACI 306R.

0330-6 POST-TENSIONED CONSTRUCTION

In addition to the provisions of Section 0330-2, Materials, Testing, and Quality Control, the PTI Post-Tensioning Manual may be used for the design and construction of post-tensioned concrete structures.

0340 PRECAST CONCRETE

0340-1 COVERAGE

This section covers materials, design, and construction of precast, precast and prestressed, and precast and post-tensioned concrete structures.

0340-2 GENERAL

In addition to the provisions of Section 0301, General Requirements, precast concrete shall comply with the PCI MNL-116. PCI MNL-120 and PTI Post-Tensioning Manual may also be used as guides for the design and construction of precast concrete structures.

0350 CEMENTITIOUS DECKS FOR BUILDINGS

0350-1 COVERAGE

This section covers materials, design, and construction of cementitious decks for building structures and prefabricated floor and roof systems such as:

- Precast reinforced concrete floor systems
- Precast and prestressed concrete floor systems
- Lightweight precast reinforced concrete planks
- Lightweight precast reinforced concrete channel slabs
- Precast concrete roof units
- Reinforced gypsum planks
- Structural cement fiber roof deck systems
- Reinforced poured gypsum over formboard roof systems

0350-2 GENERAL

The materials, design, and construction of cementitious decks for buildings shall comply with the UBC and the manufacturer's recommendations.

In the event of a conflict between the UBC and the manufacturer's recommendations, the more stringent shall apply.

0370 REPAIR AND RESTORATION OF CONCRETE STRUCTURES

0370-1 COVERAGE

This section covers evaluation of damage or deterioration, selection of repair methods, surface preparation, and repair and restoration of concrete structures. The materials covered are Portland cement mortars and concretes, latex-modified portland cement mortar, epoxy mortars, epoxy concrete, or methyl methacrylate concrete.

0370-2 GENERAL

Methods, procedures, and materials for the repair and restoration of concrete structures shall comply with guidelines ACI 503.4, ACI 546.1R, the AREA Manual for Railway Engineering (Fixed Properties) and the AASHTO Manual for Bridge Maintenance.

0380 MASS CONCRETE

0380-1 COVERAGE

This section covers the selection of materials, proportioning of mixes, mixing, placing, and curing of mass concrete.

0380-2 GENERAL

The selection of materials, mix proportioning, and construction methods and procedures for mass concrete shall comply with ACI 207.1R and ACI 207.4R.

Division 4
Masonry

0400 COVERAGE

This division covers the design and construction of masonry structures other than highway and railway structures. It shall apply to unit masonry construction, reinforced and unreinforced, using cement, clay, and stone products, and including brick, block, and tile structures. The requirements of this division shall be used in conjunction with those of Section 0111, Structural Design Requirements.

0401 GENERAL

Materials, design, and construction of masonry structures shall comply with the UBC.

The following sources may also be used as guides for the design of masonry structures:

- ACI 531
- ACl 531.1
- NCMA TR 75B
- BIA Building Code Requirements for Engineered Brick Masonry

Masonry walls shall be insulated in compliance with Section 0721-1, Cavity Walls.

0410 MORTAR AND GROUT

Mortar shall be designed to perform the following functions:

- Join masonry units into an integral structure
- Create tight seals between masonry units to prevent the entry of air and moisture

- Bond with steel joint reinforcement, metal ties and anchor bolts, where used, so that they act integrally with the masonry
- Provide a desired architectural quality to exposed masonry structures through color contrasts or shadow lines from various joint-tooling procedures
- Compensate for size variations in the units by providing a bed to accommodate the tolerances of unit sizes

Grout shall be used in reinforced bad-bearing masonry construction to bond the masonry units and the reinforcing steel so that they act together to resist the imposed loads. It may also be used in unreinforced load-bearing masonry wall construction to give it added strength.

Requirements for materials, mixing, strength, and specifications for mortar and grout for masonry structures shall comply with the UBC.

0420 UNIT MASONRY

Materials, design, and construction of masonry units shall be in accordance with the requirements of Section 0401, General.

0455 REFRACTORIES

Refractories may be classified by their basic raw materials into the following groups:

- Siliceous group, including sandstone (or firestone), mica schist and siliceous fireclays
- Fireclay group, including plastic fireclay, flint fireclay, and kaolins
- High-alumina group, including bauxite and diaspore, sillimanitc, andalusite, kyanite, tabular alumina, and fused alumina
- Magnesium-silicate group, including olivines and serpentines
- Magnesia-lime group, including natural magnesite, magnesia, brucite and dolomite
- Chromite group
- Carbon group, including natural and artificial graphites and various types of coal coke and tar

Standard definition of terms relating to refractories shall comply with ASTM C71. Materials, standards, classifications, practices, and test methods for refectories shall be comply with the current ASTM Annual Book of ASTM Standards, Volume 15.01.

Design and construction of refractories shall be in accordance with the requirements of Section 0401, General.

Division 5
Metals

0500 COVERAGE

This division covers the design and construction of steel and aluminum structures. The requirements of this division shall be used in conjunction with those of 0111, Structural Design Requirements.

0512 STRUCTURAL STEEL

0512-1 BUILDINGS AND OTHER STRUCTURES

Structural steel for buildings and other structures shall comply with the following

- UBC
- AISC S326
- AISC M011

0512-2 LIGHT-GAUGE STEEL

Light-gauge steel shall comply with AISI Specifications for the Design of Cold-Formed Steel Structural Members.

0512-3 PRE-ENGINEERED METAL BUILDINGS

Pre-engineered buildings shall comply with MBMA Metal Building Systems Manual and Section 0111, Structural Design Requirements.

Where the use of the design loadings specified in Section 0111, Structural Design Requirements, would prevent procurement of pre-engineered metal buildings, consideration may be given to deviation from said loadings. Such consideration shall be based on review of the type of occupancy and functional requirements of the particular building and a

determination as to whether such deviation could be justified and permissible in accordance with Section 0101-2, Criteria Deviations.

0512-4 STEEL CABLES

Steel cables shall comply with AISI Manual for Structural Applications of Steel Cables for Buildings.

01512-5 STEEL WATER TANKS, STANDPIPES AND RESERVOIRS

Steel water tanks, standpipes and reservoirs shall comply with NFPA 22 and AWWA D100.

0512-6 FUEL STORAGE TANKS

Fuel storage tanks shall comply with API 650.

0512-7 HIGHWAY AND RAILWAY STRUCTURES

Steel highway structures shall comply with the AASHTO HB-13.

Steel railway structures shall comply with the AREA Manual for Railway Engineering (Fixed Properties).

0512-8 TRANSMISSION TOWERS

Transmission towers for electrical power lines shall comply with ASCE 52.

0512-9 ANTENNA TOWERS

Antenna towers shall comply with the NTIA Manual, Chapter 5. Towers not covered in that manual shall comply with EIA-222-D.

0512-10 TRANSMISSION POLE STRUCTURES

Transmission pole structures shall comply with ASCE 1978-1.

0512-11 ANTENNA POLES AND MASTS

Antenna poles and masts shall comply with TM 11-486-5.

0514 STRUCTURAL ALUMINUM

0514-1 HIGHWAY AND RAILWAY STRUCTURES

Aluminum used structurally for highway structures shall comply with AASHTO HB-13 and AASHTO LTS-1.

Aluminum used structurally for railway structures shall comply with the AREA Manual for Railway Engineering (Fixed Properties).

0514-2 USE WITH DISSIMILAR METALS OR CONCRETE

Aluminum shall be isolated in applications involving contact with dissimilar metals or with concrete. Isolation shall be achieved by use of coatings, paints, or separating materials.

The use of stainless steel in contact with aluminum, without isolation, is acceptable.

0521 STEEL JOISTS

Steel joist floor and roof construction shall comply with the SJI Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders.

0531 STEEL DECKS

Steel decks for floor and roof construction shall comply with the SDI-Publ. 25 and the SDI-Publ. DDM01.

0532 METAL FASTENING

Structural connections for buildings and other structures shall comply with the requirements of the UBC and AISC M011; for highway structures the requirements of AASHTO LTS-1; and for railway structures the requirements of AREA Manual for Railway Engineering (Fixed Properties).

Welding of structures shall comply with the AWS D1.1, AWS D1.2, AWS D1.3, and AWS D5.2.

Division 6
Wood and Plastics

0600 COVERAGE

This division covers the design and construction of wood and plastic structures. The requirements of this division shall be used in conjunction with those of Section 0111, Structural Design Requirements.

0610 WOOD STRUCTURES

0610-1 BUILDINGS AND OTHER STRUCTURES

Wooden buildings and other structures shall meet the requirements of the UBC.

0610-2 HIGHWAY AND RAILWAY STRUCTURES

Wooden highway structures shall meet the requirements of the AASHTO HB-13.

Wooden railway structures shall meet the requirements of the AREA Manual for Railway Engineering (Fixed Properties).

0650 PLASTIC STRUCTURES

Design, fabrication, and erection of plastic and reinforced plastic structures and structural components shall comply with ASCE Manual 63.

Division 7
Thermal and Moisture Protection

0710 WATERPROOFING

0710-1 GENERAL

0710-1.1 Use

Waterproofing shall be used at walls, floors, or other building elements that at any time are subject to hydrostatic pressure, are below the water table, or are liable to be immersed in water.

Waterproofing shall also be used at walls, floors, and other building elements to prevent water leakage from showers, built-in refrigerators and freezers, areas using water wash-down, containment areas, and other types of water basins.

Where water is to be contained, waterproofing shall extend up walls to above the expected high water level.

Where water wash-down is used, waterproofing shall extend to fully cover the expected wall areas to be washed.

Wall, floor, slab-at-grade, and other building element waterproofing shall meet base course and through-the-wall flashings, and shall make a bond with these flashings; see Section 0715, Dampproofing.

0710-1.2 Materials and Construction

Concrete waterproofing shall comply with ACI Guide to the Use of Waterproofing, Dampproofing, Protective and Decorative Barrier Systems for Concrete.

Concrete masonry waterproofing shall comply with NCMA Waterproof Coatings for Concrete Masonry and NCMA Waterproofing Concrete Masonry Basements and Earth-Sheltered Structures.

Brick masonry waterproofing shall comply with BIA Dampproofing and Waterproofing Masonry Walls.

All other waterproofing shall comply with the manufacturer's recommendations.

A single-ply elastomeric, liquid-applied elastomeric, cementitious, bentonite clay, or fiber-reinforced fabric bituminous waterproofing shall be continuously applied to those surfaces of building elements to be protected from water.
Building elements at and below grade that receive waterproofing shall be constructed of concrete with:

- A water-reducing agent
- Non-porous aggregates
- Reinforcement to control differential movement
- Reinforcement to control cracking from temperature, live loads, dead loads, and drying shrinkage
- Expansive cement or a dampproofing admixture

Building elements above grade that receive waterproofing shall be constructed of concrete as described above or masonry as follows:

- Type M mortar in accordance with ASTM C270
- Grade SW brick in accordance with ASTM C62
- Type I, Grade N concrete brick in accordance with ASTM C55
- Type I, Grade N concrete block in accordance with ASTM C90 for hollow load bearing
- Type I, Grade N concrete block in accordance with ASTM C145 for solid load bearing

Construction joints and expansion joints shall be bridged by waterstops that shall be embedded in the materials on each side of joints.

Waterproofing at or below grade shall be chemically compatible with ground water and soils.

0710-1.3 Protective Cover

Waterproofing on walls, except cementitious and bentonite clay panel waterproofing, shall have a protective cover that shall be readily removable to repair damaged waterproofing and readily replaceable.

Waterproofing on horizontal building elements to be covered with earth, except bentonite clay panel waterproofing, shall have a protective cover.

Each slab-at-grade to be waterproofed, except those waterproofed with bentonite clay panels. shall have a concrete subslab beneath it on which waterproofing shall be placed.

0710-1.4 Capillary Water Barriers

Capillary water barriers such as sand, gravel, or crushed stone courses shall be provided beneath subslabs at slabs-at-grade and over waterproofed horizontal building elements to be covered with earth except where bentonite clay panels are used.

Drainage matting or capillary water barriers such as sand, gravel, or crushed stone courses shall be provided on the exterior side of all waterproofed vertical building elements except where bentonite clay panels are used.

0710-1.5 Penetrations

Penetrations below grade through slabs-at-grade and other horizontal building elements shall be limited to drains and structural elements.

Penetrations through waterproofing above grade shall be limited to structural and other essential building elements.

Penetrating structural elements shall be sealed to waterproofing. Penetrations by building elements other than structural elements shall be within sleeves. Sleeves shall be sealed to waterproofing, and joints between sleeves and penetrating elements shall be waterstopped.

0710-1.6 Drainage and Drainage Piping

Positive drainage away from the facility shall be provided.

Drainage piping shall be provided at the bottom of exterior walls where the amount and intensity of rain is significant. Drainage piping shall be provided at the bottom of exterior walls and under the waterproofing of slabs-at-grade where the water table at any time is at or near the level of the waterproofing.

Drainage piping shall also be provided where any one or combination of the following conditions occur:

- Walls extend above grade in a plane more than 30 feet
- Roof drains discharge directly at grade
- Water runs directly off the roof
- The unpaved grade does not slope sharply away from exterior walls
- Lawn sprinklers are used

0711 SHEET MEMBRANE WATERPROOFING

Bituminous membrane waterproofing shall comply with NRCA Roofing and Waterproofing Manual.

Fiber reinforced fabric bituminous waterproofing shall not be used where the water head is greater than 3 feet.

0714 CEMENTITIOUS WATERPROOFING

Cementitious waterproofing shall not be used on horizontal building elements at or above grade.

0715 DAMPPROOFING

0715-1 GENERAL

0715-1.1 Use

Dampproofing shall be used at walls, floors, and other building elements that at any time are subject to high humidity, dampness, or frequent direct water contact, but are not subject to hydrostatic pressure, are not below the water table, or are not immersed in water.

Dampproofing shall be used at walls, ceilings, and other building elements on the potentially damp side of shower rooms, cold storage areas, built-in refrigerators and freezers, areas using water wash-down, and similar areas with high humidity, dampness, or direct water contact. Dampproofing shall begin on these walls, ceilings, and other building elements where membrane waterproofing ends; see Section 0710, Waterproofing.

Dampproofing shall be applied to the interior face of all exterior walls with a furred interior finish, except cavity walls.

Dampproofing at slabs-at-grade shall meet base course and through-the-wall flashings and shall make a bond with these flashings.

Where exterior wall, ceiling, and other building element dampproofing meets base course, spandrel, and through-the-wall flashings there shall be a bond between the dampproofing and the flashings.

0715-1.2 Materials and Construction

Concrete dampproofing shall comply with ACI Guide to the Use of Waterproofing, Dampproofing, Protective and Decorative Barrier Systems for Concrete.

Concrete masonry dampproofing shall comply with NCMA Waterproof Coatings for Concrete Masonry and NCMA Waterproofing Concrete Masonry Basements and Earth-Sheltered Structures.

Brick masonry dampproofing shall comply with BIA Dampproofing and Waterproofing Masonry Walls.

Ail other dampproofing shall comply with manufacturers' recommendations.

A single-ply elastomeric, liquid applied elastomeric, bituminous, or cementitious membrane or coating shall be continuously applied to the exterior surfaces of wails, floors, and other building elements to be dampproofed. The material shall have low permeability and a bond strength to the substrate at least equal to the tensile strength of the substrate at the surface where the material is applied.

Continuous dampproofing of water-impermeable plastic shall be placed beneath concrete slabs-at-grade. A bed of fine sand not less than 1-1/2 inches thick shall be placed between the membrane and the concrete slab to improve concrete curing conditions and reduce shrinkage cracking.

Building elements below grade that are to be dampproofed shall be constructed of concrete or masonry. They shall have reinforcement to control differential movement and cracking from temperature, live loads, dead loads, and drying shrinkage.

(instruction joints and expansion joints shall be bridged by waterstops that shall be embedded in the materials on each side of the joints.

Dampproofing at and below grade shall be chemically compatible with ground water and soils.

0715-1.3 Capillary Water Barriers

Capillary water barriers such as sand, gravel, or crushed stone courses shall be provided beneath membranes at slabs-at-grade and on the exterior side of all walls below grade with dampproofing. At walls, drainage matting can be used instead.

0715-1.4 Drainage and Drainage Piping

Drainage and drainage piping shall comply with Section 0710, Waterproofing.

0715-1.5 Base Course, Spandrel, and Through-the-Wall Flashings

Base course flashings shall be installed to provide a water-impermeable membrane between the exterior at grade and the interior.

Water-impermeable spandrel and through-the-wall flashings shall be installed to prevent water leakage or driving rain from entering a facility at the following joints:

- Around openings
- Between walls and floors
- Between walls and roofs

- Between walls, floors, roofs and structural members

0719 VAPOR AND AIR RETARDERS

0719-1 VAPOR RETARDERS

Building element assemblies shall be analyzed for potential condensation problems and the need for vapor retarders as a part of the energy conservation analysis and the design of mechanical systems; see Section 0110-12, Energy Conservation.

Vapor retarders shall be used to resist the diffusion of water vapor through building elements and to prevent water vapor migration and condensation in exterior walls and roofs. Vapor retarders shall be installed where needed between the exterior and interior at walls, roofs, and other building elements at or below grade. Vapor retarders shall also be installed between interior spaces with different controlled temperatures and humidities.

Vapor retarders shall be located as close as practical to the warm side of an assembly of building elements. Under the most severe estimated in-use conditions, the temperature at the vapor retarder shall always be above the dew point of the actual air-vapor mixture at the vapor retarder to prevent condensation from forming on the vapor retarder itself.

The vapor retarder shall be installed to make a continuous interior envelope. Vapor retarder joints and terminations shall be sealed with material of the same or better vapor permeance as the vapor retarder.

Vapor retarders shall be installed in electronic data processing facilities.

Vapor retarders at roofs shall comply with ARMA Guide to Preparing Built-up Roofing Specifications, the NRCA Roofing and Waterproofing Manual, and NRCA Handbook of Accepted Roofing Knowledge.

0720 INSULATION

0720-1 USE

Insulation shall comply with UBC Chapter 17.

Thermal insulation shall be installed above and below grade between the exterior and interior of a facility where the exterior temperature differs significantly from the required interior temperature, e.g., such as where heated spaces are adjacent to exterior walls at slab-at-grade construction and at floors above grade, and where heated spaces are adjacent to roofs.

Thermal insulation shall be installed between interior spaces where significantly different temperatures are required.

Loose-fill insulation shall not be used where future remodeling, renovation, or expansion can reasonably be expected to occur and to require removal of portions of insulated walls.

The thermal resistance of insulation and the degradation of thermal resistance over time shall be considered as a part of the energy conservation analysis (see Section 0110-12, Energy Conservation) and the design of mechanical systems (see Division 15, Mechanical).

0720-2 MATERIALS

Thermal insulation used between the exterior and interior shall be moisture resistant.

When loose-fill thermal insulation is used, it shall be the water-repellent type.

0721 BUILDING INSULATION

0721-1 CAVITY WALLS

A clear air space of not less than 1 inch exclusive of any cavity insulation shall be provided in all masonry cavity walls above grade, except in masonry cavity walls with loose-fill insulation in the cavity.

Rigid-board insulation shall be placed on the exterior surface of the interior wythe of cavity walls. If the required thermal resistance is not met, additional insulation shall be added to the cores of such interior wythe materials as hollow masonry or to the interior surface of the interior wythe only when analysis shows that the dew point does not occur in the interior wythe.

Insulation in cavity walls shall be adhered to the exterior surface of the interior wythe. Corrosion-resistant cavity wall anchors, joint reinforcement, or metal ties shall be used to hold the insulation at its top and bottom firmly against the exterior surface of the interior wythe.

Where loose-fill insulation is used, it shall completely fill the cavity of exterior masonry or concrete cavity walls. If the required thermal resistance is not met, loose-fill insulation shall be used to completely fill the cores of such interior wythe materials as hollow masonry, provided the required thermal resistance can be achieved. If the required thermal resistance cannot be met by insulating the cavity and the cores of the interior wythe, additional insulation shall be added on the interior face of the wythe only when analysis shows that the dew point does not occur in the interior wythe.

0721-2 COLD STORAGE ROOMS

hose-fill insulation shall not be used for walls of refrigerated or cold storage rooms.

0721-3 PROTECTION

Batt insulation, blanket insulation, and fiberboard insulation exposed to view 8 or more feet above a finished floor, platform, mezzanine, walkway, stair, or landing shall be covered to prevent the shedding of fibers.

All insulation that is within 8 feet of a finished floor, platform, mezzanine, walkway, stair, or landing shall have its exposed surface covered from view and protected from physical damage.

0721-4 WINDOW AND DOOR FRAMES

The space between outside window frames and adjoining walls, and between exterior door frames and adjoining walls, shall be insulated.

0722 ROOF AND DECK INSULATION

Only insulation approved for UL Class A and FM Class I roof construction shall be used on roofs.

All roof insulation shall comply with NRCA Roofing and Waterproofing Manual and NRCA Handbook of Accepted Roofing Knowledge.

0724 EXTERIOR INSULATION AND FINISH SYSTEMS

Rigid expanded polystyrene insulation, external fabric or lath reinforcement, and base and finish coats shall comply with EIMA Guideline Specification for Exterior Insulation and Finish Systems Class PB Type A.

The following shall comply with EIMA Guideline Specification for Exterior Insulation and Finish Systems Class PM Type A and B:

- Rigid extruded insulation
- External fabric or lath reinforcement
- Base and finish coats
- Rigid extruded insulation

- Internal reinforcement tape
- Base and finish coats

Exterior insulation and finish systems shall comply with UBC Standard No. 17-6.

0727 FIRESTOPPING

Firestopping shall comply with NFPA 101, Chapter 6.

Firestopping materials and assemblies shall be tested for their fire resistance and listed by UL or similar nationally accredited testing laboratories, or shall be listed for their fire resistant as approved by FM or similar national insurance organizations. Unrated and unapproved assemblies shall be tested and approved before being considered for use in a DOE facility.

Where fire-rated assemblies (walls, floor-ceilings, roof-ceilings) are either partially or fully penetrated by pipes, ducts, conduits, or other such building elements, firestopping material shall be placed in and around the penetrations to maintain the fire resistance rating of the assembly.

0730 ROOFING TILES

Roofing tiles shall comply with UBC Chapter 32 for roof construction and covering, UBC Chapter 45 for marquee roof construction, and UBC Chapter 23 for roof design and wind design.

The roofing surface color shall be considered in the energy conservation analysis; see Section 0110-12, Energy Conservation, and Division 15, Mechanical.

Asphalt, clay tile, concrete tile, and slate roofing of steeply sloped roof decks shall comply with NRCA Steep Roofing Manual and with ARMA Residential Asphalt Roofing Manual.

0750 MEMBRANE ROOFING

0750-1 DESIGN

Membrane roofing shall comply with UBC Chapter 32 for roof construction and covering, UBC Chapter 45 for marquee roof construction, and UBC Chapter 23 for roof design and wind design.

0750-2 SLOPE

Where a roof deck's slope, after considering deflection and construction tolerances, is less than the slope required for the roofing, the slope shall be increased the required amount by the addition of fill, or tapered insulation in accordance with NRCA Roofing and Waterproofing Manual, NRCA Handbook of Accepted Roofing Knowledge, and manufacturers' recommendations.

0750-3 ROOF-MOUNTED EQUIPMENT

Supports for equipment, such as window washing equipment, cooling towers, solar collectors, evaporative coolers, and antennae, shall be by the use of curbs or structural frames in compliant with NRCA Construction Details.

Clearances for roofing maintenance and repair under structural frames shall comply with "Width of Equipment/Height of Legs" chart of NRCA Construction Details.

The weight of roof-top piping and equipment shall not be carried on any part of the roof assembly except the structural system.

The weight of equipment on roofs, the weight of equipment used during the life of the building to remove, re-install, maintain, and repair roof-mounted equipment, and the path across the roof used by that equipment to transport roof-mounted equipment shall be taken into account when establishing roof loads; see Section 0111, Structural Design Requirements.

Penetrations of roofs by pipes and equipment of all types, and by curbs and legs for structural frames to support equipment, shall be minimized. Penetrations shall comply with NRCA Construction Details. Where possible, equipment shall be contained in equipment rooms and penthouses.

0750-4 WALKWAYS

Roof walkways shall be provided from points of roof access to penthouse entrances and to roof-mounted and roof-accessible equipment and devices. Walkways that are more than 30 inches above a roof or within 10 feet of a roof edge shall have guardrails that comply with UBC Chapter 17 and UBC Chapter 23.

0750-5 WATER RETENTION

Built-up roofs designed to pond water for the cooling of roof surfaces, designed with retarded drainage to relieve storm sewer loadings, or subjected to periodic water discharges from cooling towers or industrial process shall have the weight of the water taken into account when establishing roof loads in Section 0111, Structural Design Requirements.

0751 BUILT-UP BITUMINOUS ROOFING

Built-up bituminous membrane roofing shall comply with the ARMA Guide to Preparing Built-up Roofing Specifications, NRCA Roofing and Waterproofing Manual, NRCA Handbook of Accepted Roofing Knowledge, and FM Class I.

0753 ELASTOMERIC/PLASTOMERIC SHEET ROOFING

0753-1 GENERAL

Single-ply roofing shall comply with the following:

- SPRI Single Ply Roofing: A Professional's Guide to Specifications, Parts I-IV.
- SPRI Wind Design Guide for Ballasted Single Ply Roofing Systems
- SPRI Wind Design Guide for Mechanically Attached Single Ply Roofing Systems
- SPRI Wind Design Guide for Fully Adhered Single Ply Roofing Systems

0753-2 MODIFIED BITUMEN SHEET ROOFING

Modified bituminous roofing shall comply with ARMA Recommended Performance Criteria for Roofing Membranes Using Polymer Modified Bituminous Products.

The roof surface color shall be considered in the energy conservation analysis; see Section 0110-12, Energy Conservation.

0760 FLASHING AND SHEET METAL

0760-1 SHEET METAL ROOFING

Sheet metal roofing shall comply with UBC Chapter 32 for roof construction and covering, UBC Chapter 45 for marquees roof construction, and UBC Chapter 23 for roof design and wind design.

The slope of sheet metal roofing shall be as recommended by its manufacturer, and shall take into consideration deflection and construction tolerances.

The roof surface color shall be considered in the energy conservition analysis; see Section 0110-12, Energy Conservation.

0760-2 SHEET METAL FLASHING AND TRIM

0760-2.1 Expansion Joints

Expansion joints shall be located at roof high points, and water shall drain in opposite directions from each side of the expansion joint, or expansion joints shall be located parallel to the flow pattern and water shall drain parallel to the expansion joint. The expansion joint shall be elevated above the highest expected level of water flow and shall not obstruct the flow of water off a roof.

Roof and exterior wall expansion joints shall be coordinated with structural system expansion joints. All roof expansion joints shall be elevated not less than 8 inches above the roof plane.

0760-2.2 Flashing, Trim, and Accessories

Flashing, trim, and accessories, including exterior drains and gutters, and interior drains shall have a service life at least equal to that of the roofing and shall be compatible with the roofing and exterior wall materials.

0760-2.3 Drains, Gutters, and Accessories

0760-2.3.1 General

Roof drains and gutters shall comply as a minimum with SMACNA Architectural Sheet Metal Manual for a storm of 5 minutes' duration that is exceeded only once in 10 years. Roof drainage details shall comply with NRCA Construction Details and NRCA Steep Roofing Manual.

Overflow outlets shall be provided on all roofs with parapets or curbs. The weight of retained water including that attributed to deflection of the roof due to the load of water below the bottom level of the overflow outlets shall be included as a load in structural Calculation see Section 0111, Structural Design Requirements.

Tile roofs shall use only exterior gutters and downspouts.

0760-2.3.2 Drains and Gutters

Drains shall comply with UBC Chapter 32.

Interior roof drains or exterior roof drains and gutters shall be used in locations where temperatures remain above freezing. Where temperatures remain below freezing, and freezing of gutters or downspouts is a problem, only interior roof drains shall be used, except that exterior overflow outlets are acceptable.

Interior built-in gutters shall not be used, except with sheet metal roofing and only in locations where temperatures remain above freezing.

No building roof with interior drains shall have fewer than two independent drains. Each such indepedent drain shall be imdependently connected to the storm drain.

Roof drain spacing shall not exceed 75 feet in any direction.

No roof drain shall serve a roof area greater than 10,000 square feet.

Interior roof drains shall be located only at roof low points.

Drain inlets shall be recessed below the adjacent roof level.

Drains shall have strainers.

No drain shall be less than 4 inches in diameter.

On exterior roof drains 30 feet or longer, leader heads shall be used at the junction of drains and gutters.

Exterior roof drains that discharge onto roofs shall have splash pans secured to the bottom of the drains.

Drains, gutters, and accessories shall have a service life at least equal to that of the roofing, and shall be compatible with the roofing.

Exterior roof drains shall be protected from yard maintenance and building maintenance equipment, and from vehicles at roads, parking areas, and loading areas.

Where soil erosion can occur from the discharge of exterior roof drains at grade, roof drains shall be connected to storm sewers or shall discharge into stabilized drainage ditches, splash blocks, or paving.

0790 SEALANTS AND JOINTS

Sealant selection and installation for architectural aluminum shall comply with AAMA 800.

Only non-staining sealants shall be used.

Sealants shall prevent weather damage to building elements at joints.

Joints shall be detailed to minimize the reliance on sealants for weather protection.

Joints shall be designed to prevent any local overstressing of the sealant.

Joints shall be designed to allow for the depth of sealant contact as. required for the specific sealant system being used.

Joints to be sealed shall be sized in proportion to the amount of movement that will occur.

Sealant material shall be physically and chemically compatible with adjacent materials.