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FMSD, Engineering, Planning, Architecture

Engineering, Planning, Architecture and Space

Standards and Guidelines for EPA Facilities

Strategic and Physical Facilities

Master Plan

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PREFACE

PREFACE

This document, **Engineering, Planning, Architecture and Space Standards and Guidelines for EPA Facilities**, is a compilation of generic information which shall be used in conjunction with the Facility Safety manual as the basis for developing specific project requirements and for evaluating existing facilities.

Any written text in italic type face in this document is a cue that project specific information must be compiled and inserted before the project specific document is complete. The italicized text is only the first level of information which must be incorporated to complete this document for a specific project. Each paragraph must be reviewed for each specific project to verify if it should be retained, deleted, refined, or enhanced. The intent is that the basic information, currently contained in this document, is representative of all new construction projects; however, each project is unique and a complete review and editing of this document is required to create a project specific document. All paragraphs are numbered throughout each section of this document. Note that these numbered paragraphs may be deleted without renumbering. A paragraph omitted is not used. To the reader of the document, this will be apparent; this is also explained in the INTRODUCTION (SECTION 1). By not renumbering the paragraphs of the project specific document, the project specific document can be directly compared and referenced to paragraphs within the generic document.

END OF PREFACE

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This document, **Engineering, Planning, Architecture and Space Standards and Guidelines for EPA Facilities**, is to provide support to the Facilities Management and Services Division; Engineering, Planning and Architecture Branch of the Environmental Protection Agency in developing the Program of Requirements (POR) and Solicitation for Offers (SFO) for new construction of EPA Laboratory Facilities as well as for the evaluation of existing facilities to determine condition and needs for improvement. This document is not a Program of Requirements nor a Solicitation for Offers, it is a set of standards to be used for a multiple of purposes. This document is restrictive only to the point that it is a set of minimum standards; this document shall not restrict design.

This document, **Engineering, Planning, Architecture and Space Standards and Guidelines for EPA Facilities**, provides the minimum requirements. It is not intended to inhibit the design professionals from providing more stringent or greater performing criteria for design. In developing the final program from this document, the design professional is expected to modify and supplement this document as applicable. This document, after project specific information has been added and the document edited to meet project specific requirements, forms the basis for establishing a program for design and construction. The generic information and requirements, as herein described, must be verified and further defined and refined as a detailed program for the facility or facilities. The final program must then be approved by EPA.

This document is organized into ten sections, plus appendices:

SECTION 1: INTRODUCTION
This section provides a general description and purpose of an existing facility or facilities and/or campus to be evaluated to determine need for improvement or a general description and purpose for new construction, renovations, alterations, or additions for an Environmental Protection Agency (EPA) Laboratory facility. The Introduction in this generic document is necessarily short in that the majority of the information is project specific and must be provided on a specific project by project basis.

SECTION 2: GENERAL FACILITY REQUIREMENTS
This section provides project specific information regarding EPA's planning goals which may relate to any specific project. The various project specific EPA offices, and their organizations are defined, and the planning objectives and criteria are documented. Project specific scope of requirements for a project are compiled and documented in an overview and summary fashion. The General Facility Requirements will be totally unique for each project. This section only outlines the various categories that should be addressed.

SECTION 3: GUIDE FOR FACILITY DESIGN AND LAYOUT
This section is a mixture of mostly project specific information along with some standards and guidelines which may be used for all projects. This section is an overview of the new construction and comprises the major elements and information of any project which will allow pre-design and conceptual design of the project to be performed. This section sets the tone for any specific project design and its development. This section must be carefully edited to make it project specific.

SECTION 4: OFFER REQUIREMENTS
This section establishes the procedures and requirements that all offerors must follow in responding to the information on specific projects. It is anticipated that several review phases will be a part of this project; each phase requiring a significant submittal from the design professional. The Environmental Protection Agency will define, in this section, the appropriate phases on the project and the appropriate submittals at each phase and their level of documentation. This will be provided on a project by project basis.

SECTION 5: ARCHITECTURAL REQUIREMENTS

SECTION 6: SITE AND CIVIL REQUIREMENTS

SECTION 7: STRUCTURAL REQUIREMENTS

SECTION 8: MECHANICAL REQUIREMENTS

SECTION 9: ELECTRICAL REQUIREMENTS

Sections 5, 6, 7, 8 and 9 are mostly standards and guidelines for all new construction with some amount of project specific information included. These sections contain more detailed information on each discipline. These sections must also be reviewed and edited to make them project specific.

SECTION 10: LEASE ADMINISTRATION
This section provides the method that will be used by the EPA for leasing the facility from the offeror. This section will be defined by EPA.

APPENDICES
There are several appendices included with this document. Their purpose is to include certain necessary project specific and generic information in separate attachments which are required of the project but which are generally lengthy, detailed descriptions, procedures or data. This allows the main document to flow more concisely and easily for clearer understanding and provides easier reference to the more lengthy project specific information. Included in these appendices are guideplates of room data and floor plans for specific room types. These guideplates illustrate minimum dimensions, handicapped accessibility, equipment, furnishing layouts and specific room requirements for finishes, HVAC, electrical, plumbing and communications.

END OF SUMMARY

TABLE OF CONTENTS

TABLE OF CONTENTS

ENGINEERING, PLANNING, ARCHITECTURE AND SPACE STANDARDS AND GUIDELINES FOR EPA FACILITIES

NOTE: THE INFORMATION IN THIS SECTION 4 SHALL BE PROVIDED BY EPA AND IS NOT A PART OF THE SCOPE FOR THIS DELIVERY ORDER NO. 6 - STANDARDS

Table of Contents

Table of Contents

Table of Contents

Table of Contents

SECTION 9 - ELECTRICAL REQUIREMENTS

Table of Contents

NOTE: THE INFORMATION IN THIS SECTION 10 SHALL BE PROVIDED BY EPA AND IS NOT A PART OF THE SCOPE FOR THIS DELIVERY ORDER NO. 6 - STANDARDS

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

1.1 ORGANIZATION OF DOCUMENT

1.1.1 GUIDELINES FOR PROGRAM DEVELOPMENT AND DESIGN

This document, **Engineering, Planning, Architecture, and Space Standards and Guidelines for EPA Facilities**, establishes guidelines for the design of new construction renovations, alterations and additions for all Environmental Protection Agency (EPA) Laboratory Facilities as well as for the evaluation of existing facilities to determine conditions and needs for improvement. The document is to promote and establish a consistent level of quality and excellence throughout the planning, programming and design processes and throughout the construction of new facilities. This document is not a specification, but shall be used alongside codes and regulations to develop construction documentation for EPA facilities. The document provides information and establishes criteria for the offeror and design professional to evaluate, program, plan, conceptualize, and prepare viable solutions for EPA review and comment, and with the concurrence of the EPA, to establish and develop throughout the design process a single solution meeting the requirements established herein in the form of construction documents for public bidding and construction contract award.

1.1.2 DESIGN PROFESSIONALS AND OFFEROR

This document does not relieve the Architects, Engineers, and Consultants of any responsibilities as the design professionals. It is intended to clarify and supplement the design process for the design professional and the offeror. The Architect, Engineers and Consultants shall be licensed professionals in their field of expertise and shall be experienced in the design of laboratory facilities. They will be required to assure that all portions of the project comply with all established applicable codes, regulations and practices for laboratory facilities.

1.1.3 PROGRAM VERIFICATION AND DESIGN

This document establishes basic design parameters only; it is not a program for the facility or facilities. It is a set of standards and guidelines which the design professional must use in programming and designing a laboratory. The document is meant to be restrictive to the extent of respecting standards. However, EPA recognizes that an essential aspect of the design professionals responsibility includes original and imaginative design. The facility or facilities must be planned, developed and designed from the master plan and total environmental approach under one common concept to produce a product that is functional and aesthetic.

1.1.4 DOCUMENT PARAGRAPH NUMBERING

Each paragraph of this documents is numbered. Any number missing from the numbering sequence has been intentionally deleted, and is not required for use on this project.

1.2 SCOPE OF PROJECT

1.2.1 PURPOSE

A description and purpose of any proposed new facility shall be provided. The following questions are some of the items that should be addressed when a new facility is under consideration:

.1 *Does the new facility construction replace an old facility or number of facilities?*

.2 *Does the new facility construction represent expansion or the addition of new square footage without moving the current operation?*

.3 *Does the new facility construction represent consolidation?*

.4 *Has a specific site been established or not?*

.5 *Are there any special studies that the design professional must perform early in the project development to analyze whether a group must consolidate or whether more or less space is required?*

1.2.2 PLANNING STUDIES, EVALUATIONS AND REPORTS

A list of all planning documents, studies, evaluations and reports shall be provided with an executive summary of their conclusions and results.

1.3 BACKGROUND INFORMATION

1.3.1 EXISTING FACILITY DESCRIPTION

A brief general overview and description of all existing facilities and the campus, if so composed, shall be provided. The use of photographs is encouraged.

1.3.2 FACILITY / CAMPUS COMPONENTS

A more descriptive short paragraph on each component of the facility or campus shall be provided.

1.3.3 FUNCTIONAL ORGANIZATION

A brief introductory description of the organization of the various branches and laboratories in the project and how they interrelate with a more detailed description of each shall be provided.

END OF SECTION

SECTION 2

GENERAL FACILITY REQUIREMENTS

SECTION 2

GENERAL FACILITY REQUIREMENTS

2.1 PLANNING GOALS

A brief description of EPA's goals shall be provided for any given project. The goals should state those current conditions which are good or correct and must be maintained and those current conditions which are not good or not correct which must be resolved or improved. The goals should state any new condition required to be met. Examples are as follows:

- *.1 Greater interaction and communication is required among offices and laboratories, among all laboratories and/or among all offices, etc.*
- *.2 Improve circulation to minimize travel distances and time*
- *.3 Consolidation of laboratories*
- *.4 Anticipated expansion*
- *.5 Functional zoning and separation*
- *.6 Sharing of resources*
- *.7 Increase efficiency of laboratory module*
- *.8 Modular design to laboratories*
- *.9 Typical laboratory module for flexibility*
- *.10 Increase flexibility and adaptability*
- *.11 Decrease maintenance costs*
- *.12 Enhance image*
- *.13 Enhance quality of life*
- *.14 Increase personnel safety*
- *.15 Immediate adjacencies*

2.1.1 PLANNING OBJECTIVES

Each of the goals listed under Planning Goals shall be defined, and any specific requirements noted and described.

2.1.2 PLANNING CRITERIA

Planning criteria must be established and agreed upon in order to establish the net design area for the project (net design area is defined in this Section 2 under paragraph 2.1.2.7). There are likely to be several categories of space such as Office Spaces, Laboratory Spaces , Specialized Spaces and Storage Spaces. An additional category, Exterior Areas, includes space not directly included within the facility and not included in the net design area.

2.1.2.1 OFFICE SPACE

Planning criteria must be established for general office and interior support spaces. This may be established using the GSA (General Services Administration) primary square footage for office space for clerical, administrative, paraprofessional, professional, managerial, and executive personnel at 125 net square feet plus an additional 22% or 27.5 net square feet for support areas. Support areas do not include storage or specialized spaces. Using this method, 152.5 net square feet is allocated per individual. EPA must agree upon the method to be used to establish this square footage. This method of determining general office and interior support space shall be followed unless specific and demonstrated functional requirements would justify otherwise.

2.1.2.2 LABORATORY RELATED OFFICE SPACE

Laboratory personnel who must also evaluate and interpret data and prepare written reports and manuscripts must have some office space outside of the laboratories where they work. The size of these offices should be computed the same as indicated in paragraph 2.1.2.1. The same standards as utilized in the regular office spaces are also applicable to these office spaces with the exception that the laboratory related office space should be located as close as possible to the laboratory space to which it relates, but this office space shall not be included within the physical laboratory space.

2.1.2.3 LABORATORY SPACE

Planning criteria must be established for modular laboratory space. This may be 308 net design square feet per module. Based on EPA functions and tasks, a module of 11'-0" x 28'-0" is the standard which must be followed in all laboratories except where functions and tasks would lead to a different standard.

2.1.2.4 SPECIALIZED SPACE

Specialized spaces include special laboratories which do not fit a set module and require square footages significantly larger than standard laboratories. Specialized spaces include pilot plant operations and animal care facilities. These spaces may or may not need to be located with other modular laboratory space or office space.

2.1.2.5 STORAGE SPACE

Storage spaces, as herein classified, represent large open storage areas which are required to support specialty or specific functions and is storage space in addition to standard storage space that may be a part of laboratory or office space. This storage may be required to be adjacent to or near a laboratory or remote from the new facility.

2.1.2.6 EXTERIOR AREA

Exterior Area includes space not included within the facility but which must be on-site. This space may be open air, unprotected storage, such as for vehicles, or this space may be semi-enclosed such as under a shed roof or in a fenced enclosure such as for fuel storage, or this space may be totally enclosed such as a remote power plant for support services.

2.1.2.7 NET DESIGN AREA (FOR DESIGN PURPOSES ONLY)

All space requirements set forth in the program shall be net design area. They shall not include walls or building structure, egress and other corridors, stairs, restrooms, mechanical and electrical rooms, shafts and similar non-occupied spaces. They shall also not include space designated as Exterior Area. Net design area shall not be interpreted as the net usable area of the facility as defined by GSA, refer to Section 10 for GSA definitions of net usable area.

2.1.2.8 GROSS DESIGN AREA

Refer to Section 3 for definition of Gross Design Area and efficiency.

2.2 SCOPE OF REQUIREMENTS

2.2.1 GENERAL

A brief overview of the scope of the specific project requirements shall be provided.

2.2.2 CODES

A brief statement about applicable local codes which shall be followed shall be provided here with a reference to APPENDIX A - CODES, REGULATORY REQUIREMENTS, REFERENCE STANDARDS, TRADE ORGANIZATIONS AND GUIDES. This reference shall include a statement clarifying that not all potentially applicable codes, requirements, references, organizations and / or guides may be listed. A code review document shall be produced by the design professional which documents all of the research performed to comply with all applicable codes. This document shall be updated, at a minimum, at the end of each phase of the project.

2.2.3 FACILITY ORGANIZATION

Provide program function statements for each of the offices, branches and laboratories involved in the project and how they interrelate.

2.2.4 SUMMARY OF REQUIREMENTS

A general description of the required new facility total net area shall be provided, excluding all Exterior Areas. A general description of the Exterior Area net area shall be provided.

2.2.4.1 FACILITY SUMMARY

A general listing of net assignable space shall be provided in net area for each of the following types of space:

- *.1 Office Space*
- *.2 Modular Laboratory Space*
- *.3 Specialized Space*
- *.4 Storage Space*
- *.5 Exterior Areas*
  - *.5.1 Vehicle Holding*
  - *.5.2 Fuel Storage*
  - *.5.3 Hazardous Material / Waste Storage*
  - *.5.4 Source Simulator*

2.2.4.2 NET AREA SUMMARY

An example summary chart of total net area is provided in Table 2.2.4.2 - NET AREA SUMMARY

2.2.4.3 PERSONNEL SUMMARY

An example summary chart of personnel by organizational structure is provided in Table 2.2.4.3 - PERSONNEL SUMMARY

TABLE 2.2.4.2 NET AREA SUMMARY **EXAMPLE**

		OFFICE	LAB	SPECIAL	STORAGE	TOTAL
ORD		127,900	137,597	99,535	15,470	380,722
	HERL	41,283	73,350	38,733	2,890	158,256
	OD	1,375	0	1,320	600	3,295
	NTD	6,937	11,110	1,210	220	19,477
	GTD	10,138	16,720	1,870	0	28,728
	RSD	6,000	1,100	30,583	1,410	39,093
	DTD	6,650	15,180	1,440	0	23,270
	ETD	10,183	31,240	2,310	660	44,393
	AREAL	54,325	42,120	22,305	9,080	128,050
	OD	4,950	0	990	5,200	11,140
	ACMD	14,375	9,680	3,190	440	27,685
	MRDD	10,500	12,100	8,985	220	31,805
	HEFRD	9,625	6,920	4,840	3,200	24,585
	QATSD	7,500	9,020	3,860	0	20,380
	EERD	7,375	4,400	440	240	12,455
	AEERL	20,670	16,590	33,482	1,100	71,842
	OD	3,035	0	6,402	0	9,437
	GECD	8,170	3,520	3,840	0	15,530
	PCD	9,465	13,070	23,240	1,100	46,875
	ECAO	9,372	0	1,400	1,600	12,372
	OSORD	2,250	3,537	3,615	800	10,202
OAR		55,030	4,620	9,385	3,680	72,715
	OAQPS	55,030	4,620	9,385	3,680	72,715
	OD	2,935	0	2,455	0	5,390
	ESD	20,900	0	1,680	400	22,980
	AQMD	19,195	0	3,650	640	23,485
	TSD	12,000	4,620	1,600	2,640	20,860
OARM		71,125	0	100,415	10,023	181,563
	OARM	71,125	0	100,415	10,023	181,563
	OD	2,250	0	600	150	3,000
	CMD	7,000	0	1,920	738	9,658
	HRMD	3,500	0	1,920	300	5,720
	NCPD	11,250	0	2,525	300	14,075
	FMSD-O	6,250	0	11,505	3,385	21,140
	FMSD-C	6,250	0	23,980	0	23,980
	NDPD	40,875	0	57,965	5,150	103,990
EPA - BUILDING TOTALS		**254,055**	**142,217**	**209,335**	**29,173**	**635,000**

TABLE 2.2.4.3 PERSONNEL SUMMARY **EXAMPLE**

		OFFICE*	TECHNICIAN**	TOTAL
ORD		893	428	1,321
	HERL	254	295	549
	OD	11	0	11
	NTD	42	46	88
	GTD	55	89	144
	RSD	48	35	83
	DTD	40	45	85
	ETD	58	80	138
	AREAL	417	60	477
	OD	22	60	82
	ACMD	115	0	115
	MRDD	84	0	84
	HEFRD	77	0	77
	QATSD	60	0	60
	EERD	59	0	59
	AEERL	142	73	215
	OD.POO	23	4	27
	GECD	58	23	81
	PCD	61	46	107
	ECAO	62	0	62
	OSORD	18	0	18
OAR		418	0	418
	OAQPS	418	0	418
	OD	19	0	19
	ESD	160	0	160
	AQMD	143	0	143
	TSD	96	0	96
OARM		567	108	675
	OARM	567	108	675
	OD	18	0	18
	CMD	56	0	56
	HMRD	28	0	28
	NCPD	90	0	90
	FMSD-O	50	0	50
	FMSD-C	0	0	0
	NDPD	325	108	433
EPA BUILDING		1,878	536	2,414

***Office people working in laboratories are shown only as office occupants in the table.**

****The term "technician" refers only to laboratory people who do not have office space in laboratories or elsewhere. This is done so that the total personnel count reflects an accurate head count of people.**

END OF SECTION

SECTION 3

GUIDE FOR FACILITY DESIGN AND LAYOUT

SECTION 3

GUIDE FOR FACILITY DESIGN AND LAYOUT

3.1 GENERAL SPACE PROVISIONS

3.1.1 OVERVIEW

In general, the information contained in this document, **Engineering, Planning, Architecture and Space Standards and Guidelines for EPA Facilities**, must apply to existing buildings as well as any possible new construction. The EPA can only present the generic space criteria requirements, identify the types of spaces anticipated for the various functions of the facility, identify general technical requirements and give general guidance for actual layout. This section contains design requirements that shall be used as guides and references. Additionally, model Room Data Sheets are included in Appendix C with examples which provide general, and some specific, program requirements. Specific program criteria, space identification and sizes shall be developed by the design professional during the Program Verification Phase of the specific project. The purpose of the Program Verification Phase is to determine the quantitative and qualitative requirements of the specific program and relate these requirements to the available budget. Specific program criteria and requirements must be verified by the design professional with the EPA. The design professional must work in close coordination with the Agency (EPA) to produce the final building layout in accordance with this document and the guidance gained through consultation with the Agency. Appropriate local, state and federal regulatory agencies shall also be consulted.

3.1.2 SITE RELATED INFLUENCES AND DEVELOPMENT

3.1.2.1 SURVEYS, PRE-CONSTRUCTION TESTING & ENVIRONMENTAL ASSESSMENT

The design professional shall provide and be responsible for complete site surveys, pre-construction testing (subsurface soil exploration), and environmental assessment. All site surveys, preconstruction testing, and environmental assessments shall be performed by a registered geotechnical engineer.

.1 SURVEYS
Upon award, and once a written Notice to Proceed is issued to the design professional, the design professional shall arrange for surveying of the site to be performed by a Registered Professional Land Surveyor.

.1.1 As a minimum, the survey(s) shall describe legal property boundaries, easements, and legal restrictions as well as all man-made and natural physical characteristics, utility service locations (temporary and permanent), horizontal and vertical controls, bench marks, roadways and parking areas.

.2 PRELIMINARY SUBSURFACE EXPLORATION.
The design professional shall arrange for preliminary subsurface exploration to be performed by a registered geotechnical engineer. The registered geotechnical engineer shall supervise all required testing; review and analyze all data and samples and submit his report. All tests shall be performed by independent testing laboratories.

.3 ENVIRONMENTAL ASSESSMENT
The design professionals will be required to evaluate the additions and improvements on the local environment. They may also be required to prepare an Environmental Assessment (EA) which will determine the need for an Environmental Impact Statement (EIS). The preparation of the Environmental Assessment, if required by the Agency, shall be included as a part of the professional services contract.

.3.1 The design professional will be required to complete the Indoor Air Quality (IAQ) requirements described in Appendix B of this document. To address these requirements, the design professional must respond to the primary strategies for Indoor Air Quality control as listed in Appendix B, paragraph B.1.1.2. The first strategy for Indoor Air Quality control is Source Control which involves outdoor pollutant sources. The design professional must respond to the requirements established under Site Evaluation as defined in Appendix B, paragraph B.1.2.1.3 which includes a list of factors which must be considered.

3.1.2.2 SITE DEVELOPMENT
In the development of a site proposed for construction, the design professional is required, as a minimum, to address, analyze, and assess all site related issues outlined below:

.1 IMPACT

.1.1 On-site capacities of present and future utilities
.1.2 Existing buildings, including the need for temporary facilities and services to these buildings.
.1.3 Existing site utilities, including the need for utility relocation and shutdown.
.1.4 Existing traffic patterns and vehicles, including emergency and service vehicles.
.1.5 The need for traffic phasing/control plan requirements.
.1.6 Existing parking structures and surface parking, including the need for temporary parking areas and additional capacity.
.1.7 Need for an environmental impact statement.

.2 DEVELOPMENT

.2.1 Preserve surrounding neighborhoods and communities.
.2.1.1 Laboratory facilities shall be located at a distance no less than 1/4 mile from existing residential developments, and shall be located such that prevailing winds will not direct fumes exhausting from EPA stacks toward existing residential developments.
.2.2 Preserve the character of the site, to the maximum extent, by retaining natural features, such as ground forms, trees and other natural vegetation.

.2.3 Use the existing site potential to the best advantage by locating and orienting buildings so they are compatible with natural site features.

.2.4 Develop functional relationships between site access points, parking lots, buildings, service areas and all other project site elements.

.2.5 Provide for orderly future expansion of facilities by considering logical expansion of buildings, parking and support services.

.2.6 Review and assess the impact of development with respect to any approved campus master plan and site infrastructure master plan.

.3 DESIGN CONSIDERATIONS

.3.1 ENERGY CONSIDERATIONS

A careful analysis of sun angles, prevailing winds, existing topography, micro-climatic conditions and major wooded areas shall be reviewed in order to contribute to a more energy efficient solution. Enhance energy conservation by careful consideration and evaluation of the orientation of buildings. Maximize climate assets and minimize climate liabilities.

.3.2 VIEWS

Proper orientation to capitalize on major vistas as a design opportunity is strongly encouraged. Views into the site from major roadways should also be considered.

.3.3 TOPOGRAPHY & DRAINAGE

The design professional shall provide a design which works with and not against the existing grades. Significant positive drainage away from any existing or new construction is a primary concern. The design professional shall preserve, as much as is practical, any major existing drainage patterns.

.3.3.1 Use natural grades of site to develop multi-level entry points, if possible. Preserve major drainage patterns and allow for positive drainage away from all portions of the building.

.3.3.2 Assess impact of development on storm water runoff.

.3.4 ADJACENT LAND USE

Consideration should be given to existing land uses or potential development nearby when siting a facility. Existing and proposed traffic patterns may affect drive locations and site access, ultimately influencing building location or orientation.

.3.5 NOISE & ODORS

Adjacent land uses may also contribute noise or odors, or both; these uses shall be considered in the site development process. Noise or odors may be severe enough to disqualify a site from consideration; thus a thorough analysis of neighboring facilities must be undertaken to ensure compatibility of the proposed facility to the existing adjacent land uses and environment.

3.1.2.3 HISTORICAL & ARCHAEOLOGICAL CONSIDERATIONS
The design professional shall review all publicly available documents for any on-site historical and/or archaeological information. Any public record indicating historically or archaeologically sensitive areas on-site must be reported to the Agency before any design is initiated. Archaeologically and historically sensitive areas on-site must be completely avoided until and after a thorough investigation has been completed and findings documented which provides direction to the design professional whether the area(s) in question may be used or must be preserved for future exploration.

3.1.2.4 COMMUNITY ISSUES
The design professional shall address environmental justice issues as set by EPA, and ascertain the requirements of the required communities review processes and provide a report to the Agency early in the design process well before any community review is required on the project. All community reviews are over and above any Agency design review; reviews shall not be combined. Community review panels may require but are not limited to requiring the following:

.1 Separate plans prepared to specifically highlight or emphasize that group's concern.
.2 Research and data collection to be used in generating special reports, environmental assessment.
.3 Presentation graphics for a formal submission/presentation during the review process.
.4 Document the review and approval process, submission requirements, deadlines for each portion of the process and the sequence that must be followed.

3.1.3 SITE EVALUATION

3.1.3.1 PURPOSE OF STUDY
The ultimate purpose of the Site Evaluation is to provide the Environmental Protection Agency with pertinent data sufficient to allow for a complete understanding of the physical assets and liabilities of the given project site.

3.1.3.2 SITE DATA COLLECTION
From the information developed above in 3.1.2, SITE RELATED INFLUENCES AND DEVELOPMENT and other sources as required by this document, planning and zoning criteria for the subject property shall be considered, including the investigation of all potential site development regulations such as density limitations, building setbacks, building coverage, buffer requirements, and other development guidelines as set forth in any applicable campus, site or facility master plan or as elsewhere defined in this document.

.1 An on-site investigation and review shall be conducted which shall include representatives from the Client, design professional and pre-construction testing and inspection company. A site representative shall verify land features indicated on the survey. Photographs shall be taken at various locations for a visual record to aid in the development of the site analysis drawings.

3.1.3.3 SITE RESOURCE INVENTORY AND ANALYSIS

A site resource inventory and analysis shall be prepared which shall include investigation of soils information, site vegetation, hydrology and drainage analysis, topographic and elevation analysis, view corridors and other physical characteristics of the site. A "Buildable Area" plan shall be developed by compiling information from the various analysis drawings. This plan shall indicate the acres of land suitable for construction with least amount of site limitations. The site inventory and analysis shall include but shall not be limited to the following:

.1 SITE OVERVIEW
.1.1 Location
.1.2 Parcel delineation and acreage
.1.3 Existing zoning
.1.4 Adjoining land uses

.2 PHYSICAL SITE CHARACTERISTICS
.2.1 Slope analysis
.2.2 Elevation analysis
.2.3 Vegetation
.2.4 Hydrology analysis
.2.5 Geological and soils analysis
.2.6 Site analysis
.2.7 Buildable areas analysis

.3 UTILITIES
.3.1 Storm water drainage
.3.2 Potable water
.3.3 Sanitary sewer
.3.4 Electrical and Communications
.3.5 Mechanical

3.1.4 ACCESS, CIRCULATION AND PARKING

3.1.4.1 GENERAL

Although access to the project site and thus the project facilities is deemed to be visually critical and the site access experience and facility entrance experience is vital, primary access requirements involve fire and life safety. The EPA Facility Safety Manual shall be reviewed by the design professional. Access involves fire department apparatus and on-site fixed fire safety equipment (fire hydrants, fire loops, post indicator valves, automatic sprinkler and/or standpipe system connections, etc.), vehicular circulation, pedestrian circulation and parking.

3.1.4.2 FIRE DEPARTMENT APPARATUS ACCESS

The design professional must research public records for any codes, on-site/campus design requirements, ordinances, and local fire department requirements for all emergency requirements. The following minimum requirements shall be provided.

.1 All new buildings shall have at least two sides readily accessible to fire department apparatus at all times.

.2 Fire lanes shall be provided for buildings which set back more than 150 feet from a road or exceed 30 feet in height and are set back more than 50 feet from a road.

.3 Fire lanes shall be at least 20 feet in width with the road edge closest to the building at least 10 feet from the building.

.4 The minimum roadway turning radius shall conform to a 48 feet semitrailer template.

.5 Fire lanes shall be constructed of an all weather driving surface capable of supporting imposed loads of 25 tons.

.6 Any dead end road more than 300 feet long shall be provided with a turnaround at the closed end at least 90 feet in diameter.

.7 Fire lanes and access areas for fire hydrants and automatic sprinkler/standpipe connections shall be clearly identified by painting the curbs yellow with black lettering reading "NO PARKING - FIRE LANE" spaced at 40 foot intervals. In addition, signage shall be posted and spaced at 100 foot intervals.

3.1.4.3 CIRCULATION

.1 VEHICULAR CIRCULATION

.1.1 Vehicular circulation shall be designed in accordance with industry standards, code requirements and any overall campus master plan or facilities master plan philosophy in effect at the subject site. Circulation shall respect the campus and/or facilities pedestrian circulation environment and provide for safe movement of vehicles and pedestrians. Existing traffic studies shall be evaluated and coordinated in order to implement the best possible overall circulation system.

.1.2 Vehicular access to a new project shall be evaluated with respect to existing and planned site circulation and shall provide for clear separation of staff, visitor, service and bus vehicular circulation.

.1.3 Provide adequate emergency vehicle access to all points on the building periphery including proper grades, surface materials and clearances.

.1.4 Entrances to the facility or campus shall be clearly marked and located so that access to each building, parking areas, group of buildings and service area is convenient and recognizable.

.1.5 The siting of new buildings shall consider the requirements for future expansion, design of buildings, roads, and surface and structured parking.

.1.6 Site vehicular design shall provide adequate space for queuing at drop-offs and exit drives for visitors, buses, 18 wheel vehicles, taxis, etc., keeping turning conflicts to a minimum and providing for proper service vehicle maneuvering and staging.

.1.7 Internal drive aisle widths and turning radii shall be designed to allow for the expected service and emergency vehicles.

.2 PEDESTRIAN CIRCULATION

.2.1 Pedestrian circulation shall be designed in accordance with industry standards, code requirements and any overall campus master plan philosophy in effect at the subject site.

.2.2 Sidewalks shall follow accepted design standards.

.2.3 Pedestrian walks shall have a minimum of one percent cross pitch for drainage.

.2.4 The width of walks shall be a function of pedestrian traffic volumes determined by the master plan and/or specific project requirements.

.2.5 Walks shall accommodate handicapped persons. Slopes, landings and access points shall be in accordance with ADA as well as the most stringent applicable code or combination of codes applicable to the project.

.2.6 Crosswalks from parking and other buildings shall be clearly painted and properly assigned.

.2.7 Walkway paths shall be designed in response to expected origin/destination analysis of the site and its users.

.2.8 Drop curb transitions for handicapped persons shall be at crosswalks, drop-off zones, and end-of-walk conditions.

3.1.4.4 PARKING

Parking for the proposed development shall be based on applicable codes for occupancy, local zoning requirements and any campus or facility master plan in effect at the subject site. As part of the site development phase, multi-level parking garages or below ground parking shall be considered as an alternative to surface parking. As a minimum, the following guidelines shall be followed:

.1 Distribution of total parking (i.e., employee (by type), police, emergency vehicle, visitors, handicapped, motorcycle, bicycle, etc.) shall be calculated and clearly shown in the site development phase. The minimum size for standard passenger car stalls shall be 9'- 0" x 19'- 0". Up to 15% of the parking may be designated for use of compact cars and shall be a minimum of 8'- 0" x 18'- 0".

.2 The structural design for pavement on surface lots shall comply with local state highway department standards for general parking areas.

.3 Parking aisles or lots subject to frequent truck traffic shall be evaluated for requirements of thicker pavement sections.

.4 Design calculations shall provide for a potential growth in staff of 10%. Consideration shall also be given for 25% expansion of the facility if such expansion would impact design calculations.

.5 Clearly relate parking areas to entry points. Keep walking distances to a minimum.

.6 Provide handicapped parking stalls within 100' or closer, depending on local ordinances and costs, of the facility entry and on the building side of the roadway.

.7 Provide handicapped parking stalls per the ADA requirements or more stringent if so required by local ordinances and codes.

.8 Provide sufficient slope (1 percent minimum) for positive drainage for runoff.

.9 Limit slopes to no more than 4 percent.

.10 Allow sufficient open lawn area adjacent to parking lots for snow storage as required by climate and area.

.11 Wherever possible, use 90 degree parking design.

.12 Dead-end parking bays are not allowed.

.13 Integrate existing large trees into new parking area where feasible.

.14 Provide curbs and avoid the use of concrete wheelstops.

3.1.5 PROGRAMMED SPACE FOR DESIGN AND LAYOUT

The final accepted program shall establish the definite net design area requirements for the facility and shall establish gross and net area requirements for the Exterior Areas of the project. Exterior Areas are those areas not contained within the building envelope of the main facility but which must occur on-site with the facility. With an understanding of the efficiency of the facility and all Exterior Areas, all on-site requirements can be laid out. The EPA may require additional space in remote facilities, however, these are not a part of the program established by this document.

3.1.5.1 GROSS DESIGN AREA

Gross design area represents all of the net design area plus all of the additional space required to provide a complete and functioning facility (egress and other required corridors, stairs, restrooms, mechanical and electrical rooms, interior and exterior walls, building structure, shafts and similar non-occupied or non-occupiable spaces and construction, etc.). The net design area divided by the gross design area defines the percentage design efficiency of the facility. Refer to Section 10, LEASE ADMINISTRATION, for definitions of net usable and gross usable area which are distinct from net and gross design areas.

3.1.5.2 NET AND GROSS DESIGN AREA & EFFICIENCY
Net design area for the project is established by the planning goals and objectives and the planning criteria defined in Section 2 - GENERAL FACILITY REQUIREMENTS. The planning goals and objectives along with the established typical generic or specific laboratory requirements as defined in the Room Data Sheets included in Appendix C, produces an efficiency for research facilities of this type which range from approximately 50% to 65% with an average efficiency of approximately 58%.

3.1.6 EXTERIOR AREAS AND FACILITIES
The specific area requirements for Exterior Areas for this project are listed in Section 2 - GENERAL FACILITY REQUIREMENTS. Information for specific facility design and layout is provided in this Section 3 - GUIDE FOR FACILITY DESIGN AND LAYOUT. Exterior areas may include the following:

3.1.6.1 OUTSIDE SERVICE AREAS
Outside service areas include the following:

.1 Meters
.2 Vaults
.3 Transformers
.4 Dumpsters
.5 Compactor Units
.6 Emergency Generators
.7 Oxygen Tank/Manifold
.8 Pressure Reducers
.9 Valves
.10 Pump Hoses
.11 Loading Docks

3.1.6.2 ANCILLARY FACILITIES
Ancillary facilities are requirements of the building program that must be located immediately outside of a laboratory or specialty space in close proximity to that space.

3.1.6.3 OUTSIDE STORAGE
Outside storage includes, but is not limited to, the following:

.1 VEHICLE HOLDING

.2 FUEL STORAGE

.3 HAZARDOUS MATERIAL / WASTE STORAGE FACILITY
The primary purpose of the Hazardous Materials/Waste Storage Facility is to house hazardous and flammable materials away from the main laboratory facility and other structures. This facility shall be constructed for the highest hazardous rating per applicable building code and in accordance with NFPA 30, Flammable and Combustible Liquids Code. Located a minimum of 50 feet from the main facility and from the property line, the facility shall contain five fully enclosed rooms for the storage of drum containers, flammable and combustible liquids, toxic chemicals, acids, and cylinder gases.

3.1.7 REMOTE FACILITIES

Remote facilities are facilities which are not located on property contiguous to the main facility. Remote facilities and net area requirements for remote facilities are not a part of this project. If such information is provided to the design professional by the Agency it is for informational purposes only. The design professional may wish to so confirm such information.

3.1.8 EXPANSION

Expansion is an integral part of the requirements for this project. The design professional shall review and/or confirm with the Agency all anticipated expansion needs and shall recommend methods to accommodate expansion to include these anticipated needs as well as address future expansion beyond these anticipated needs. It shall be the responsibility of the design professional to recommend the direction(s) of expansion after consultation with the Agency. The design professional shall accommodate all expansion in a logical manner both programmatically as well as by construction sequencing.

.1 Corridor layout and circulation patterns shall enhance flexibility and aid in future expansion. Open plans, where feasible and practical, which allow greater flexibility in expansion and general facility changes are encouraged.

.2 Avoid floor plan arrangements that encircle a department with permanent corridors, stairs, mechanical and electrical rooms or other fixed building elements which are difficult to relocate.

.3 Column-free functional areas should be maximized while the use of transfer beams should be minimized.

.4 Anticipated expansion must be reviewed by all disciplines on the project.

.5 Design electrical, mechanical, plumbing and other support systems in such a manner as to permit modifications and expansion in support of functional changes with the least first cost and least disruption to the overall operations.

.5.1 Utilities and support services such as heating, ventilation, air-conditioning, plumbing, and electrical systems shall allow expansion or contraction in the services provided. The utilities and support services location and size of lines, method of connection and valving shall be such as to minimize interruption of service, to maximize accessibility of systems to the space they service, and to allow access to the system for service and repair of each module without disrupting services in other modules.

.6 Massing studies which integrate existing building and site conditions with proposed building and site designs are required. All studies shall be at the same scale. The design professional may include enlarged studies of selected areas. However, the Agency desires a complete overview massing of the entire site for each proposed design with expansion and flexibility clearly defined.

3.2 SPACE IDENTIFICATION

3.2.1 GENERAL

This information will be provided as part of the specific information for a particular project.

3.3 SPECIFIC ROOM REQUIREMENTS

3.3.1 ROOM DATA SHEETS

A typical Room Data Sheet which could be used for various anticipated functions is contained in Appendix C with examples showing how to use these room data sheets. These Room Data Sheets must indicate specific room/laboratory requirements and identify appropriate installed equipment. The final design for these areas will be the responsibility of the design professional in consultation with representative facility users and approval by the EPA.

3.3.2 STANDARDS AND SYMBOLS

In addition to the specific requirements, standard requirements must also be identified for each area or room in the various sections of the guidelines. An example of a listing and definition of the standard requirements, symbols and abbreviations (where used) are annotated in this section.

3.3.3 SPECIAL EQUIPMENT

The list of Movable Equipment and Furnishings required on the Room Data Sheets is to assist the design professional in determining the anticipated demand loads for electrical, HVAC, plumbing, specialty gases, and other piped services connections. All special equipment will be furnished by the EPA unless otherwise identified during the Program Verification and Design Phase of the specific project. The exceptions are in major fixed pieces of equipment requiring hard connected electrical and piped utility services and HVAC requirements (e.g., fumehoods, Environmental Rooms, glassware washers). It is the responsibility of the design professional to provide that each room or area housing special equipment have the required utilities, electrical power, and/or HVAC capability necessary to ensure the equipments' proper and efficient operation.

3.4 GUIDE FOR ARCHITECTURAL LAYOUT

3.4.1 CONCEPT

The concept for Architectural Layout should be to group all administrative functions and all technical functions into separate organizational blocks of space, while keeping them close together to facilitate and encourage employee interaction. The principle guide in developing the basic concept shall be the separation of the facility into three definable zones: Administrative with support, laboratory, and building support. This will allow not only the most flexibility for facility design, but the most cost effective construction.

3.4.2 ADJACENCIES

The building design concept shall establish the appropriate horizontal and vertical zoning of the facility to facilitate required programmatic relationships. Floor plate areas shall be optimized to accommodate the required occupancies and to allow for future flexibility.

3.4.2.1 LABORATORY ZONE

The laboratory zone should be the center of the three zones allowing for future horizontal expansion possibilities. This zone shall include all laboratories and laboratory support areas within an individual branch or section. Laboratory offices shall be co-located in close proximity to related laboratories and laboratory support spaces across from or in blocks or "clusters" along the lab corridor. The laboratory block(s) shall utilize a modular laboratory planning concept intended to provide flexible and adaptable research space that accommodates current and future research needs as emphasis changes on environmental based issues. Window exposure for both offices and laboratories should be maximized.

3.4.2.2 ADMINISTRATIVE WITH SUPPORT ZONE

The administrative with support zone should be physically separated from the laboratory block(s) which are in the same building structure. Building links between the administrative with support zone and the laboratory zone shall house interaction spaces that must be pleasant and comfortably designed. These types of spaces shall include, but shall not be limited to, break areas, toilet rooms, copier areas, mail rooms and conferencing areas.

3.4.2.3 BUILDING SUPPORT ZONE

The building support zone should be located adjacent to the laboratory zone to facilitate the movement of equipment and material to and from the laboratories. Its location shall be determined in accordance with the site master plan, optimizing service vehicle circulation, and designed to house a receiving dock, facility physical plant, and central storage. An isolated Hazardous Material/Waste Storage Facility shall be located in proximity to this zone for ease of transportation and handling of explosive/flammable and toxic chemicals and biohazardous waste prior to disposal at an off-site location by a licensed contractor.

3.4.3 BUFFER ZONES

The buffer zone distance required between the EPA facility and other existing or proposed building(s) allowed by code to be built in the future, shall be no less than 100 feet. Existing highways or streets can be part of the 100 foot buffer zone. The Hazardous Materials/Waste Storage Facility (HMSF) shall be at least 50 feet away from any building. Both the main facility and the HMSF shall be located at least 50 feet away from the property line. Paved parking area(s) for vehicles can be considered as part of the building buffer zone.

3.4.4 TECHNICAL SPACE

It is desirable to provide work space for research support personnel (i.e., technicians, post-doctoral employees, lab assistants) outside of the laboratories in order to minimize long-term exposure to laboratory chemicals and hazards presented by their use. Technician space can be located elsewhere as long as these spaces, such as shared offices, alcoves, and cubicles, can be placed reasonably close to the laboratory. There is also a need to provide some desktop work space in the laboratory for laboratory related reporting and documentation tasks that should not be done at the laboratory bench. These work stations, where provided, must be located in the laboratory so as to minimize exposure to noxious or otherwise hazardous conditions. The supply air and exhaust distribution system within the laboratory must be carefully coordinated with the designed work space to provide a "clean air" zone(s). In some instances, a physical separation or barrier may be required between the work space and laboratory bench.

3.4.5 LABORATORY SUPPORT SPACE

Laboratory support space is defined as the space which houses common or shared activities or equipment, such as analytical instrumentation, specialized equipment, environmental rooms and glassware preparation areas which indirectly support laboratory activities. These types of spaces can be located between laboratories, supporting a specific activity, or be grouped together adjacent to a block of laboratories. The design professional shall pay particular attention to functional relationships of laboratory support spaces and laboratories with emphasis on the efficiency of the travel path of personnel, tasks and material within a particular zone or between zone.

3.4.6 EXTERIOR AREAS AND FACILITIES

Exterior areas and facilities are discussed in paragraph 3.1.6 of this section.

3.5 ENVIRONMENTAL DESIGN REQUIREMENTS

3.5.1 GENERAL

The facility shall be designed to conserve energy, avoid the use of construction materials insensitive to the environment, efficiently utilize water, promote effective recycling, be radon free, provide excellent indoor air quality to its occupants, and avoid the use of ozone depleting chemicals. The architectural and engineering design of the facility shall implement proven methods, strategies and technologies with respect for and protection to the environment. These include the selection of site; materials and construction systems that prevent infiltration of radon; to the extent possible, the use of recycled construction materials and construction materials produced with minimal expenditure of energy; and use of insulation, fire protection and refrigeration systems that avoid CFCs and other ozone depleting chemicals. The facility shall also be designed to promote the use of natural light and to afford optimum use of energy efficient lighting systems (ballasts, task lighting, etc.). The facility shall be designed to meet the EPA Internal Pollution Prevention Program. All EPA buildings should be designed with ecological design criteria which include maximum use of natural light, Green Lighting, light fixtures operated by sensors, recycled material, and other devices to economize energy without jeopardizing safety.

3.5.2 ENERGY CONSCIOUS DESIGN

Fundamental design decisions related to energy conservation shall be made during the conceptual planning stages. The new design shall utilize passive design techniques to minimize heating and cooling loads.

.1 Siting of facilities in relation to sun path, wind and vegetation.

.2 Efficient design of building form and envelope in response to the climate.

.3 Reduce cooling load through use of daylighting.

.3.1 The use of natural but controlled daylighting shall be maximized to the extent that it does not conflict with other Agency energy conservation objectives. The Agency values natural light and perceives it as part of exemplary working environment where possible. The building organization and design concept shall consider bringing natural light into personnel spaces.

.3.2 Window size, number, and location shall be determined by need for natural light and/or ventilation as well as by other energy considerations. All windows used in heated or air conditioned spaces shall be double glazed insulated windows. It is intended that Low E glass be used throughout the exterior of the facility.

.4 Reduce solar heat gains through proper design of solar shading devices combined with proper selection and location of building materials.

.5 HVAC systems design for an integrated energy conserving facility.

.6 The new facility shall meet Energy Efficiency Standards set by ASHRAE 90-1 (1989) for New Buildings or most current edition.

.7 The building design and all construction features (materials, methods of installation, including mechanical and electrical systems) shall provide concepts that will reflect reduced energy consumption.

3.5.3 CONSTRUCTION MATERIALS

The Environmental Protection Agency desires a very active role in the selection of materials used in the project and during the construction process. In this regard, the design professional in close coordination with the Agency shall carefully examine the environmental sensitivity of materials and products specified for construction and build-out for its new facility. The Agency will encourage minimal use of products that are insensitive to the environment during and after manufacture.

3.5.3.1 MATERIALS TO BE AVOIDED AND / OR NOT USED

.1 Insulations containing chloroflurocarbon compounds (CFCs) and refrigerants harmful to the environment.

.2 Products that off - gas chemical pollutants and are hazardous by their presence such as formaldehyde - treated materials (especially materials containing urea-formaldehyde). (EPA/400/1-91/033, Building Air Quality - A Guide for Building Owners and Facility Managers, dated December 1991)

.3 Products that are not biodegradable when repaired or removed.

.4 Products that contain asbestos.

3.5.3.2 MATERIALS TO USE

.1 The use of interior architectural systems that are of non-toxic materials and components, and are free of asbestos, lead-based paints and toxic fumes is required. (EPA Facility Safety Manual)

.2 Sanitation finishes selected shall be non-permeable, noncorrosive, easily cleaned and easily maintained.

3.5.3.3 RECYCLED CONSTRUCTION MATERIALS
Under Section 6002 of the Resource Conservation and Recovery Act (RCRA), the Agency has set guidelines for federal, state and local procuring agencies, using appropriated federal funds, to purchase items composed of the highest percentage of recovered materials practicable. The Agency desires that its facility follow the guidelines for "Procurement of Building Insulation Products Containing Recovered Materials" - 40 CFR Part 248, dated February 17, 1989 and "Cement and Concrete Containing Fly Ash" - 40 CFR Part 249, dated January 28, 1983, within the given constraints of cost and technical performance required.

3.5.3.4 BUILDING SHELL MATERIALS
The external treatment and materials utilized shall be of proven long-term durability requiring minimum maintenance. The quality of materials shall be consistent with the image and dignity appropriate for a U.S. Agency. Their selection should be based upon an anticipated 100-year life cycle.

3.5.4 RECYCLING
The facility shall be designed to support an aggressive Solid Waste Management Plan. The facility design shall properly locate and provide for spaces that facilitate the collection, separation, compaction, storage and shipment of all recyclable materials. General office space, freight elevator area, shipping and storage area and loading docks shall be designed to respond to this important activity.

3.5.5 RADON ABATEMENT
The Agency seeks to limit the presence of radon or radon daughters into the new facility. The design professional shall have site geological surveys carefully examined to obtain predictive radon infiltration data from subgrade geological structures. The design professional shall also require that building materials such as concrete aggregate and stone be selected from sources with low probabilities of radioactivity. The level of activity in any area of the building shall not exceed 4 picocuries per liter of air. Areas known to have high radon in structures shall have buildings designed to include preventative techniques such as caulking of all joints between concrete slab and walls below grade, caulking all pipe penetrations and venting of all non-occupied spaces below grade.

3.5.6 ELECTROMAGNETIC FIELDS (EMF)
The Agency seeks to limit the presence of electromagnetic fields in close proximity to people within the new facility. Prudent avoidance is required of the design professional in the routing of electrical power. The Agency recommends that the routing of power throughout the facility be well away from people and offices such as locating elevator electrical chases and other electrical chases away from offices and locating them on exterior walls.

3.5.7 WATER CONSERVATION
The Agency requires that new facilities be designed to minimize water consumption through the use of water saving measures. The facility design shall make use of gray-water recycling where feasible, flow-restricting spray nozzles for faucets and showers, low flow flushments for fixtures, and shall optimize the sizing of all plumbing systems.

3.5.8 OZONE DEPLETION PROTECTION

3.5.8.1 GENERAL
A contribution to depletion of the ozone layer of the geosphere by the use of CFCs (chlorofluorocarbons) will be discouraged. The Agency requires that selection of materials or processes using CFCs are consistent with goals of their guidelines related to "Protection of Stratosphere Ozone" 40 CFR, Part 82, dated August 1988.

3.5.8.2 CFC'S
The design professionals shall review and respond to current recommendations, guidelines and requirements. Among other documents, the AIA Environmental Resource Guide (latest update) on CFCs shall be reviewed and used.

3.5.8.3 REFRIGERANTS
Electrically driven chillers may use Refrigerant 22 whose Ozone Depletion Factor (ODF) is 0.05. Alternate refrigerants whose ODF is 0.05 or less may be considered, provided the material is approved by all governmental authorities having jurisdiction and that satisfactory performance has been documented by at least one full year of successful use in machines of comparable size in at least five locations in the continental USA. Given evidence of successful performance, R-123 whose ODF is 0.02 and R-134A whose ODF is 0.0 will be considered for centrifugal chillers. Ventilation requirements for the chiller plant(s), new and existing, shall comply with ASHRAE Standard 15-1991 Safety Standard for Mechanical Refrigeration. In addition, the design professional shall specify a portable refrigerant pump out unit for all refrigeration systems excluding water cooled centrifugals. Centrifugals shall have their own pump out system.

3.5.8.4 HALON
Use of halon for fire protection systems is prohibited.

3.5.8.5 INSULATION
The design professional shall review and respond to the use of HCFCs (hydrochlorofluorocarbons) and HFCs (hydrofluorocarbons) in lieu of CFC based insulations.

3.5.9 INDOOR AIR QUALITY (IAQ) REQUIREMENTS
Refer to Appendix B for the Indoor Air Quality requirements.

3.6 LANDSCAPING AND SITE RELATED REQUIREMENTS

3.6.1 GENERAL
Landscape planning, design and development must integrate with the building massing, design and materials. The landscaping design process must coincide with the building design process to create one single design which integrates site and buildings(s). The use of durable exterior materials which enhance both the site landscaping and the building design and help to integrate the two design disciplines are strongly encouraged.

.1 If the facility is to be a part of an existing campus or among other buildings in a master planned development, the landscape design as well as the building design must integrate and be compatible with the style(s) of the previously constructed permanent facilities on campus. The design professional must take advantage of the existing and developed site assets. The design professional shall observe and document the existing physical features of the site and surrounding buildings.

.2 The landscaping of the site shall create an environmentally sensitive and aesthetically attractive design. Blending of the natural environment with the proposed new construction is required.

.3 Landscaped courts and open spaces accessible to all staff are encouraged.

.4 Grass covered areas away from public view shall be provided for placement of outside eating and visiting areas (picnic tables, benches and landscape furnishings).

.5 The facility surroundings shall be landscaped with trees, shrubs, flowering plants and grasses in a manner which will enhance the aesthetic character of the building(s) and hide or screen exposed equipment and building parts, features or functions which, by their nature, are not aesthetically pleasant. Vegetation may be used to screen or form a barrier to particulate matter and to protect the building(s) from motor vehicle pollutant sources.

.6 The topography of the site around the building(s) shall slope away from the building(s) and away from neighboring building(s) in a manner to direct any water away from the new facility or any other neighboring building(s).

.7 Xeriscape design practices shall be used for minimizing maintenance of the plantings (vegetation requiring minimal watering).

.8 In General, low maintenance landscape design and features shall be used.

3.6.2 PROFESSIONAL REQUIREMENTS

The entire site landscaping work shall be designed by a Registered Landscape Architect. This Landscape Architect must maintain his or her registration, at minimum, throughout the entire design and construction process and life of the design contract for the project (continuously and unbroken).

.1 The entire site landscaping work shall be installed and/or modified by a Professional Landscaper or Professional Gardener. All landscaping shall be guaranteed (plants and grass) for a period of sixteen months after acceptance by the Agency. This guarantee does not include annuals if used.

.2 The design professional shall anticipate all costs for the landscaping in the final estimate of costs. These costs shall be included in the overall costs of the project. Such cost shall include, but shall not be limited to, the following:

.2.1 Retaining curbs and walls
.2.2 Plantings and grasses
.2.3 Exterior signage and graphics
.2.4 Site furniture and furnishings
.2.5 Irrigation
.2.6 Site hardscape and special pavings

.2.7 Warranties and guarantees
.2.8 Exterior screens and barriers
.2.9 Specialty features incorporated into the design
.2.10 Maintenance guarantees
.2.11 Site lighting
.2.12 Site Sculpture

3.6.3 GENERAL SITE REQUIREMENT

All landscaping and site amenities for the proposed development shall be in accordance with all applicable local, state and federal codes and industry standards. Also, any master plan or campus design and construction requirements and/or standards shall be incorporated and used. The more stringent requirements shall be used if a conflict exists.

3.6.3.1 EXISTING CONDITIONS

.1 Preserve existing trees and undergrowth where appropriate for buffers. Review buffer requirements of the local community.

.2 Use existing trees for greater immediate impact on site.

3.6.3.2 PLANTINGS

.1 Establish functional design criteria.
.2 Consider focal or entry areas, with an obvious sense of arrival at main entry.
.3 Create views and/or screen views.
.4 Develop color and seasonal interest.
.5 Provide orientation and creation of shade.
.6 Consider ultimate size and scale relative to specific area or site size.
.7 Consider formal planting plan or informal, naturalistic plan.
.8 Avoid major plantings in areas where expansion is planned.
.9 Provide appropriate location of plantings relative to prevailing wind and sun.
.10 Break up large areas of pavement with landscape islands.
.11 Planting to be tolerant of climate, weather conditions, rainfall, etc.
.12 Determine irrigation requirements.
.13 Determine maintenance requirements such as fertilization rates, soil acidity and, if required, pruning/trimming needs.
.14 Plantings to be coordinated with location of signs, light standards, hydrants, underground utilities, etc.
.15 Lawns to slope for proper drainage and shall be a minimum 1 percent grade.
.16 Provide ground cover on severe slopes for aesthetic and maintenance considerations.
.17 Planting must be reviewed and approved by the appropriate Agency personnel.

3.6.3.3 SITE FURNITURE AND FURNISHINGS

.1 Furniture design shall compliment the building theme.
.2 Determine quantity and location of furniture.

.3 Establish function intended for seating/waiting areas, outdoor meeting areas and eating areas.

.4 Determine flag pole heights, location, quantity and integrate into the design.

.5 Identify and locate the style, color and purpose of fences.

.6 Integrate trash receptacles, cigarette urns, newspaper dispenser boxes and mailboxes into the design.

.7 Include safety review of proposed surfaces, equipment and layout of programmed recreational or playground equipment.

3.6.3.4 SITE LIGHTING

.1 Lighting design shall compliment the Architectural and Land Planning theme and shall be in accordance with any current master plan or campus requirements.

.2 Utilize energy efficient and easily maintainable fixture types (the selection of lighting fixtures must consider long term costs).

.3 Heights of lighting standards are to be appropriate to the building scale or the area being lit.

.4 Provide lighting intensity commensurate with its use and the health and safety of the employees and public accessing the building during non-daylight hours.

.5 Control light onto adjacent property.

3.6.3.5 EXTERIOR SIGNAGE AND GRAPHICS

.1 Provide appropriate scale.

.2 Consider angle viewed and speed of observer.

.3 Determine appropriate color, letter style and clarity of message.

.4 Establish appropriate locations for signage including intersection, parking lots and entries.

.5 Design to compliment the building style, accent color or building color.

.6 Identify functions clearly; show traffic direction, orientation and general information.

.7 Building identification at site entries and on the building must be coordinated, strong, legible and compatible with interior signage and graphics.

.8 Signage ordinances shall be reviewed; compliance is required.

.9 Special identification, if required, will be provided for the specific project on a case by case basis.

.10 Signage must be reviewed and approved by appropriate Agency personnel.

.11 Exterior signage shall be designed to allow future removal and change without requiring the existing exterior materials to be damaged or requiring repair as a result of signage removal. Consideration shall be given to allow the reuse of the signage after its removal and/or the reuse of the lettering of the removed signage.

3.6.3.6 OUTSIDE SERVICE AND UTILITY AREAS

There are many elements necessary for the proper operation of a building. Some are visually undesirable and require proper planning for screening and buffering incorporated into the building design. The design professional is responsible for coordinating the work of all disciplines and identifying all elements of the proposed project which will have a visual impact. The following are among the items to be considered for appropriate screening and buffering:

Meters
Vaults
Transformers
Dumpsters
Compactor Units
Emergency Generators
High Pressure Gas Cylinder Storage and Manifold Systems
Pressure Reducers
Valves
Pump Hoses
Outdoor Storage Areas
Loading Docks
Mechanical Equipment
Compressors and Cooling Towers

3.6.4 HARDSCAPE REQUIREMENTS

The hardscape and hardscape materials shall integrate with the building and architectural planning and landscaping design and concept. In general, materials that produce a softening of typical hardscape (paving) designs shall be used. Appropriate material usage shall be integrated with an understanding of project budget and public versus restricted access and use areas.

3.6.5 RECREATIONAL REQUIREMENTS

Recreational site requirements shall be reviewed with the Agency on a project by project basis.

END OF SECTION

SECTION 4

OFFER REQUIREMENTS

SECTION 4

OFFER REQUIREMENTS

NOTE: THE INFORMATION IN THIS SECTION 4 SHALL BE PROVIDED BY EPA AND IS NOT A PART OF THE SCOPE FOR THIS DELIVERY ORDER NO. 6 - STANDARDS

4.1 HOW TO OFFER

4.2 OVERVIEW OF SERVICES

4.3 PHASES, TASKS AND DELIVERABLES

4.4 OFFER DUE DATE

4.5 OCCUPANCY

4.6 TERM

4.7 NEGOTIATIONS

4.8 PRICE EVALUATION

4.9 AWARD

4.10 CONSTRUCTION

4.11 FIRE PROTECTION/OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY

4.12 HANDICAPPED AND SEISMIC SAFETY

4.13 ALTERNATE PROPOSALS

4.14 QUALIFICATION CRITERIA

4.15 EVALUATION FACTORS FOR AWARD

END OF SECTION

SECTION 5

ARCHITECTURAL REQUIREMENTS

SECTION 5

ARCHITECTURAL REQUIREMENTS

5.1 CONCEPTS AND COMPONENTS

5.1.1 GENERAL
The architecture of any proposed facility for the United States Environmental Protection Agency shall be functional and flexible, capable of keeping pace with changes continually occurring in the Agency programs due to increased regulatory activity. Its components shall be organized in a functional as well as aesthetic manner, utilizing a modular design concept that addresses the needs of all users of the facility. The facility design should blend with its natural and man-made environment, and provide for reduced energy consumption as called for in these design guidelines. Locating mechanical equipment on roofs is to be avoided, unless it is totally impractical to do otherwise. If mechanical or other equipment is located on the roof, particular attention must be paid to aesthetically screen the equipment. Screening shall be of such design as to prevent the entrance of rain into the fresh-air intakes of the facility and to prevent re-entrainment of laboratory exhaust air into the fresh-air intakes of this facility and adjacent facilities.

5.1.2 QUALITY OF LIFE
This section establishes requirements for quality of life standards within the laboratory spaces for the users of this facility. Creation of comfortable work environments stimulate productivity, enhance recruitment and help retain top scientific investigators.

5.1.2.1 LABORATORY DENSITY
Providing each investigator with adequate laboratory work space, laboratory support space, office space and administrative support space is a critical element in creating an appropriate and comfortable work environment. These are important quality of life standards to be achieved in the design process. When researchers are not provided an adequate amount of space in which to productively work, they will creatively resolve their work space shortage, generally compromising both the health and safety of themselves and others. Refer to Section 2.2.5 - SUMMARY OF REQUIREMENTS for the minimum space requirements.

5.1.2.2 NATURAL LIGHT
Proposed non-laboratory work areas that are above grade and contiguous with an outside wall shall have windows. The introduction of natural light into the laboratory provides investigators with an opportunity for visual relief from the pressures and stress of the work environment. This presents design challenges in large, multi-storied facilities and has significant impact on planning and functional zoning concepts. Whenever possible, and unless in direct conflict with functional requirements, laboratories shall be located in such a manner to maximize natural daylight through direct or indirect means. If windows are provided in laboratory spaces, they shall be fixed panel non-operable type windows. Laboratories utilizing photographic and optical diagnostic techniques shall have blackout capability.

5.1.2.3 LIGHTING

Laboratories require a high quality of lighting to be provided for close, investigative work to eliminate eye strain and fatigue. Task lighting must be bright, uniform, and glare free. Lighting fixtures must be positioned in a manner to provide shadow-free illumination of the laboratory work area. Goals set forth in EPA's GREEN LIGHT Program shall be followed throughout the facility.

5.1.3 FLEXIBILITY / ADAPTABILITY

The building itself and all its systems, architectural, mechanical and electrical, shall also be as flexible and adaptable as possible since functions and related laboratory operations often change. The proposed building(s) and systems shall allow for future space adjustments with minimal disruption to ongoing activities.

5.1.4 MODULAR DESIGN

Modular design is the concept upon which flexible laboratory facilities are created, with the laboratory module representing the fundamental planning and organizing element. The discipline of repetitiveness, regularity of size , shape and arrangement of space provides the ability to convert and/or renovate space quickly dependent on each investigator(s) unique set of laboratory design requirements and demands.

5.1.4.1 PLANNING MODULE

The laboratory planning module establishes a dimensional discipline for dividing space and a method to calculate laboratory systems requirements and distribution concepts. The intent is to determine common space and systems denominators that will accommodate a variety of functions and systems. As changes are required, a modular planning approach allows the expansion, subdivision or reconfiguration of rooms without disturbing adjacent spaces or altering or forcing shutdown of central building utility systems.

.1 A modular design is required. The planning module size establishes the most responsive sizing of space to these criteria. The design professional shall, therefore, study the requirements, evaluate the equipment and instrumentation needed for each laboratory and either use this module size, or propose other module sizes which architecturally and operationally will provide the required features.

.2 The structural system shall allow for future changes in various mechanical and utility services. Floor-loading capability shall be uniform throughout the building to permit space usage conversions.

.3 Laboratory systems capacity must be determined based on the common laboratory module denominator which can anticipate future needs, where each module represents a unit of capacity for the building system (i.e., gallons of water, watts of power, CFM of supply and exhaust air). This generic method of calculating systems distribution insures adequate building utility systems capacity and prevents costly shutdown and reconstruction of primary building systems components.

.4 Modular laboratory design shall integrate primary building systems (HVAC, piping, electrical power, and communication) into consistent, recurring points of distribution relative to the planning module. These points of distribution provide modules with accessibility to all laboratory systems, so any additional services required in the future can easily be extended from the main distribution loop to the point of use.

.5 Building systems must be readily accessible for maintenance and servicing. Components that require routine servicing should be located, in corridor ceiling spaces or other spaces outside the laboratory module perimeter. Servicing building systems components inside the laboratories is disruptive and difficult due the amount of scientific equipment that must be protected. Whenever systems components are placed above ceilings, a lay-in type ceiling should be used or access panels installed to facilitate access for servicing and maintenance.

5.1.4.2 EXPANSION

Recognizing the probability of future expansion, a plan should be established that zones the facility horizontally and/or vertically and accommodates future growth in a logical manner. This plan must establish a framework for central building systems which can easily be extended or added to dependent on the amount of growth.

5.1.5 ENTRANCE REQUIREMENTS

All entrances to the facility must be clearly defined. There shall be only one main entrance although access to this main entrance may be from a variety of directions. The following are general design requirements for the main entry area:

.1 Means of egress shall comply with all applicable codes with particular attention to NFPA 101 and Chapter 4, paragraph 6 of the most current version of the Facility Safety Manual for fire safety requirements.

.2 The entry area shall be consistent with the design of the facility. The space(s) and material selection shall be designed to express the Agency's and facility's position in the world environmental community. Materials shall be high quality and durable.

.3 The entry spaces should be open, airy and inviting to the entrant.

.4 The entry must be easily recognizable and allow easy transition to other facility areas by first time users of the facility.

.5 The building(s) subdivisions and arrangement of exits, corridors, vestibules, lobbies and rooms should be such as to allow fast and orderly exit in case of emergency and provide appropriate security for the protection of personnel, property and experiments. The facility and interior modules shall have controllable access which would assure a safe and secure working environment.

.6 Security control shall be at the main entrance, and shall have good visual control over the building entrance and lobby spaces as well as monitor control over other exits and entrances.

.6.1 Often times a full-time security station is not economically justified for the level of staff and visitor traffic through the entrance of the facility. The receptionist may need to fulfill the security roll.

.7 Administrative areas shall be in close proximity to security control.

.8 Reception function activities shall support the security control staff and shall be at the same location within the entrance/lobby area.

.9 The lobby shall be sized and designed to include the special concerns involving tours while maintaining discrete security and function.

5.1.6 AMENITIES

A work place that encourages communication, interaction and collaboration among its users results in enhanced worker productivity and higher employee retention. Staff interaction, especially in laboratory facilities, must be a sought after element in the design solution. Functional organization and relationships that promote these elements must be utilized. Planning concepts that promote casual encounters through strategic location of common support areas, i.e., conference rooms, restrooms, coffee and vending areas, clerical support services and supplies, and carefully considered circulation patterns can serve to further foster meaningful interaction and provide a place to safely consume food and drink outside the laboratory. Building amenities must be dedicated, neutral spaces that are protected from encroachment and future conversion.

5.1.7 NOISE CONTROL

Noise levels in the different rooms of this facility should be in accordance with the latest edition of ASHRAE Handbook, HVAC Systems and Applications, Chapter 52 (Sound and Vibration Control). Proper schematic planning should isolate noise sensitive areas from noise sources by separation with a non-sensitive buffer area. In addition, dedicated laboratory support spaces should be provided to isolate noise producing equipment, such as centrifuges and vacuum pumps from laboratories. In any instrument or laboratory space in which one or more fume hoods are used, the noise level should preferably be 65 dB but not exceed 70 dB at the working position in front of the hood. Noise generated from vibration by HVAC systems may be minimized by several means: judicious equipment selection, limitation of fluid flow velocities, isolation of key mechanical, piping, and ducting systems, and other prudent engineering and architectural means.

5.1.7.1 VIBRATION ISOLATION

Vibration isolation systems should be provided on rotating mechanical equipment greater than 1/2 hp located within a critical area, greater than 5 hp elsewhere in the building, and greater than 10 hp outside the building within 200 feet of the building. Reciprocating equipment (other than emergency equipment) shall not be used.

.1 Concrete inertia bases will be used with rotating mechanical equipment handling liquids (e.g., pumps) and with compressors. Steel frames will be used for air-handling equipment.

.2 Flexible pipe connectors (e.g., twin-sphere connectors) will be used on piping connecting to isolated equipment and where piping and ducting exit the mechanical room(s).

.3 Flexible duct connectors will be used in a manner similar to flexible piping connectors.

5.1.7.2 PIPING AND DUCTING SYSTEMS

Passive piping and ducting are those that are at great distance from their energy source and have low flow rates and/or infrequent use such as city water, gases, waste water, etc. Conversely, active piping systems are those close to energy sources and can be a major vibration concern requiring isolation.

.1 Flow velocities for active piping and ducting shall be sized for economical flow velocities.

.2 Ducts less than 24 inches in diameter do not require isolation provided the flow velocities do not exceed 1,200 feet/minute. Ducting not meeting this requirement shall be isolated.

.3 Active piping associated with HVAC (chilled water, condenser water, hot water, steam, and refrigerant piping) within mechanical rooms or within a 50 foot distance (whichever is longer) from connected vibration isolated equipment (chillers, pumps, air handlers, etc.) or ground shall be isolated from the building structure; resilient penetration sleeves shall be used where this piping penetrates walls. Flexible piping connectors shall be used where the piping leaves the mechanical room. All active piping in the critical area having a diameter of 4 inches or less shall be isolated.

5.1.8 HANDICAPPED ACCESSIBILITY

The design and layout of an EPA facility must be accessible by the physically challenged in accordance with the most current revision or superseded version of the Uniform Federal Accessibility Standards (1988) adopted by the General Services Administration (GSA) in 41 CFR 101-19.6, the Americans with Disabilities Act (ADA) and the most current revision or superseded version of all other applicable federal, state and local laws and standards for buildings and facilities requiring accessibility and usability for physically challenged people (Barrier Free Design). Where in conflict, the more stringent code shall apply. In the event that the more stringent code for a particular conflict cannot be determined by the design professional, the Government reserves the right to make the final decision on the interpretation of all codes.

5.1.8.1 GENERAL ACCESSIBILITY

General access to the facility and any portion thereof shall respond to common sense design and all applicable standards, guidelines, codes including ADA and GSA 41 CFR 101-19.6. The Agency recognizes that the facility is not intended to be designed for a population of 100% physically challenged individuals. However, the design professional shall clearly understand all such applicable requirements and produce a final design that not only accommodates these requirements, but also applies their essence in a common sense design throughout 100% of the facility. As a minimum, the design professional shall meet and exceed all such applicable standards, guidelines and codes. Other aspects of general access are as follows:

.1 Avoid crossing pedestrian and vehicular circulation paths.

.2 Provide adequate circulation space at points of traffic congestion and architectural features that emphasize overall circulation patterns and major entrances.

.3 Avoid confusing corridor systems and extensions of through corridors from department to department.

.4 Avoid horseshoe shaped major corridor systems that require excessive walking distances.

.5 Avoid dead end departmental corridors.

.6 Minimize single loaded corridors.

.7 Eliminate major corridors through elevator lobbies or through other areas which tend to concentrate circulation patterns.

.8 Locate vertical transportation so that it is visible from major entrances.

5.1.8.2 LABORATORY ACCESSIBILITY
Accommodating the handicapped will require flexibility, adaptability, and common sense in the design of a laboratory environment that functions properly within handicapped compliance requirements of the law, and offers safety for the users. There should be at least one work station and support area for each type laboratory that is accessible to handicapped individuals. Some general criteria for handicapped accommodation in laboratories are as follows:

.1 The handicapped accessible work station shall provide for a work surface 30 inches above the floor with all wheelchair clearances below. Adjustable work surfaces which provide a range of height adjustments shall be considered for all such work stations.

.2 Utilities, equipment, and equipment controls for laboratory furniture should be within easy reach for persons who are physically handicapped and of limited mobility. Controls shall have single action levers or blade handles for easy operation.

.3 Aisle widths and clearances shall be adequate for maneuvering of wheelchair bound individuals. Aisles 42 to 48 inches wide are recommended with turn around areas as required by code.

.4 Locate handicapped work stations as close to laboratory exits and safety showers as possible.

5.1.8.3 ADA COMPLIANCE
The Americans with Disabilities Act is only one of several applicable and required standards, ordinances, codes and guidelines to which the design professional must adhere. The more stringent shall govern on an item by item, case by case basis.

5.2 EXTERIOR BUILDING MATERIALS

5.2.1 GENERAL

In selecting building materials, careful consideration shall be given to all technical criteria. Vapor barriers shall be selected with respect to vapor flow through the walls and roofs to prevent moisture accumulations and condensation within the building structure, reduction of thermal performance and increased latent cooling load in the space.

5.2.2 EXTERIOR ELEMENTS

Mechanical, electrical, transportation and equipment items which are to be located on the exterior of the facility shall be integrated elements of the design. These elements include air intake/exhaust vents, exterior lights, utility connections, plumbing vents, fuel tank vents, liquid oxygen tanks, transformers, trash compactors, containers, loading docks, condensers, cooling towers, and mechanical equipment.

5.2.3 DESIGN CHARACTERISTICS

Evaluate the design characteristics of wall schemes for aesthetic, functional and cost effectiveness as their characteristics relate to the following:

.1 Moisture Transport.

.2 Thermal Performance.

.3 Aesthetic Appropriateness.

.4 Historic Considerations (if applicable and appropriate).

.5 Durability (life cycle maintenance costs).

.6 Exterior wall termination at the roof or top of parapet walls (including penthouse).

.7 Construction and control joint locations, considering impact on construction sequence and building movement due to expansion and contraction.

.8 Corner conditions, especially material relationships at the intersection of vertical planes and the continuity of wall supports and flashings.

.9 Load transfer of the wall to the structure, including consideration of structural frame exposure and lateral wall supports.

.10 Weathertight design, including sealant profiles, material adjacencies and flashing configuration.

.11 Window placement relative to the wall, secondary connection requirements, material adjacencies, window washing, glass type and thickness and life safety hardware.

5.2.4 THERMAL RESISTANCE

Obtain the thermal characteristics of single materials or wall assemblies from the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) *Handbook of Fundamentals* or from manufacturer's certified technical information. Identify thermal resistance (R) values for each element in the building shell. Prepare "U" factor calculations following recommended procedures as documented in the ASHRAE *Handbook of Fundamentals.*

5.2.5 MOISTURE TRANSPORT

Prepare dew point calculations following recommended design procedures in the ASHRAE *Handbook of Fundamentals* (Reference 4c). Design the exterior envelope to prevent condensation.

5.3 PARTITIONS

5.3.1 GENERAL

Standardization of interior partitions is desirable. Partitions within the administrative area should be easily removable. Sound isolation and laboratory partitions between modules shall be designed to be removable to accomodate future reconfiguration of spaces.

5.3.2 SUB-DIVIDING PARTITIONS

Office sub-dividing partitions shall comply with the Uniform Building Code (UBC) and local requirements. They must be provided at a ratio of one linear foot for each 10 square feet of space provided. Partitioning over interior office doors is included in the measurement. Partitions must extend from the finished floor to the finished ceiling and have a flamespread rating of 25 or less, a smoke development rating of 50 or less (ASTM E-84-Test), and a minimum STL rating of 40.

5.3.3 PERMANENT PARTITIONS

Permanent partitions must be provided as necessary to surround stairs, corridors, elevator shafts, toilets, janitor closets, and mechanical rooms. They shall have a flamespread rating of 25 or less and a smoke developed rating of 50 or less (ASTM E-84 Test). Stairs, elevators, and other floor openings shall be enclosed by partition(s) and have the fire resistance required by applicable codes.

5.3.4 FINISHES & COVERINGS

5.3.4.1 WALL FINISHES

In general, the walls shall be gypsum wallboard on metal studs with a painted finish. Paint shall be carefully selected so as not to affect laboratory operations. Walls in laboratory areas will be required to support additional loads due to movable casework, mounting rails, upper cabinets or adjustable shelves, and equipment anchorage. As such, structural wall studs, backing plates, and lateral bracing sufficient to withstand heavy loads will be required. Where concrete masonry unit (CMU) block or poured concrete walls occur due to other design requirements or constraints, they shall be furred with gypsum wallboard, or covered with other appropriate finish.

5.3.5 MAGNETIC LIQUID CHALK DRY MARKER BOARDS & TACK BOARDS

Magnetic dry marker boards (liquid chalk) shall be used except when solvent markers used on these boards would affect operations undertaken in laboratories; chalk type chalkboards shall not be used. Locations of magnetic dry marker boards and tack boards shall be determined by the design professional in close coordination with the appropriate representative from the Agency.

5.4 INTERIOR FINISH MATERIALS

5.4.1 GENERAL

The required finishes are called out for each room in the room data sheets included with this document.

5.4.2 WALL MATERIALS

Wall materials must be capable of withstanding washing with detergents and disinfectants. Materials selected shall be compatible with the intended use and shall emphasize durability and low maintenance while creating a comfortable work environment.

5.4.3 FINISH CEILINGS

Ceilings shall be set at a minimum 9'-8" in both general spaces and laboratory spaces. With the exception of service areas, they must have acoustical treatment acceptable to the Contracting Officer, a flamespread of 25 or less, and a smoke developed rating of 50 or less (ASTM E-84). Protrusions of fixtures into traffic ways is not allowed.

5.4.3.1 CEILINGS NOT IN EXIT PATH

Ceilings and interior finishes in areas not part of the normal exit may have flamespread and smoke development limits of 200, unless an applicable code is more restrictive. The more restrictive applicable code shall be used.

5.4.3.2 CEILINGS IN EXIT PATH

In sprinkler protected exits or enclosed corridors leading to exits, ceilings and interior finishes may be composed of materials having a flamespread rating of 75 or less and a smoke development rating of 100 or less unless an applicable code is more restrictive. The more restrictive applicable code shall be used.

5.4.3.3 CEILING FINISHES

Where ceiling finishes are required, they will, in general, be suspended acoustical tile with recessed fluorescent lighting fixtures. Other ceiling finishes will be required in special rooms as called out on the room data sheets. These will include hard ceilings with sealed openings for clean analytical laboratories. Special consideration shall be given to the type of grid system and acoustical tile when used in moist, wet, food service and other specialty areas.

5.4.4 OPEN CEILINGS

All areas above open ceilings shall be painted. The design professional shall assure that the necessary coordination occurs for all requirements regarding painting of exposed areas, including engineered systems which require color coded painting or stenciling as well as general code required stenciling of nomenclature defining the rating of fire walls.

5.4.5 SOUND DAMPENING

Sound dampening features (acoustical treatment), preferably of rigid materials, shall be provided in the following instrument rooms, and the noise level should preferable be 65 dB but shall not exceed 70 dB to ensure a maximum of 70 decibels at the work stations in the laboratory: Gas Chromatography/Mass Spectrometer Laboratory (Extractables), Gas Chromatography/Mass Spectrometer Laboratory (Volitales), Gas Chromatography/ Mass Spectrometer Laboratory (Air), Metals Induced Plasma Laboratory, Metals Induced Plasma/Mass Spectrometer Laboratory, and X-Ray Fluorescence Laboratory.

5.5 FLOOR TREATMENTS

5.5.1 GENERAL

Floor finishes shall be compatible with the intended use of the room and shall emphasize durability and low maintenance. Materials must be smooth, nonabsorbent, skid-proof and wear resistant. Laboratory flooring should resist the adverse effects of acids, solvents and detergents. Materials must be monolithic or have a minimal number of joints. The base may be a 4 inch vinyl or rubber base or integral coved base where sheet vinyl flooring is used.

5.5.2 CARPET

Carpet tiles shall cover all office floors and must meet the static buildup and flammability requirements which follow:

5.5.2.1 SPECIFICATION

The following specifications must be met for all new carpet installation:

.1 Pile yarn content: Continuous filament soil-hiding nylon or wool/nylon combinations.

.2 Carpet pile construction: Level loop, textured loop, level cut pile, or level cut/uncut pile.

.3 Pile weight: 28 ounces per square yard minimum.

.4 Secondary back: Synthetic fiber or jute for glue-down installation.

.5 Total weight: 64 ounces per square yard minimum.

.6 Flammability: In all areas except exits, carpet must have a critical radiant flux (CRF) of 0.25 or greater with a specific optical density not over 450. Carpet in exits must have at least a CRF of 0.50. Carpet passing the Consumer Products Safety Commission FFL-70 (Pill Test) is acceptable for office areas. It may also be used in corridors which are protected by automatic sprinklers. Check applicable codes for any more restrictive requirements. The more restrictive requirement shall be used.

.7 Static Buildup: 3.5 KV maximum with built-in static dissipation is recommended, "static-controlled" is acceptable. More restrictive levels shall be required in sensitive areas such as computer rooms and shall be determined by calculations for any special equipment utilization.

5.5.2.2 COLOR

For new carpet to be installed, the design professional shall provide the Government a minimum of 3 color samples. The sample and color must be approved by EPA prior to installation. No substitutes may be made by the design professional after sample selection.

5.5.2.3 INSTALLATION

Carpet must be installed in accordance with manufacturer's instructions.

.1 Carpet shall be replaced at least once every seven years during government occupancy or any time when backing or underlayment is exposed; and/or there are noticeable variations in surface color or texture.

.2 Carpet replacement shall include the moving and returning-in-place of all furniture. Floor perimeters at partitions must have wood, rubber vinyl, or carpet base. Any exceptions must be approved by the Contracting Officer.

.3 The design professional shall specify that an additional 10% of the selected carpet tiles be provided by the Contractor for Owner's own stock and replacement. These carpet tiles are not to be used during the warranty period.

.4 The requirements for "Off-Gassing" in accordance with Chapter 5 paragraph 12.c. of the current version of the Facility Safety Manual shall be followed.

5.5.3 VINYL TILE

All new Vinyl Tile, unless indicated otherwise elsewhere in this document, shall be 12" x 12" x 1/8" thick, 35% to 40% reflectance, high density, meeting requirements of Federal Specification SS-T-312, Type IV. Adhesives used to set tiles shall be environmentally acceptable. Colors and patterns will be selected from three or more manufacturers by the Government.

5.5.4 SEAMLESS VINYL FLOORING

Seamless flooring shall be vinyl seamless flooring, chemical resistant as manufactured by Tarket or Mipolan or an approved equal and shall be coved 4 inches up the wall of same material. Joints shall be chemically welded smooth without any grooves. Adhesive to set the flooring shall be environmentally acceptable.

5.5.5 CERAMIC TILE FLOORING

Ceramic tile flooring shall be sealed in all grout areas. A minimum of 5 color samples shall be incorporated into the color boards provided by the design professional for approval by the Agency representative.

5.5.6 SPECIAL FLOORING

Special floor coating systems shall be a troweled, jointless floor system with a slip resistant top coating which shall be waterproof and resistant to alkalies and acids. The special flooring system selected should be compatible with the intended use.

5.5.7 EXPOSED CONCRETE FLOORING

Steel trowel finish shall be used on exposed concrete floors not receiving other finish. Exposed interior concrete floors shall be sealed with a penetrating-type solvent base or water-emulsion-base unpigmented sealer containing a suitable type resin and no wax.

5.6 DOORS

5.6.1 GENERAL
Doors must have heavy duty hardware with hardware stops. All public use doors must be equipped with push plates, pull bars or handles and automatic door closer. Corridor and outside doors must be equipped with cylinder locks and door checks. All locks must be master keyed. The Government must be furnished with at least two master keys and two keys for each lock. Hardware for doors in the means of egress shall conform to NFPA Standard No. 101.

5.6.2 EXTERIOR DOORS
Exterior doors shall be weather-tight, equipped with automatic door closer, open outward and shall have drip rain deverter mounted above the door to channel water to exterior wall.

5.6.3 INTERIOR DOORS
Interior doors must have a minimum opening of 36 inches by 80 inches as required by handicapped accessibility. Hollow core wood doors are not acceptable. Hardware shall be handicapped compliant. Doors shall be operable by a single effort, and be provided with vision panels in accordance with all applicable Code requirements. All requirements of the most current version of ADA shall be incorporated.

5.6.3.1 LANDING AREAS
The landing area for doors that open on to walkways, ramps, corridors, and other pedestrian paths of travel, shall be clear and level with a slope no greater than 1:50 and extend a minimum of 5 feet from the swing side of the door, 4 feet from the opposite side, and a minimum of 1-1/2 feet past the latch side (pull side) and a minimum of 1 foot past the latch side (push side) of the door.

5.6.4 FIRE DOORS
Fire doors shall conform with National Fire Protection Association Standard No. 80.

5.6.5 LABORATORY DOORS
Laboratory doors shall be 48" wide (36 inches wide for the active leaf and 12 inches wide for the inactive leaf and 84 inches high) adequate to facilitate easy movement of equipment and carts. In general, large vision panels should be provided as a means of easy, quick safety inspection of the laboratory spaces. Hardware shall be handicapped compliant and provide various levels of access control as required, and will include both combination and key access locks. Areas where a high level of security will be required shall be provided with card-key access control.

5.7 WINDOWS

5.7.1 GENERAL

The use of natural but controlled daylighting should be maximized with a specific study of energy conservation. The Agency values natural light and perceives it as part of an exemplary working environment as well as a source of potential energy savings. The building organization and design concept shall bring adequate natural light into personnel spaces. Window size, number, and location shall be determined by need for natural light and/or ventilation as well as by energy considerations. All exterior windows used in heated or air conditioned spaces shall use double glazed insulated low E glass and thermal break sash.

5.7.2 FIXED WINDOW SYSTEMS

Laboratory space shall have non-operable windows, except with a key where required for cleaning purposes, for the purpose of maintaining temperature and humidity control and room pressurization relationships.

5.7.3 STOREFRONT AND CURTAIN WALL SYSTEMS

Windows extending 18 inches from the floor and located at least 4 feet above grade shall be provided with a safety bar on the interior window approximately 3 feet above floor level. Off-street, ground-level windows and those accessible from fire escapes and adjacent roofs must have anti-intrusion alarm systems to deter forcible entry.

5.8 WINDOW COVERING

5.8.1 GENERAL

The design professional shall be responsible for providing window coverings for interior and exterior windows where required by the room data sheets. All exterior windows shall be reviewed and considered for window coverings. The design professional shall also be responsible for considering window coverings where not listed in the data sheet when solar glare and heat gain should be controlled.

5.8.2 BLINDS

Window blinds in laboratory spaces may be either vertical or horizontal with non-metallic slats. Color selection will be made by the Agency representative. The hardware and blind mechanisms shall be acid resistive materials.

5.8.3 BLACKOUT SHADES

Rooms requiring blackout capability shall be equipped with blackout shades. Shades should be a pre-engineered unit with a fiberglass-coated fabric shadecloth. They must have a noncorroding, concealed variable adjustment mechanism, adjustable from 100% friction (static mode) with finite positions to 15% friction (dynamic mode) with only pre-selected positions.

5.9 WALLS - COVERING & FINISH

5.9.1 GENERAL
The required finishes must be designated for each room in the room data sheets, a copy of which is included with this document. Actual material selection, color, texture, etc. is left to the design professional who shall select them in consultation with the users. The design professional must also select finish materials for those items and areas not specifically designated in the Room Data Sheets. This selection shall be submitted for final approval by the government representative.

5.9.2 FLAMESPREAD AND SMOKE LIMITATIONS
Wall finishes which are a part of a means of egress must have a flamespread of 25 or less, and a smoke development rating of 50 or less. All new construction for EPA shall be protected throughout by a sprinkler system meeting the Government's approval, as such wall finishes in all areas, except those areas which are a part of the means of egress, may have flamespread and smoke development limits of 200 (ASTM E-84), unless otherwise restricted by any applicable code. The more restrictive requirement shall govern. For any existing construction which is not protected throughout by a sprinkler system meeting the Government's approval, wall finishes must have a flamespread of 25 or less, and a smoke development rating of 50 or less.

5.9.3 VINYL WALL COVERING
Vinyl wall covering where provided in the administrative and other office areas (none shall be provided in the laboratory areas), shall be as follows:

5.9.3.1 CONSTRUCTION
All material shall be of uniform color throughout. Colors and patterns shall be chosen by the Government from standard lines of manufacturers offered by the design professional.

5.9.3.2 MAINTENANCE PROPERTIES
All vinyl wall covering shall be resistant to permanent stains and mildew, and shall be capable of being cleaned with mild non-abrasive cleaners.

5.9.3.3 FIRE HAZARD REQUIREMENTS
Each type of vinyl wall covering used will have a minimum smoke development rating of 15 and a maximum flame spread rating of 15 when tested in accordance with ASTM-E-84.

5.9.3.4 APPLICATION
Application of all vinyl wall covering shall be in accordance with manufacturer's recommendations.

5.10 PAINTING

5.10.1 GENERAL
Prior to occupancy, all surfaces designated by EPA for painting must be newly painted in colors acceptable to and approved by the Project Officer. The design professional shall provide the Government with color samples and color schemes, with their average surface reflectance value clearly identified, for selection.

5.10.2 REFLECTANCE VALUES
Minimum average surface reflectance values which will be used as a base for the selection of interior colors are as follows:

Ceiling	80%
Walls	50%
Floors	30%
Furniture and Equipment	35%
Chalkboards	Not less than 15% nor more than 20% as recommended by the American Illuminating Engineering Society and the American Institute of Architects in their report: American Standard Practice for School Lighting, AIA No. 32F28.

5.10.2.1 ADDITIONAL SPECIFICATIONS
Deviations from these figures are allowed for aesthetic treatment of such areas as conference rooms, lobbies, corridors, executive offices, etc. Surfaces shall also have a matte finish to prevent excessive brightness ratios and to minimize specular reflections.

5.10.3 WALL & CEILING COLORS
Ceiling color can be extended down on walls from one to three feet or to the level of the fixtures to obtain up to 20% increase in utilization.

5.10.4 ACCENT AREAS
Up to 20% of wall surfaces may have values lower than those listed for accent purposes without being considered part of the average.

5.11 INTERIOR SIGNAGE SYSTEMS AND BUILDING DIRECTORY

5.11.1 GENERAL
All signage, identification, room numbering and building directory shall comply with ADA requirements.

5.11.2 DOOR IDENTIFICATION
Door identification shall be installed in approved locations adjacent to office entrances. The form of door identification must be approved by the Agency. Toilet, stairway, and corridor doors must be identified by the international symbol of accessibility at a height of 54 to 66 inches above the floor, and wherever possible, mounted on the wall at the latch side of the door. Seldom used doors to areas posing danger to the blind must have knurled or acceptable plastic abrasive coated handles. Tactile warning indicators shall not be used to identify exit stairs.

5.11.3 ROOM NUMBERING
A room numbering and room naming system for the identification of all spaces for the facility is required. The design professional shall submit plans to the Agency for their review and approval prior to the beginning of construction documents.

5.11.4 BUILDING DIRECTORY
A wall-mounted, glass-enclosed directory with lock shall be provided at a conspicuous location in the lobby or entrance of the building. The directory shall be approximately 2 feet x 3 feet in size. The building directory shall be approved by the Project Officer.

5.12 SAFETY

5.12.1 EXITS
All exits, stairs, corridors, aisles, and passageways shall comply with NFPA Standard No. 101, except that there must be a minimum of 2 separate exits available from every floor. The minimum width of any corridor or passageway in a laboratory area serving as a required exit shall not be less than 72 inches in clear width. The maximum length of dead-end corridors and common paths of travel shall not exceed 20 feet; the design professional shall review applicable codes for more stringent requirements. Vestibules, with double sets of doors, shall be provided at public entrances and exits wherever weather conditions and heat loss are important factors for consideration. Further, in event of negative air pressure conditions, additional provisions shall be made for equalizing air pressure.

5.12.2 EXIT LIGHTING
Emergency lighting must provide at least three (3) foot- candles of illumination throughout the exit path, including exit access routes, exit stairways, or other routes such as passageways to the outside of the building. The requirements of Chapter 6, Paragraph 17. of the current version of the Facility Safety Manual shall be followed. Refer to Section 9, ELECTRICAL REQUIREMENTS, of this document.

5.12.3 EMERGENCY LIGHTING
The emergency lighting system used must be such that it will operate even if the public utility power fails. The system may be powered from connections to separate substations or to a network system from the public utility. Automatic switching must be provided for the emergency power supply. The requirements of Chapter 6, Paragraph 17. of the current version of the Facility Safety Manual shall be followed.

5.12.4 PORTABLE FIRE EXTINGUISHERS
The design professional shall provide and locate portable fire extinguishers within recessed cabinets in accordance with NFPA 10, Standard for Portable Fire Extinguishers. Portable fire extinguishers shall be provided based on classes of anticipated fires and the size and degree of hazard affecting their use. Portable fire extinguishers containing halon shall not be used.

5.12.4.1 FIRE EXTINGUISHER LOCATIONS
Portable fire extinguishers shall be provided in every laboratory room. In the other areas of the building, the minimum number of fire extinguishers needed for protection shall be determined in accordance with NFPA Standard No. 10, Chapter 3, Distribution of Extinguishers.

.1 Class A and D extinguishers shall be located so that the travel distance shall not exceed 75 ft., from the Class A and D hazard areas respectively.

.2 Class B extinguishers shall be located so that the travel distance shall not exceed 50 ft., from the Class B hazard areas.

.3 Extinguishers with Class C ratings shall be located on the basis of the anticipated A or B hazard.

.4 One extinguisher may be installed to provide protection against several hazard areas provided travel distances are not exceeded.

5.12.5 SAFETY DEVICES

Provide eye and face washing equipment and safety showers in every laboratory and laboratory support room where chemicals are being utilized in accordance with ANSI Z358.1. At least one double spray head, hands free operating eyewash shall be provided within every laboratory or every two laboratory modules. Safety showers shall be provided in accessible locations that require no more than 10 seconds to reach and should be within a travel distance no greater than 100 feet from the hazard. The location and installation of emergency showers and eyewash equipment shall be in accordance with Chapter 7, Paragraph 12 of the current version of the Facility Safety Manual.

5.13 TOILET ROOMS

5.13.1 GENERAL

Each of the men's and women's toilet rooms that are located in the laboratory area shall have shower stalls and adequate lockers as may be needed by the laboratory operation and the number of people, men and women, who may be required to use them. All sanitation finishes shall be nonpermeable, noncorrosive, and easily maintainable.

5.13.2 FINISHES

All toilet rooms shall have ceramic tile to a height of 4' 6" and vinyl wall covering not less than 13 ounces per square yard as specified in PS CCC-W-408 on remaining wall areas or equivalent quality as approved by the Contracting Officer, unless an alternate finish is approved by the Contracting Officer.

5.14 JANITOR CLOSETS

Janitor closets shall be provided in sufficient numbers to service the different areas of the building(s). Each block shall have at least one janitor closet with mop sink. These rooms shall be equipped with exhaust ventilation and louvered doors.

5.15 HAZARDOUS WASTE HANDLING

5.15.1 GENERAL

Provide for the safe handling and storage of hazardous materials within the laboratory spaces and in the facility generally. A system for hazardous waste materials management for the facility must be carefully planned with the EPA and the facility users. The plan shall consider receiving, storage, distribution, use and waste removal for all materials utilized in the laboratory spaces of this facility. Recognizing a need to reduce the quantities of hazardous materials stored in the laboratories, the plan must provide for centralized storage areas specifically designed to store and dispense hazardous materials.

5.15.2 RADIOISOTOPES

Requirements for laboratories using radioisotopes vary depending on the quantity and energy level of the isotopes utilized. The design professional shall be responsible for the verification and evaluation with the users of the facility to determine specific project requirements for the safe storage and handling of radioisotopes. A space near the loading dock of this facility shall be provided where radioisotope waste containers can be marshalled for removal from the facility by a certified radioisotope waste contractor.

5.16 CHEMICAL STORAGE AND HANDLING

Ventilated cabinets must be provided for collection of waste in each laboratory. A central area for collection and storage of chemical waste for disposal must be provided where the chemical waste disposal contractor can collect the waste for removal from the facility. Refer to Section-3 paragraph 3.1.6.3.3 HAZARDOUS MATERIAL/WASTE STORAGE FACILITY.

5.17 SECURITY

5.17.1 ACCESS / EGRESS

The building(s) subdivisions and arrangement of exits, corridors, vestibules, lobbies and rooms shall be such as to allow fast and orderly exit in case of emergency and provide appropriate security for the protection of personnel, property and experiments. The facility, buildings, and interior modules shall have controllable access which would assure a reasonably safe and secure working environment.

5.18 LABORATORY CASEWORK

5.18.1 GENERAL

Preferably, all laboratory casework and associated fume hoods required in the facility shall be the product of one manufacturer and installed under the recommendations of that manufacturer. The laboratory casework shall meet the functional, aesthetic, flexibility and maintenance needs of each user.

5.18.2 MODULAR DESIGN

Basic laboratory casework system shall be of modular dimensioned components of modern design consisting of a self-supporting steel frame to contain service piping, drain lines, and to permit the attachment and/or support of various styles of countertops, sinks, cupsinks, and umbilical independently from base cabinet assemblies. Support system shall provide the flexibility and unlimited horizontal interchangeability of any or all cabinet sizes without removal of the working top and interference of immediate vertical legs, supports, brackets, or framing between cabinets.

5.18.3 SUPPORT CAPABILITY

The system shall be capable of independently supporting work surfaces and to contain and support steel undercounter cabinets. All components shall be self supporting and essentially independent of the building structure and shall support sinks, service fittings, plumbing fixtures, and service and waste lines utilizing pipe clamps. The assembly shall be designed and manufactured in such a manner that for each linear foot of span between supporting elements, there is the capability of supporting a live load of 200 pounds per linear foot plus a dead load of 50 pounds per linear foot. In addition, a concentrated load of 250 pounds may also be placed on the front edge at any point (assuming legs spaced at 6'-0" on center) without causing the system to fail in its suspension or tip or deflect more that 3/16 inch.

5.18.4 CABINET ASSEMBLIES

Cabinet assemblies shall be suspended from the support system with fastener devices mounted in front of the unit for attachment to the front rail and shall be designed so that easy removal of units can be accomplished by use of common hand tools. Such devices shall be of forged or cast steel and shall be commercially cadmium plated. Filler panels shall be provided at exposed-to-view areas, between back of cabinets and walls, between backs of cabinets at the end of the peninsula or island benches, and at knee openings to allow for the maintenance of mechanical services.

5.18.5 BASE CABINETS

Casework shall be of a metal construction of slim-line design and shall be constructed in accordance with highest standards and practices of the metal casework industry. Superior quality casework shall be established by proper machinery, tools, dies, fixtures, and skilled workmanship such that the fit of doors and drawers allow vertical and horizontal openings of minimal tolerance. All units shall be of flush-front construction such that drawer and door faces are in the same plane as exterior case members. Each unit shall be a completely welded structure and should not require additional parts, such as applied panels at ends, backs,or bottom.

5.18.6 WALL CABINETS

Upper wall cabinets shall be designed so cabinets hang rigidly vertical without sag or tilt. The design professional shall be responsible for ensuring that proper reinforcement is installed at the walls to support resulting load. Cabinets should be of similar construction as base cabinets and shall be modular in design and installation to permit immediate interchangeability of all wall cabinets and/or shelf units.

5.18.7 SHELVING

5.18.7.1 REAGENT SHELVES

Reagent shelves shall be 1 inch thick plywood faced on both sides with acid-resistant plastic laminate with all exposed edges edge-banded in 3 mm (1/8 inch) PVC. Shelf supports shall be 1 inch OD, cold-rolled, seamless mechanical tubing attached to the benchtop with 3/8 inch diameter studs screwed to metal backup plates.

5.18.7.2 ADJUSTABLE SHELVING

Adjustable shelving shall be 16-gauge steel shelving with hat section reinforcing and shall be interchangable with wall hung cabinets. Shelving standards shall be double slotted type, 30 inches in length mounted at a height of 54" above finished floor to the bottom of the standard. Brackets shall be 16 gauge metal with three blade hooks and screwed to each shelf.

5.18.8 COUNTERTOPS

Countertop materials will vary depending on the intended use. The design professional shall be responsible to evaluate the requirements of the laboratories to determine the countertop material most suitable for each specific application. The same material determined for use as the countertop material shall also be used for back-splashes, side-splashes and services ledge covers.

5.18.8.1 PLASTIC LAMINATE

Chemically resistant plastic laminate countertops may be used in many applications where the use of extremely corrosive chemicals or large amounts of water are not expected to be used.

5.18.8.2 EPOXY RESIN

Epoxy resin countertops shall be utilized in laboratories or in areas where large quantities of water or extremely corrosive chemicals are being utilized on a routine basis. All joints shall be bonded with a highly chemical and corrosion resistant cement having similar properties as the base material.

5.18.8.3 STAINLESS STEEL

Stainless steel countertops shall be used in special applications where sterile conditions are required (e.g., glassware washing areas, autoclave rooms), controlled environmental temperatures (e.g.,cold rooms, growth chambers), and where radioisotopes are being used.

5.18.9 MATERIALS

Standard Laboratory casework shall be of metal construction unless otherwise indicated. For those rooms not requiring casework of metal construction, the casework materials shall be of wood or approved plastic. Hardware used for wood or plastic casework shall be epoxy coated.

5.18.10 QUALITY

Laboratory casework required as described above, shall be those having the components, configuration, materials, finish, and performance (that includes chemical and physical performance tests) comparable to cantilevered frame (C-frame) casework systems manufactured by Hamilton Industries, Kewaunee Scientific Equipment Corporation, and St. Charles Manufacturing Company. Equipment manufactured by others is acceptable, based on products of equal performance and similar appearance and construction, but only after approval by the Contracting Officer.

5.18.11 MINIMUM STANDARDS

Performance set forth herein shall establish minimum standards for design, performance and function. Products that fail to meet these standards will not be considered.

5.18.12 LABORATORY FUME HOODS

Fume hoods shall be provided in all laboratories and laboratory support spaces where chemicals and other hazardous and toxic materials are being utilized. The purpose of the laboratory fume hood is to prevent or minimize the escape of contaminants from the hood into the laboratory. Fume hood work surface shall be of recessed design so that spills can be effectively contained. The design professional shall be responsible for determining types and sizes of fume hoods, appropriate to its intended use, with the users of the facility. See Section-8, paragraph 8.2.7 for more specific requirements.

5.18.12.1 FUME HOOD LOCATION

Fume hoods must be located away from doors and pedestrian traffic. The location of the hood shall be at the end of a room, bay, corner, or created corner, where the operator is essentially the only one who enters the zone of influence. Further, hoods shall be located in such a manner such that one hood cannot draw air from another hood.

5.18.13 ENVIRONMENTAL ROOMS

Environmental rooms shall be of a modular, insulated panel construction providing temperature and humidity control with specified setpoint control. Temperature requirements of individual rooms shall be as appropriate to their intended use. Rooms shall be provided with emergency auxiliary power back-up to allow 24-hour operation. All rooms involving laboratory procedures shall be ventilated. Fume hoods shall not be allowed in environmental rooms. Provide remote air or water cooled dual sequencing compressor, temperature and humidity recorders, high/low alarm, adjustable epoxy coated wire shelving on wall supports or moveable racks, and personnel emergency alarm.

5.19 EQUIPMENT AND FURNISHINGS

5.19.1 DESIGN

Develop equipment plans as building systems and integrate with the planning of architectural, structural, mechanical and electrical systems. Equipment shall be arranged and organized so as to provide circulation, work flow and maintenance clearances.

5.19.2 CATALOG CUT SHEETS

Provide appropriate catalog cut sheets for all items of equipment. Each cut sheet shall have a logistical category and code. Each item shall be clearly identified if it has unique utility requirements, structural support or space requirements.

5.19.3 LAYOUT AND CLEARANCES

Arrange equipment to provide service clearances and maintenance access with minimum disruption to work spaces. When expansion is anticipated in a project, allow for some additional equipment without disruption or reconfiguration of work flow.

5.19.4 FLOOR PREPARATION

Provide floor depressions to accommodate items such as cart washers, environmentally-controlled room equipment, walk-in refrigerators, computer rooms, and any other appropriate spaces, or items except in laboratory spaces where future flexibility is a requirement.

5.19.5 STRUCTURAL SUPPORT

Adequately reinforce wall partitioning systems for wall-hung equipment and toilet accessories. Structurally brace ceiling support systems for service columns, hoist equipment and other ceiling mounted items. Mount all fixed equipment to resist seismic forces in accordance with seismic levels defined for each applicable project.

5.19.6 SPECIAL VENTILATION REQUIREMENTS FOR EQUIPMENT

Control of ventilation for the employee working environment must be provided by the equipment supplier. The design professional shall respond to Appendix B - INDOOR AIR QUALITY.

5.19.7 EQUIPMENT SPECIFICATIONS

The design professional shall develop equipment specifications for all equipment that does not have current guide specifications. All equipment specifications should permit procurement of the latest model of equipment through GSA services where possible. Develop all equipment specifications to accommodate reputable vendors. In equipment specifications, discuss the scope of services to be provided by mechanical and electrical contractors for installing Government furnished equipment.

5.19.8 HIGH TECHNOLOGY EQUIPMENT

Project specific guidance on high technology equipment of this category should be obtained. Design shall be in accordance with selection and guidance of the respective manufacturers.

5.19.9 EQUIPMENT CONSULTANTS

An equipment consultant is recommended to define and specify the research equipment required for procurement. They shall also provide information on equipment during the design and construction document phases to assist the design professional in planning and documentation.

END OF SECTION

SECTION 6

SITE AND CIVIL

SECTION 6

SITE AND CIVIL REQUIREMENTS

6.1 SCOPE OF PROJECT

6.1.1 GENERAL
The location, type of building and support facility proposed, impact on site development and general scope of work shall be described for the project. The description shall include access roads, parking areas, loading/unloading areas, etc.

6.1.2 DEVELOPMENT CODES

6.1.2.1 ZONING
A brief overview of local zoning and/or land development codes and their impact on site development shall be described for the proposed project.

6.1.2.2 BUILDING CODES
A description of the applicable building code shall be stated, with any specific references to seismic, flood plain or coastal development as they relate to site development.

6.1.2.3 ADA REQUIREMENTS
The proposed project will comply with current Federal (28 CFR, PARTS 35 & 36), State and local ADA guidelines for the physically disabled.

6.2 SITE INFLUENCES

6.2.1 LAND RESOURCES

6.2.1.1 GEOGRAPHY
The geographic location shall be described for the project. Appropriate information relative to the local area economy, business and industry shall also be described.

6.2.1.2 PHYSIOGRAPHY & GEOLOGY
A general description of known site geology and physiography shall be described. Appropriate information shall be taken from the preliminary geotechnical investigation if performed and available at the time the research gathering is performed for this document.

6.2.1.3 CLIMATOLOGY
The specific climate conditions of the proposed site shall be described, especially precipitation and predominant wind directions. Where available, local precipitation data shall be used in lieu of regional data for specific site hydrologic modeling.

6.2.1.4 HYDROLOGY

A general description of site hydrology shall be described, including data taken from the preliminary geotechnical investigation and the SCS soil survey. The following specific site information shall be assembled for use in the hydrologic modeling of the project:

.1 Geographic location
.2 Precipitation frequency data
.3 Drainage area
.4 Soil and cover
.5 Runoff distribution

Rainfall intensity-duration curves based on historic record should be developed and used for each locale. The design storm events shall be based on a study of precipitation frequency, 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. Design storm precipitation values taken from documented sources or derived by published engineering methodology, shall be used to estimate design flood discharges.

6.2.2 TRANSPORTATION SYSTEMS

6.2.2.1 AIR

A general description of project requirements relative to heliports or airfields shall be described.

6.2.2.2 LAND

A general description of the proposed project and its location relative to the existing roadway network shall be described.

.1 The development of the proposed facility and impacts on the existing roadway system shall be addressed by the design professional, including references to the traffic impact analysis if required for the project.

6.2.2.3 WATER

A general description of specific project requirements relative to boating shall be described, including marinas, docking and/or storage facilities and seawalls refueling facilities. Applicable permitting requirements with Federal, State and Local agencies shall also be addressed.

6.2.3 ENVIRONMENTAL CONSIDERATIONS

6.2.3.1 AIR QUALITY

The proposed project's impact on air quality shall be addressed by the design professional including all sources of air emissions and regulatory compliance with Federal, State and Local agencies.

6.2.3.2 WATER RESOURCES

The proposed project's impact on available water resources shall be addressed by the design professional including both ground and surface waters.

6.2.3.3 NOISE POLLUTION
A description of noise pollution associated with the proposed project, impacts on surrounding development, and compliance with applicable zoning and/or land development codes shall be addressed by the design professional.

6.3 SITE DEVELOPMENT

6.3.1 ENVIRONMENTAL ASSESSMENT
A general overview of site environmental considerations, including specific references to the environmental assessment done under the National Environmental Policy Act (NEPA), shall be performed. Field notes and final plots of surveys shall be furnished to the cognizant EPA authority. Any boundary surveys and recorded maps shall be forwarded to the appropriate EPA authority.

.1 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 EPA 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.

6.3.2 GEOTECHNICAL INVESTIGATION

6.3.2.1 GENERAL
For permanent structures, 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, supplemented by additional investigations at the specific location as deemed necessary by the design engineer.

Subsurface investigations shall be performed under the direction of a professional geotechnical 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 capacity, and the possible effects of seismic activity on the soil mass. A settlement analysis under different design loads shall be performed where differential settlement may cause structural, architectural or any other type of building damage.

6.3.2.2 TESTING AND SAMPLING METHODS
Testing 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 consistency. The depth of soil samples shall be determined by the geotechnical engineer after consulting with the project engineer on site related design requirements.

6.3.2.3 TEST 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, results of tests, and further inspection of samples in the laboratory by the geotechnical engineer preparing the report. As a minimum the report shall:

.1 Include a chart illustrating the soil classification criteria and the terminology and symbols used on the boring logs.

.2 Identify the ASTM or other recognized standard sampling and test methods used.

.3 Provide a plot plan giving dimensioned locations of test borings.

.4 Provide vertical sections plotted showing material encountered, referred to known datum, number of blows per lineal foot (N value), and groundwater level for all holes when encountered. Data for groundwater shall include both the initial groundwater level and the static groundwater level. Groundwater levels need to be recorded when initially encountered and after they are allowed to stabilize.

.5 Note the location of strata containing organic materials, weak materials or other inconsistencies that might affect engineering conclusions.

.6 Describe the existing surface conditions.

.7 Summarize the subsurface conditions present.

.8 Provide pavement structural design data including California Bearing Ratio tests or modulus of subgrade reaction tests.

.9 Provide a profile and/or topographic map of rock or other bearing stratum.

.10 Analyze the probable variations in elevations and movements of subsurface water due to seasonal influences.

.11 Report all laboratory determinations of soil properties including shrinkage and expansion properties.

6.3.3 SURVEYING

6.3.3.1 GENERAL

Construction, control, property and topographic surveys shall be coordinated with the cognizant EPA authority. Where feasible, surveying support available from EPA contractors shall be used. Survey field notes shall be legibly recorded on standardized (8-1/2 x 11 inch) field note forms. Field notes and final plots of surveys shall be furnished to the cognizant EPA authority. Any boundary surveys and recorded maps shall be forwarded to the appropriate EPA authority.

.1 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 EPA 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.

6.3.3.2 SURVEY CONTROL

The cognizant EPA authority shall be responsible for establishing, recording, and perpetuating primary on-site horizontal and vertical control monumentation. In addition, the appropriate EPA authority shall also be responsible for correlating primary site-specific horizontal and vertical monumentation with that of other appropriate agencies. All surveying and mapping shall conform to the latest revisions or substitutions of the standards listed in Table 6.6.3.2 SURVEY STANDARDS.

TABLE 6.3.3.2 - SURVEY STANDARDS

TEC-1110-1-147	CORPSCON
ETL-1110-1-150	GPS/Dredging
EM-1110-1-1000	Photogrammetry
EM-1110-1-1001	Geodetic Control
EM-1110-1-1002	Monumentation
EM-1110-1-1003	GPS Control
EM-1110-1-1005	Topographic and Field S&M [FY-94]
EM-1110-1-1006	Land Boundary [FY-95]
EM-1110-2-1003	Hydrographic Survey
EM-1110-1-1807	CADD (Volumes 1-4)

.1 Temporary on-site horizontal and vertical control monumentation shall comply with the standards listed in Table 6.3.3.2 SURVEY STANDARDS.

6.3.3.3 MONUMENTATION

.1 Temporary Control:

.1.1 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 into the existing system and approved.

.1.2 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 to an established grid. The surveyor setting such monumentation shall submit legible notes, drawings, and reproducible documentation to the appropriate EPA authority. The location and construction of all temporary monuments within the immediate vicinity of new construction shall be provided on the construction drawings.

.1.3 Temporary control monuments shall be 5/8-inch diameter mild steel bars or 3/4-inch diameter iron pipe with a minimum length of 2 feet or plastic hubs. These monuments shall be set flush or within 0.2 feet of the ground surface. Manhole rims, markings chiseled in concrete, PK nails in asphalt, and lead and tack in bedrock shall be suitable as an alternative temporary monumentation when approved.

.1.4 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 of the Corps of Engineers.

.2 Permanent Control:

.2.1 The placement, number and location of permanent survey monuments for horizontal and vertical control shall be coordinated with and approved by the cognizant EPA authority. The location and description of the nearest permanent survey monument shall be provided on construction drawings. These monuments shall be tied to an established state plane coordinate system.

.2.2 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.

.2.3 Permanent survey monuments shall be considered properly positioned and represented only after the cognizant EPA authority has approved all survey procedures and calculations and has verified conformance to the latest edition of the Corps of Engineers standards and specifications.

.2.4 Permanent survey monuments shall be identified as prescribed by Corps of Engineers standards.

.2.5 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 appropriate EPA authority. Permanent survey monuments shall not be removed without prior authorization from the cognizant EPA authority.

.3 Bench Marks:

.3.1 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. Elevations shall be referenced to the NAVD of 1983 and 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 or Corps of Engineers standards.

.3.2 Permanent bench marks shall be identified in the same manner as permanent survey monuments. Permanent bench marks shall not be removed without prior approval from the cognizant EPA authority. The location and description of all bench marks in the immediate vicinity of new construction shall be provided on the construction drawings.

.4 Utility, Roadway and Parking Area Surveys:

.4.1 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.

.4.2 Principal points of definition for potable water and natural gas distribution systems shall be valve boxes, main line intersects and fire hydrants.

.4.3 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:

.4.3.1 Stations and deflection angles for each point of intersection

.4.3.2 Right-of-way lines and markers

.4.3.3 Spot elevations (centerline, edge of pavement, and at intersects) at minimum intervals of 100 feet Pavement width

.4.3.4 Other improvements (e.g., drainage inlets, wheelchair ramps, fire hydrants, sidewalks, and curb and gutter)

.4.3.5 Topographic features within project limits

.4.3.6 Elevation contours

.4.3.7 Overhead and underground utility crossings (plan and profile)

.4.3.8 Roadway drainage crossings

.4.3.9 Location and description of underground utility witness markers

6.3.3.3.5 UNDERGROUND UTILITIES
Where exact routes of underground utilities are not defined within record drawings, the cognizant EPA authority shall coordinate necessary electronic line detection and exploratory excavation activities. Such utilities shall be located by survey and documented on the construction drawings.

6.3.3.3.6 CONSTRUCTION STAKING
Construction staking for new EPA facilities shall comply with local standards and with practices approved by the cognizant EPA authority.

6.3.4 FACILITY SITING

6.3.4.1 GENERAL
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.

.1 Preparation of an environmental assessment prior to the initiation of a government action that may significantly affect the environment shall be performed during facility siting.

.2 To the extent possible, facility siting shall preclude the use of flood plains or areas subject to flash floods and shall minimize destruction, loss, or degradation of wetlands.

.3 During site selection for new facilities the following conditions and requirements shall be considered:

.3.1 Programmatic and operating efficiency

.3.2 Natural topographic and geologic conditions

.3.3 Existing cultural, historic, and archaeological resources

.3.4 Endemic plant and animal species
.3.5 Past use of site and existence of known RCRA and/or CERCLA sites

.3.6 Special siting requirements for facilities containing, using, or processing hazardous materials

.3.7 Health, safety and environmental protection requirements

.3.8 Indoor air quality impacts (e.g., presence of radon in foundation soils and contamination from other exterior sources, natural or man made).

.3.9 Hazardous operations and consequences of potential accidents in adjacent facilities

.3.10 Natural hazards including seismic activity, wind, hurricane, tornado, flood, hail, volcanic ash, lightning and snow

.3.11 Wave action within any natural or man-made body of water (in accordance with CERC Shore Protection Manual)

.3.12 Physical protection requirements, security and safeguard requirements (e.g., patrol rooms, gates, security posts and vehicle barriers).

.3.13 Adequacy of existing or planned support and service facilities, including utilities, roads, and parking areas

.3.14 Interrelationships between facilities and aesthetic compatibility

.3.15 Energy conservation requirements

.3.16 Impact of site selections

6.3.4.2 BUILDING LOCATION

New buildings and building additions shall be located in accordance with the site development plan.

.1 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. Offsite drainage areas and environmental impacts of proposed stormwater management practices on surrounding properties shall also be carefully reviewed by the design engineer.

.2 During site selection for new buildings the following conditions and requirements shall be considered:

.2.1 Architectural and functional compatibility with the environment

.2.2 Operation and service function relationships

.2.3 Natural topographic and geologic conditions

.2.4 Existing cultural and archaeological resources

.2.5 Historical sites

.2.6 Abandoned mines or wells and potential for subsidence

.2.7 Endemic plant and animal species

.2.8 Availability of existing utility services

.2.9 Building setback requirements

.2.10 Availability of existing road systems

.2.11 Traffic volume

.2.12 Refuse handling and loading zone requirements

.2.13 Adequacy for parking, future expansion, and other land use requirements

.2.14 Health, safety, and environmental protection requirements

.2.15 Physical protection requirements

.2.16 Security and safeguard requirements

.2.17 Energy conservation requirements

.2.18 Indoor air quality impacts (e.g., presence of radon in foundation soils.)

.2.19 Impact of site selection

.2.20 Minimum fire separation between buildings (in accordance with NFPA 80A)

6.3.5 SITE PREPARATION

6.3.5.1 GENERAL

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, denuded areas, and restoration of areas disturbed by the project. Restoration shall be to original or improved conditions.

6.3.5.2 DESIGN CONSIDERATIONS

Site preparation design shall comply with the following criteria:

.1 Site drainage design shall comply with Section 6.5, Stormwater Management

.2 Vehicle parking, sidewalks and road requirements shall comply with Section 6.4, Transportation

.3 Site power and lighting shall comply with Section 6.6.4, Electrical Distribution Systems

.4 Site security requirements shall be taken into account and provided for in accordance with criteria established by the cognizant EPA authority

6.3.6 DEWATERING

6.3.6.1 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 the latest edition of TM 5-818-5. The design engineer shall determine if the assistance of a qualified groundwater hydrologist shall be required.

6.3.6.2 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 the construction contractor responsible for dewatering and groundwater investigation.

6.3.7 SHORING AND UNDERPINNING

6.3.7.1 GENERAL

All shoring and underpinning shall comply with the safety requirements of CFR 1926, Subpart P.

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.

.1 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.

6.3.8 EARTHWORK

6.3.8.1 GENERAL

Earthwork includes excavation, filling, stabilizing and compaction of earth at the site. Earthwork also includes the addition of borrow and disposal of excavated material. Prior to earthwork design, the project engineer shall confer with the geotechnical engineer to define subsurface investigation recommendations required in accordance with Section 6.3.2, GEOTECHNICAL INVESTIGATIONS. The earthwork design and specifications shall comply with the recommendations as outlined in the geotechnical report.

6.3.9 WATERFRONT CONSTRUCTION

6.3.9.1 GENERAL

Waterfront construction includes seawalls, docks, marinas, and other ancillary boating facilities associated with coastal development. This type of construction for EPA facilities shall comply with applicable federal, state, and local standards and with practices approved by the cognizant EPA authority.

6.4 TRANSPORTATION

6.4.1 ROADWAYS

6.4.1.1 GENERAL

Traffic data shall either be provided to the design professional or a traffic impact analysis (TIA) will be performed by the design professional. 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 one (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.

.1 Design and details of construction of flexible and rigid pavements shall comply with the local State highway department standards. Concrete valley gutters may be provided if swales are necessary with flexible pavements. Joint layout plans and details shall be provided for all rigid pavements. A thickened edge shall be used along edges of rigid pavement where future construction will occur.

.2 Signs, pavement markings, channelization, and other traffic control measures shall comply with the requirements of the USDOT Manual of Uniform Traffic Control Devices.

6.4.1.2 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. Wherever possible, curb openings with inlets located in grassed areas are to be utilized in lieu of curb inlets.

.1 In locations 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. Lower classification roadways shall be designed to convey runoff from the 10-year, 6-hour storm frequency. 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 10-1/2 inches at any point within the street right of way or extend more than 2-1/2 inches above the top of curb in urban streets. Inverted crown roadway cross sections shall not be used unless approved by the cognizant EPA authority.

6.4.2 PARKING AND LOADING FACILITIES

6.4.2.1 GENERAL

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.

.1 Handicapped parking allocations shall comply with ADA guidelines. 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.

.2 Positive drainage shall be provided for parking area pavements. The following requirements shall be followed:

.2.1 Provide positive surface drainage with a (.5%) five tenths percent minimum slope in the direction of drainage

.2.2 Limit slope in direction of parking to (4%) four percent maximum

.2.3 Limit slope perpendicular to direction of parking and slope of parking lot drives to (6%) six percent maximum for bituminous or concrete surfaces and (3%) three percent for other surfaces

6.4.3 PEDESTRIAN ACCESS

6.4.3.1 GENERAL

A functional system of walks connecting structures, operational areas, parking areas, streets and other 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 be the physically disabled shall comply with current ADA guidelines.

6.4.4 AIRPORTS AND HELIPORTS

6.4.4.1 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, facilities and equipment constructed to facilitate maintenance, ground handling, and flight operations.

.1 Landing and takeoff paths (traffic patterns) shall be oriented in such a manner as to preclude requiring critical facility overflights. Traffic patterns and altitudes shall be established and published to provide for aircraft operations on approaches that are away from critical facilities.

.2 Heliports shall be sited and traffic patterns established to provide for normal operation that does not require overflights of critical facilities. Heliports shall not be located closer to critical facilities than two (2) times the dimension of the landing pad or three (3) times the rotor diameter of the largest helicopter authorized to land at the heliport.

6.4.4.2 SITE CONSIDERATIONS

The following site conditions shall be taken into account in determining the adequacy of the aviation facility:

.1 Topography
.2 Vegetative cover and existing construction
.3 Weather elements
.4 Prevailing wind direction for both summer and winter conditions
.5 Soil conditions
.6 Flood hazards
.7 Natural and man-made obstructions
.8 Adjacent land uses
.9 Availability of usable airspace
.10 Accessibility of usable roads
.11 Location of site utilities
.12 Capability for future expansion
.13 Aboveground utilities

6.4.4.3 DESIGN CONSIDERATIONS

The layout of airfield facilities shall support operational efficiency and provide safe conditions for takeoff and landing operations and ground handling of aircraft.

.1 Airfield safety clearances shall comply with clearance criteria in accordance with FAA AC 150/5300. The critical decision point and emergency landing areas for the various aircraft using a facility shall be determined from the respective aircraft performance charts.

.2 All other applicable design considerations shall conform to the latest FAA criteria.

.3 Airfield layout shall also include:

.3.1 Wind direction and velocity analyzed in accordance with FAA AC 150/5070-6A
.3.2 A taxiway system
.3.3 Parking aprons
.3.4 Supporting facilities

6.4.5 RAILROADS

6.4.5.1 GENERAL

The basis for railroad facilities design shall be the criteria in the 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.

.1 Special requirements such as derailers are required where railroads cross security boundaries. The cognizant EPA authority shall be consulted for determining specific design requirements.

6.4.5.2 DESIGN CONSIDERATIONS

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 the classification track. Track-side drainage swales, drainage ditches, intercepting ditches, culverts, cross drains, pipe drains, and other drainage facilities shall comply with AREA Manual for Railway Engineering (Fixed Properties).

.1 The design strength of railroad structures shall not be 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.

.2 Super elevation shall not be used on curves where the speed is less than 20 miles per hour except when required by the servicing railroad. Super elevation shall be provided on access or main running tracks where the speed is equal to or greater than 20 miles per hour.

6.5 STORMWATER MANAGEMENT

6.5.1 WATERSHED DEVELOPMENT

Site development plans shall carefully review impacts within the watershed. Appropriate stormwater management strategies shall be developed that minimize and/or eliminate any adverse effects on existing/future development within the watershed.

6.5.2 EROSION AND SEDIMENTATION CONTROL

Erosion and sedimentation control measures, in accordance with Federal, State and Local standards are to be implemented during construction. The site is to be properly graded and vegetated so as to minimize any adverse impacts of erosion.

6.5.3 STORMWATER RETENTION / DETENTION
Site development plans shall incorporate, as applicable, appropriate stormwater retention/detention facilities as part of the storm drainage system. These facilities are to be designed in strict accordance with all applicable Federal, State and Local requirements.

6.5.4 CONVEYANCE

6.5.4.1 STORM SEWERS
Subsurface drainage systems shall be sized to accommodate runoff from the 10-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 system designs. Storm sewers shall be designed to maintain a minimum scour velocities of 2 feet per second. New storm sewers shall be sized for open channel flow. The minimum storm sewer size shall be 15 inches. The minimum culvert size shall be 15 inches. For roof drain systems, the minimum pipe size for laterals and collectors shall be 6 inches.

6.5.4.2 OPEN CHANNELS
Open channel stormwater conveyance systems shall be sized to accommodate the 10-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.

.1 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 EPA authority. Preference for earth-lined or "armored" 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.

6.5.5 STORMWATER QUALITY
The site development shall include quality control measures that reduces the concentration of pollutants in stormwater prior to discharge into receiving waters.

6.5.6 FLOODPLAIN / WETLANDS DEVELOPMENT
Development, modification or occupancy of floodplains and wetlands should be avoided, particularly where practical alternatives exist. To the extent possible, EPA shall accommodate the requirements of Executive Order Nos. 11988 and 11990 through appropriate procedures. EPA shall exercise leadership and take action to:

.1 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 for new development

.2 Incorporate floodplain management goals and wetland protection considerations into its planning, regulatory, and decision-making processes

.3 Undertake a careful consideration of the potential impacts of any EPA action in a floodplain and any new construction undertaken by EPA in wetlands not located in a floodplain

.4 Identify, consider, and as appropriate, implement alternative actions to avoid or mitigate adverse floodplain and wetlands impacts

.5 Provide opportunity for early public review of any plans or proposals for actions in floodplains or new construction in wetlands

.6 Construction within floodplains or wetlands shall comply with the following:

.6.1 10 CFR 1022
.6.2 NEPA and implementing regulations

6.5.7 COASTAL DEVELOPMENT
The development of site boating, docking and seawall facilities shall conform to all Federal, State and Local requirements.

6.6 UTILITIES AND SUPPORT SERVICES

6.6.1 WATER DISTRIBUTION SYSTEMS

6.6.1.1 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 EPA 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 EPA Facilities Engineering Group. Both systems must also be clearly identified on the record drawings.

.1 Cross-connections between domestic and industrial or irrigation systems are prohibited. Domestic water conveyed within distribution systems that serve EPA facilities shall comply with the applicable SDWA, 40 CFR 141, 40 CFR 142 requirements and all other State, regional and local requirements. The quality of domestic water within such distribution systems shall be protected from degradation by installation of reduced pressure principal assembly backflow preventers to preclude backflow of contaminants or pollutants into the system.

.2 Backflow prevention devices shall be installed in accordance with the National Plumbing Code. Only those devices approved by the Foundation for Cross-Connection Control and Hydraulic Research shall be approved. Refer to the Manual of Cross-Connection Control, (6th Ed., Aug. 1979)

6.6.1.2 PLANNING CONSIDERATIONS

.1 During route selection and initial planning efforts for water distribution systems, the following conditions and requirements shall be considered:

.1.1 Future population and development projections
.1.2 Anticipated average daily flow for fully developed conditions
.1.3 Anticipated peak flows for domestic, industrial, fire and special water usage
.1.4 Hydraulic design criteria
.1.5 Health and safety requirements
.1.6 Physical constraints (e.g., utility corridors and topographic features)
.1.7 Energy conservation and environmental constraints

.2 Distribution system layouts shall be simple and direct as possible. Where feasible, initial planning efforts shall optimize system layouts (e.g., system loop lines) in order to:

.2.1 Facilitate future system expansion
.2.2 Strengthen fire protection capabilities
.2.3 Minimize conflicts with other utilities
.2.4 Reduce maintenance requirements

.3 Water distribution systems shall be included within the utility master plan.

6.6.1.3 SYSTEM DESIGN CONSIDERATIONS

Domestic water distribution mains shall be sized to accommodate 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 warrant).

.1 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.

.2 Each fire hydrant within the distribution system must be capable of delivering 1000 gpm at a residual of not less than 20 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. Fire hydrants shall be installed at a maximum spacing of 400 feet and shall not be located more than 300 feet from buildings that are to be protected. Each building shall be protected by a minimum of two hydrants. All water mains, supplying fire protection systems, fire hydrants, etc., shall be treated as fire mains and installed in accordance with NFPA 24. Water mains shall have a minimum pressure rating of 150 psi. Water distribution systems shall be designed to maintain normal operating pressures between 40 psi to 100 psi (at ground level) in mains and building service lines. Where the gradient across the service area is such that multiple pressure zones are necessary to maintain the 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.

.3 Air release and vacuum breaker valves shall be installed, as required, at high points within the distribution system and in long supply mains.

.4 Distribution system mains shall have a minimum depth of cover of 3 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 1-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. Water storage facilities shall comply with NFPA 22.

.5 Site soil and groundwater conditions (e.g., soil corrosivity) shall be considered during the selection of pipe materials. Where ferrous pipe is installed within the distribution system, insulating couplings shall be installed to preclude galvanic corrosion.

6.6.1.4 WELLHEAD DESIGN CONSIDERATIONS FOR RESEARCH PURPOSES

Where and when water is to be provided for fish culture, unless otherwise revised or required by the EPA project officer, on-site, drilled wells shall be capable of producing a minimum of 20 gallons of water per minute of consistent quality. The water must be of a quality suitable for rearing and maintaining fish cultures. The water must not be contaminated with pesticides, heavy metals, sulfides, silica or chlorides. The anions should be those found in natural lakes or streams.

.1 Water quality parameters should fall within the following limits:

.1.1	Dissolved oxygen :	> 6.0 mg/L
.1.2	pH:	7.2 - 8.5
.1.3	Hardness:	40 - 200 mg/L (as CaCO3)
.1.4	Alkalinity:	slightly less than hardness
.1.5	Iron:	< 1.0 mg/L
.1.6	Chlorides:	< 250 mg/L as chlorides & sulfates
.1.7	Sulfides:	< 2.0 ug/L as undissociated H2S

.2 The well and pump shall be housed so as to be protected from the elements. Two 500 gallon water tanks shall be installed to serve as reservoirs prior to distribution.

6.6.2 WASTEWATER COLLECTION SYSTEMS

6.6.2.1 GENERAL

This section applies to sanitary wastewater collection systems (i.e., lift stations, force mains, collector sewers and interceptor sewers and building sewers 5 feet beyond the building foundation).

6.6.2.2 SYSTEM DESIGN CONSIDERATIONS

Industrial wastewater and pollutants above EPA minimal concentrations shall be excluded from sanitary wastewater collection systems.

.1 Pretreatment systems (such as acid neutralization) shall be installed where required and shall meet EPA specifications.

.2 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 lift stations and force mains shall not be used unless approved by the cognizant EPA authority. Feasibility analyses and economic evaluations of lift station and force main costs for construction, operation, and maintenance shall be prepared and submitted to the appropriate EPA authority for approval. Sewers and force mains shall be sized to accommodate the estimated daily maximum and minimum flow for the initial and final years of the design period specified by the cognizant EPA authority in accordance with ASCE 37:

.2.1 Velocities in gravity sewers and force mains shall not exceed 10 feet per second.

.2.2 Gravity sewers shall be designed for a minimum velocity of 2 feet per second.

.2.3 Force mains shall be designed for a minimum velocity of 3.5 feet per second.

.3 For preliminary design, domestic water consumption rates shall be used to approximate wastewater flows. Where possible, actual flow data from an adjacent service area typical of the service area under consideration shall be used to estimate wastewater discharges for final design. In the absence of such data, metered water use, less the consumptive use (i.e. water withdrawal rate), can be used.

.4 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. Sewer and 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.

.5 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 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.

.6 Water pipe shall not be laid closer horizontally than 10 feet from a sewer or force main except where the bottom of the water line will be at least 12 inches above the top of the sewer pipe or force main, in which case the water pipe shall not be laid closer than 6 feet from the sewer or force main. Where water pipes cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall not be less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

.7 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 whenever possible.

.8 The selection of sewer and force main 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 shall also be used for sewers located in parking lots and or other high traffic areas. Pipe joints shall have a watertight seal. Maximum infiltration-exfiltration test requirements shall be specified within the contract documents.

6.6.3 NATURAL GAS DISTRIBUTION SYSTEMS

Gas distribution shall comply with local codes and requirements. Fuel gas shall comply with NFPA 54. Liquified petroleum gas shall comply with NFPA 58.

6.6.4 ELECTRICAL DISTRIBUTION SYSTEMS

The design engineer shall coordinate site power and lighting as detailed in Section 9, Electrical Requirements.

6.6.5 TELECOMMUNICATIONS SYSTEMS
The design engineer shall coordinate site communication as detailed in Section 9.14, Communication Systems.

6.6.6 SOLID WASTE COLLECTION SYSTEMS
Management of nonhazardous solid waste shall comply with 40 CFR 264 and subtitle D of the RCRA. Management of hazardous waste shall comply with 40 CFR 264 and Subtitle C of RCRA.

6.7 REFERENCE MATERIALS

6.7.1 GENERAL
All work done in this section shall comply with all applicable Federal, State, City and Local codes, regulations, ordinances, publications, and manuals. When codes and/or regulations conflict, the more stringent standard shall govern.

6.7.2 LISTING OF POTENTIAL SOURCES
Refer to Appendix A for some of the many potential codes, regulations, trade organizations, publications and guides that may be applicable.

END OF SECTION

SECTION 7

STRUCTURAL REQUIREMENTS

SECTION 7

STRUCTURAL REQUIREMENTS

7.1 STRUCTURAL DESIGN REQUIREMENTS

7.1.1 GENERAL

7.1.1.1 APPLICABILITY
This section applies to the structural elements of buildings and other incidental structures. The structural elements include, but are not limited to, the following:

.1 All floor, roof, and wall framing members and slabs

.2 All piers, walls, columns, footings, piles, and similar elements of the substructure

.3 All other substructures and superstructure elements that are proportioned on the basis of stress, strength, and deflection requirements

7.1.1.2 MATERIAL, FRAMING, SYSTEMS AND DETAILS
Material, framing systems, and details shall be compatible with the following:

.1 Clear space and span requirements

.2 Serviceability requirements

.3 Applicable fire protection classification

.4 Security requirements

.5 Foundation conditions

.6 Future expansion requirements

.7 Architectural requirements

.8 Climatic conditions

.9 Structural design loads for the specific facility and location

7.1.1.3 CONSTRUCTION MATERIALS AND LABOR
Local availability of construction materials and labor force shall be considered in the selection of the structural system.

7.1.1.4 DESIGN CRITERIA
The structural design drawings shall indicate the design criteria , the structural materials and their strengths with applicable material standards, the design loads including loads that can occur during construction, and the allowable foundation loads that were used in the design.

7.1.2 CALCULATIONS

7.1.2.1 GENERAL
All design shall be performed and checked by registered Structural Engineer, this includes calculations. All calculations shall be on 8 1/2"x 11" paper. Calculations shall be indexed and every page numbered. Dividers shall be placed between distinct sections. A summary shall be included describing type of structure and indicating the live load capacity of each floor and roof.

7.1.2.2 MANUALLY PREPARED CALCULATIONS
Manually Prepared Calculations: Shall be neat and legible. Each sheet shall indicate the Structural Consultants firm name, address and telephone number. Each sheet shall indicate the designers name or initials, checkers name or initials and date prepared. Design assumptions regarding live loads, material strengths, conditions of fixity, etc. shall be clearly stated. Calculations shall be sufficiently cross-referenced such that a third party can review the calculations without requiring additional information.

7.1.2.3 COMPUTER ANALYSIS AND DESIGN
Computer Analysis and Design: Software used for structural analysis and design shall be from a nationally recognized vendor. Each separate run shall indicate software licensee, project name and number, engineers name and date. Provide additional manual annotation if necessary to adequately cross-reference computer printouts, such that a third party can review the calculations without requiring additional information.

7.1.3 LOADS

7.1.3.1 GENERAL REQUIREMENTS
Structures and their elements shall be designed for the loads prescribed in these criteria unless applicable codes or ordinances provide more stringent requirements. The more stringent requirement shall be used.

7.1.3.2 DEAD LOADS
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 of the drawings.

.1 The minimum allowance for the weights of partitions, where partitions are likely to be rearranged or relocated, shall be as follows:

.1.1 For partition weights of 150 plf or less, an equivalent uniform dead load may be used as determined on the basis of the room dimension (normal to the partition) and the partition weight pounds per lineal feet (plf), but not less than 20 pounds per square feet (psf).

.1.2 For partition weights above 150 plf, the actual loads shall be used.

.1.3 Partitions that are likely to be rearranged or relocated should be calculated as live loads for load factor design. A factor of 1.1 shall be applied to the live loads due to moveable partitions prior to application of building code required live load factors.

.2 The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ANSI/ASCE 7-88. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturer's drawings or catalogs.

.3 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 fixed furnishings. The weight of service equipment that may be removed with change of occupancy of a given area shall be considered as live load.

7.1.3.3 LIVE LOADS

Live loads shall include all loads resulting from the occupancy and use of the structure whether acting vertically down, vertically up, or laterally. The weight of service equipment that may be removed with change of occupancy (e.g. fume hoods) of a given area shall be considered as live load. 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.

.1 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/ASCE 7-88, or as required by the local building code, whichever is more stringent. A minimum of 60 psf of hanging load shall be included for any central energy plant or major mechanical room where significant hanging loads are anticipated.

.2 Live loads on roofs shall be as stipulated in ANSI/ASCE 7-88, or as required by local building codes, whichever is more stringent. 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 effect. An allowance of 10 psf shall be included in the design of all roofs to allow for one re-roofing in the future.

.3 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.

7.1.3.4 SNOW LOADS

Shall be as calculated in compliance with the provisions of ANSI/ASCE 7-88, or as required by local building codes, whichever is more stringent.

7.1.3.5 WIND LOADS

Wind load design for buildings and other structures shall be determined in accordance with procedures in ANSI/ASCE 7-88, or local codes, whichever is more stringent, using the basic wind speed obtained therein.

.1 Exposure "C" as defined in ANSI/ASCE 7-88 shall be used as a minimum for all 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).

.2 To determine the design wind loads, all factors and coefficients stipulated in ANSI/ASCE 7-88 shall be applied to the site-specific basic wind speeds.

.3 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.

7.1.3.6 SEISMIC LOADS

Seismic load design for buildings and other structures shall be determined in accordance with the requirements of local building codes. In the absence of local building code requirements the procedures outlined in the latest edition of the BOCA National Building Code shall be used to calculate seismic loads.

.1 An independent review of the seismic design shall be made for buildings located in seismic zones 3 or 4 and which are designated as essential for hazardous facilities. This review shall be performed by a registered structural engineer hired by the owner. The review shall be made in two stages, the first at the end of preliminary design and the second before final design is complete.

7.1.3.7 OTHER LOADS

.1 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 (e.g. fume hood exhaust fans, vacuum pumps, etc.) 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.

.2 Every foundation or other wall serving as a retaining structure shall be designed to resist, in addition to the vertical loads acting on in, the incident lateral earth pressures and surcharges, plus hydrostatic pressures corresponding to the maximum probable groundwater level.

.3 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 effects on the stability of the walls shall be considered. Lateral earth pressures shall be determined in accordance with accepted structural and geotechnical engineering practice.

.4 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.

.5 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.

.6 The design professional shall be responsible to verify the requirements of and for installation of vibration sensitive equipment in all laboratory areas. The structural system in laboratory areas shall be designed to accommodate and control specific high localized frequency loads and vibration inputs from the general building systems to these sensitive areas. There are five controls that need to be pursued:

.6.1 Use of physical separation to keep powerful sources of vibration well clear of the laboratory space.

.6.2 Identification and isolation of particular services which involve running speeds close to the natural frequencies of the floor.

.6.3 Identification and additional isolation of sources, which, although not matching the running speed and primary structural response frequencies, potentially produce sufficient vibration power to make excessive building response a threat.

.6.4 Identification of powerful transient impulses from services (e.g., switching in/out), and appropriate attenuation where possible.

.6.5 Providing structural stiffness to reduce the peak acceleration responses due to footfall-induced vibration.

7.1.3.8 LOAD COMBINATIONS
Combination of loads, allowable stresses, and strength requirements for buildings and incidental structures shall be as stipulated in the local governing building code.

7.1.4 STRUCTURAL SYSTEMS

7.1.4.1 FOUNDATIONS
The provisions of the local governing building code shall be the minimum requirements for foundation design. The potential adverse effects of frost heave and movements due to expansive soils shall also be considered in the design. For all structures the requirements of these design criteria shall be complied with to determine subsurface conditions, recommended foundation type, allowable design soil bearing pressure, seismic potential, and differential settlement.

.1 Where concrete slab-on-grade construction is used, the slab shall be placed on a capillary water barrier overlying a compacted subgrade. A moisture retarder 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.

7.1.4.2 FRAMING SYSTEMS
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.

.1 In the selection of a particular framing system, consideration shall be given to the structure's functional requirements, including:

.1.1 Column-free areas

.1.2 Floor-to-ceiling heights

.1.3 Number of stories

.1.4 Elevator, escalator, crane, or hoist installations

.1.5 Heavy loads

.1.6 Other particular requirements pertaining to the specific facility

.2 For framed floors, the economy of prefabricated systems shall be considered, especially systems that simplify the installation of mechanical, electrical, and communications services.

7.1.4.3 LATERAL LOAD RESISTING SYSTEMS
Provide lateral load resisting systems to resist the effects of wind, earthquake motions, thermal forces, soil pressures and dynamic forces due to rotating, reciprocating or moving equipment. Use systems recognized by the local building code. In the absence of local building code criteria, use structural systems recognized by the BOCA National Building Code for use in resisting seismic loads.

7.1.5 BUILDING MOVEMENT JOINTS

7.1.5.1 CONTROL JOINTS
Shall be provided in all materials subject to drying shrinkage. Control joint size and spacing shall be based on a rational analysis.

7.1.5.2 EXPANSIONS JOINTS
Shall be provided in all materials subject to thermal expansion. Expansion joint size shall be based on a rational analysis.

.1 Building expansion joints shall be provided as recommended in the publication Expansion Joints in Buildings by the Federal Construction Council of the Building Research Advisory Board, in the absence of local building code requirements.

7.1.5.3 SEISMIC JOINTS
When seismic design is required, building expansion joints shall be seismic type. Buildings shall be separated adequately to avoid contact during an earthquake which would damage the structural systems of the buildings.

7.2 CONCRETE

7.2.1 GENERAL REQUIREMENTS

7.2.1.1 DESIGN AND CONSTRUCTION
This section covers the design and construction of plain, reinforced, or prestressed concrete structures, whether of cast-in-place or precast concrete construction. The requirements of this section shall be used in conjunction with those of Structural Design Requirements.

7.2.1.2 CODES
Concrete materials, design, and construction for buildings and other structures shall comply with ACI 318 and local building codes.

7.2.2 CONCRETE FORMWORK

7.2.2.1 FORMWORK
Formwork for concrete construction shall comply with ACI 347, ACI SP-4 and local building codes.

7.2.3 CONCRETE REINFORCEMENT

7.2.3.1 REINFORCEMENT MATERIALS
For buildings and other incidental structures shall comply with local building codes and ACI 318.

7.2.3.2 REINFORCEMENT DETAILS
Shall comply with ACI 352R and ACI SP-66 in addition to ACI 318 and local building codes.

7.2.4 CAST-IN-PLACE CONCRETE:

7.2.4.1 GENERAL
This section covers the selection of materials, proportioning of mixes, mixing, placing, testing, and quality control of cast-in-place concrete.

7.2.4.2 MATERIALS, TESTING, AND QUALITY CONTROL
Shall comply with ACI 318 and local building codes.

7.2.4.3 TOLERANCES
Shall be as recommended in ACI 347.

7.2.4.4 SELECTING PROPORTIONS FOR CONCRETE MIXES
The selection of proportions for concrete mixes of normal weight concrete shall comply with ACI 211.1. The selection of proportions for structural lightweight concrete shall comply with ACI 211.2.

7.2.4.5 MIXING, TRANSPORTING, AND PLACING
Shall comply with the recommendations of ACI 304.

7.2.4.6 CLIMATIC CONSIDERATIONS
Hot weather concreting shall comply with the recommendations of ACI 305R. Cold weather concreting shall comply with the recommendations of ACI 306R.

7.2.4.5 POST-TENSIONED CONCRETE
In addition to the provisions of other sections, the PTI Post-Tensioning Manual may be used for the design and construction of post-tensioned concrete structures.

7.2.5 PRECAST / PRESTRESSED CONCRETE - STRUCTURAL

7.2.5.1 GENERAL
This section covers materials, design, and construction of precast, precast and prestressed, and precast and post-tensioned structures. In addition to the requirements of other sections, 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.

7.2.6 PRECAST / PRESTRESSED CONCRETE - ARCHITECTURAL

7.2.6.1 GENERAL

This section covers materials, design, and construction of architectural precast , and architectural precast and prestressed concrete members. In addition to the requirements of other sections, architectural precast members shall comply with the PCI MNL-117.

7.2.7 CEMENTITIOUS DECKS FOR BUILDINGS

7.2.7.1 GENERAL

This section covers materials, design, and construction of cementitious decks for building structures and prefabricated floor and roof systems such as:

.1 Lightweight precast reinforced concrete planks

.2 Lightweight precast reinforced concrete channel slabs

.3 Reinforced gypsum planks

.4 Structural cement fiber roof deck systems

.5 Reinforced poured gypsum over formboard roof systems

7.2.7.2 MATERIALS, DESIGN AND CONSTRUCTION

The materials, design, and construction of cementitious decks for buildings shall comply with the requirements of local building codes and the manufacturer's recommendations. In the event of a conflict between the local building code and the manufacturer's recommendations, the more stringent shall apply.

7.2.8 REPAIR AND RESTORATION OF CONCRETE STRUCTURES

7.2.8.1 GENERAL

This section covers the evaluation of damage or deterioration, selection of repair methods, surface preparation, and repair and restoration of concrete structures. The material covered are portland cement mortars and concretes, latex-modified portland cement mortar, epoxy mortars, epoxy concrete, or methyl methacrylate concrete.

7.2.8.2 METHODS, PROCEDURES, AND MATERIALS

Methods, procedures, and materials for the repair and restoration of concrete structures shall comply with guidelines ACI 503.4 and ACI 546.1R.

7.2.9 CONCRETE INSPECTION AND TESTING

Shall comply with requirements of local building codes and ACI 318.

7.3 MASONRY

7.3.1 GENERAL REQUIREMENTS

7.3.1.1 DESIGN AND CONSTRUCTION
This section covers the design and construction of masonry 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 section shall be used in conjunction with those of other sections.

7.3.1.2 MATERIAL, DESIGN AND CONSTRUCTION
Materials, design, and construction of masonry structures shall comply with the requirements of local building codes. The following sources may also be used as guides for the design of masonry structures:

.1 ACI 531

.2 ACI 531.1

.3 NCMA TR 75B

.4 BIA Building Code Requirements for Engineered Brick Masonry.

7.3.2 MORTAR AND GROUT

7.3.2.1 GENERAL
Requirements for materials, mixing, strength, and specifications for mortar and grout for masonry structures shall comply with local building codes.

7.3.2.2 MORTAR
Shall be designed to perform the following functions:

.1 Join masonry units into an integral structure

.2 Create tight seals between masonry units to prevent the entry of air and moisture

.3 Bond with steel joint reinforcement, metal ties and anchor bolts, where used, so that they act integrally with the masonry

.4 Provide a desired architectural quality to exposed masonry structures through color contrasts or shadow line from various joint-tooling procedures

.5 Compensate for size variations in the units by providing a bed to accommodate the tolerance of unit sizes

7.3.2.3 GROUT
Shall be used in reinforced load-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 construction to give it added strength.

7.3.3 UNIT MASONRY

7.3.3.1 MATERIALS, DESIGN AND CONSTRUCTION
Materials, design, and construction of masonry units shall be in accordance with the requirements of General Requirements.

7.3.4 MASONRY ACCESSORIES

7.3.4.1 CODES AND SPECIFICATIONS
Joint reinforcement, anchors, ties and wire fabric shall comply with the following:

.1 Local building codes
.2 ACI 530.1

7.3.5 REINFORCED MASONRY

7.3.5.1 CODES AND SPECIFICATIONS
Design and construction of reinforced masonry shall comply with the following:

.1 Local building codes
.2 ACI 530
.3 ACI 530.1

7.3.6 MASONRY INSPECTION AND TESTING
Inspection and testing of unit masonry, grout, mortar reinforcing and accessories shall comply with the following:

.1 Local building codes
.2 ACI 530.1

7.4 METALS

7.4.1 GENERAL REQUIREMENTS

7.4.1.1 DESIGN AND CONSTRUCTION
This section covers the design and construction of steel and aluminum structures. The requirements of this section shall be used in conjunction with those of other sections.

7.4.2 STRUCTURAL STEEL

7.4.2.1 CODE AND STANDARDS
Structural steel for buildings and other incidental structures shall comply with the following:

.1 Local building codes

.2 AISC M016 or MO15L

7.4.3 STEEL JOISTS

7.4.3.1 CODES AND SPECIFICATIONS
Steel joist and joist girders shall comply with the following:

.1 Local building codes

.2 Steel Joist Institute Standard Specifications Load Tables & Weight Tables for Steel Joists & Joist Girders

7.4.3.2 INTENDED USE
Steel joists shall not be used for wind bracing, nor other types of bracing. They shall be used only as vertical load carrying members supporting floor and roof decks.

7.4.3.3 SUPPORT OF VIBRATING EQUIPMENT
Steel joists shall not be used to support air conditioning, air handling or any type of vibrating equipment. Steel joists serving as floor joists and roof purlins shall not have bracing members attached to them which would transmit vibrations from vibrating equipment into the steel joists and/or structural diaphragms.

7.4.4 STEEL DECKS

7.4.4.1 STEEL DECKS SHALL COMPLY WITH THE FOLLOWING

.1 Local building codes

.2 Steel Deck Institute Publication 20

.3 Steel Deck Institute Publication DDM01.

7.4.5 MISCELLANEOUS METALS

7.4.5.1 DEFINITION
Miscellaneous metals shall be all ferrous and non-ferrous metals other than structural steel as defined in the AISC Code of Standard Practice.

7.4.6 LIGHT GAGE STEEL

7.4.6.1 CODES AND SPECIFICATIONS
Light gage steel shall comply with the following:

.1 Local building codes

.2 AISI Specification for the Design of Cold-Formed Steel Structural Members.

7.4.7 PRE-ENGINEERED METAL BUILDINGS

7.4.7.1
Pre-engineered metal buildings shall comply with:

.1 Local building codes

.2 MBMA Metal Building Systems Manual

7.4.7.2 LOADS
Where the use of the design loadings specified in these design criteria, would prevent procurement of pre-engineered metal buildings, consideration may be given to deviate from said loadings. Such considerations shall be based on an evaluation as to whether such deviations would tend to jeopardize personnel and/or material safety, on review of the type of occupancy and functional requirements of the particular building and on a determination as to whether such deviation could be justified and permissible in accordance with local building codes.

7.4.8 STRUCTURAL STEEL INSPECTION AND TESTING

7.4.8.1 INSPECTION
Structural steel inspection shall be as required by:

.1 Local building codes

.2 AISC Manual of Steel Construction

END OF SECTION

SECTION 8

MECHANICAL REQUIREMENTS

SECTION 8

MECHANICAL REQUIREMENTS

8.1 GENERAL

The design professional shall be responsible for insuring that all mechanical systems conform to the requirements of this solicitation and that all systems are installed and operating in accordance with all governing codes, ordinances, regulations and the latest edition of publications and as set forth below. The design professional is responsible for the design of all mains, lines, meters, etc., required for utility services. The building air conditioning, heating and ventilation systems shall provide a safe and suitable environment to satisfy both occupants and functional operation of the facility.

8.1.1 HVAC REQUIREMENTS

The design professional shall provide a heating, ventilating and air conditioning (HVAC) system that will satisfy the requirements indicated in this document. Mechanical systems shall not use CFC or HCFC-22.

8.1.1.1 GENERAL

The design professional shall evaluate building HVAC systems and sub-systems and select major HVAC equipment components based on a consideration of health and safety requirements, initial costs, operating costs, and maintenance costs. A Life Cycle Cost Analysis (LCCA), using a nationally recognized computer program, shall be performed to select the most cost effective HVAC system.

8.1.1.2 SELECTION PROCEDURE

HVAC equipment shall be sized to satisfy the building and cooling load requirements and to meet all equipment design and selection criteria contained in the ASHRAE Fundamentals handbook, ASHRAE Equipment handbook, ASHRAE Systems handbook, ASHRAE Applications handbook, and ASHRAE Refrigeration handbook.

8.1.1.3 INSIDE DESIGN TEMPERATURES

Environmental design temperatures and relative humidities for special space uses other than those listed here shall be designated in the project criteria.

.1 When space cooling is required, the inside design temperature (the design values are not necessarily the same as the operational values) to maintain personnel comfort shall be 78°F dry bulb unless otherwise indicated by project criteria. The relative humidity shall be 50%. Summer humidification shall not be provided for personnel comfort. Cooling systems shall be designed to maintain space relative humidity conditions through the normal cooling process and should not have controls to limit the maximum relative humidity unless system type or project-specific criteria dictate.

.2 The inside design wintertime temperature (the design values are not necessarily the same as the operational values) for personnel comfort shall be 72°F dry bulb unless otherwise indicted here or directed by other project-specific criteria. The following design temperatures shall be used for the space usages indicated in Table 8.1.1.3. - INSIDE DESIGN TEMPERATURES.

TABLE 8.1.1.3 - INSIDE DESIGN TEMPERATURES

TEMPERATURE (F° db)	SPACE
As indicated by project criteria	Storage (unoccupied)
55°	Storage (occupied)
50°	Warehouses
60°	Kitchens
65°	Laundries
65°	Shops (high work activity)
70°	Toilets
75°	Change Rooms (heating only when occupied)
As indicated by project criteria	Specialty Rooms (i.e. labs, clean rooms etc.)

.3 Except where it can be substantiated from recordings or engineering computations that the inside relative humidity will be less than 30 percent, winter humidification for personnel comfort and health shall not be provided. Where such conditions have been substantiated, a design relative humidity of 30 percent shall be used in establishing minimum humidification equipment requirements.

8.1.1.4 OUTSIDE DESIGN TEMPERATURES

The design professional shall design the HVAC system equipment using outside design temperatures as indicated in Table 8.1.1.4 - OUTSIDE DESIGN CONDITIONS for the particular application. The percentage dry bulb (db) and wet bulb (wb) temperatures refer to the sources of tabulated weather data described below. Where data for a particular location are not listed, design conditions shall be estimated from data available at nearby weather stations or by interpolation between stations, taking into account elevation and other local conditions affecting design data. Weather data for use in sizing HVAC equipment shall be obtained from one or more of the following:

.1 Local weather station

.2 AFM 88-29

.3 ASHRAE Fundamentals handbook

TABLE 8.1.1.4 - OUTSIDE DESIGN CONDITIONS

WINTER	SUMMER	APPLICATION
99% db	1% db and mean coincident wb	Process, laboratory and other uses where close temperature and humidity control is required by project criteria.
97-1/2% db	2-1/2% db mean coincident wb	Personnel comfort systems
----	1% wb	Cooling towers* and research, technical-type systems
----	1% db plus 5°F	Air-cooled condensers*

*Temperature should be verified by actual site conditions

8.1.1.5 EQUIPMENT SIZING
The capacity of central heating, refrigeration, and ventilation equipment shall be sized for the peak block building or the maximum simultaneous zone heating and cooling design loads and in accordance with the ASHRAE Fundamentals handbook. The equipment shall not be sized for future additional capacity nor redundancy unless indicated in project-specific criteria. Individual zone equipment shall be sized according to the peak zone load.

8.1.1.6 EVAPORATIVE / ADIABATIC COOLING
In locations where a wide variation exists between the dry and wet bulb temperatures for extended periods of time, evaporative/adiabatic cooling shall be considered for the applications listed below. Selection of cooler types shall depend on the system configuration, user experience, and LCCA. All evaporative coolers shall maintain a positive water-bleed and water-makeup system for control of mineral buildup.

.1 Applications that shall be considered include warehouses, shops not requiring close (plus or minus 5°F) temperature control, non-residential size kitchens, makeup air ventilation units, and mechanical equipment spaces.

.2 Air duct design, number and location of coolers, and relief of the higher rate of air supply to the atmosphere shall be considered to ensure a satisfactory operating system. Multi-stage evaporative cooling systems shall also be considered.

.3 Indoor design dry bulb temperatures for spaces air-conditioned by adiabatic cooling systems shall be as specified by project-specific criteria. Design operating efficiency of adiabatic cooling equipment shall be a minimum of 70 percent. System-installed capacity shall be based on the conditioned space peak design cooling load. An arbitrary air-change rate for design air flow shall not be used. Adiabatic cooler specifications shall be stated in terms of the air capacity and the entering ambient dry and wet bulb temperatures and leaving dry bulb temperature.

8.1.1.7 VENTILATION - EXHAUST SYSTEMS

The design professional shall select ventilation-exhaust systems for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, mists, and excessive heat and for the provision of fresh air to occupants. The design criteria contained in this section shall be followed in determining the required air quantity and quality for ventilation and exhaust systems.

.1 The use of exhaust stack(s) shall be considered to provide dispersion and preclude exhaust-to-intake return of air to this or an adjacent facility. Local weather and site conditions along with guidance found in ASHRAE Fundamentals shall be used to determine requirements.

.2 Areas from which air shall not be recirculated include areas that produce or emit dust particles, heat, odors, fumes, spray, gases, smoke, or other contaminants that cannot be sufficiently treated and could be potentially injurious to health and safety of personnel or are potentially damaging to equipment. These areas shall be 100-percent exhausted (e.g. fume hood exhausts). Project criteria shall indicate other areas of non-recirculation.

.3 Rest rooms, janitor's closets, garbage rooms, and other malodorous spaces shall be exhausted at a rate of not less than 50 cfm per water closet and/or urinal as specified in ASHRAE Standard 62, or local building codes, whichever is the more stringent, regardless of any other calculated ventilation requirements. Space ventilation air from adjacent spaces should be used as the ventilation supply air for the 100-percent exhausted spaces, as long as:

.3.1 Ventilation by this method does not violate any requirements of NFPA 90A, NFPA 101, or special space pressurization requirements.

.3.2 The air supplied is not potentially more hazardous than the air from the space exhausted.

.3.3 Adjacent spaces are not laboratory or specialty spaces requiring once-through ventilation.

.4 Industrial-type facilities and laboratories shall be provided with ventilation (supply and exhaust) systems as required for heat exposure control, or dilution ventilation. Ventilation air shall be provided in the quantities required to maintain OSHA air quality limits. Design air quantities and transport velocities shall be calculated according to the calculation methods prescribed by the ASHRAE Systems handbook, the ASHRAE Applications handbook, the ACGIH Industrial Ventilation Manual, and NFPA 45.

.5 Design professionals shall comply with ASHRAE Applications Chapter 14, "Laboratories," when designing laboratories and laboratory buildings except where EPA standards are more stringent. Makeup air shall be provided in the quantities required to maintain required positive or negative room static pressure requirements and to offset local exhaust air quantities. Makeup air shall be tempered.

8.1.1.8 EQUIPMENT ROOM VENTILATION

Mechanical and electrical equipment rooms shall be exhausted so that room temperature does not exceed NEMA equipment ratings. The project criteria shall provide the space temperature limit criterion. Where mechanical ventilation cannot maintain a satisfactory environment, evaporative cooling systems (indirect evaporative cooling for electrical rooms) or other mechanical cooling systems shall be provided. Exhaust air openings should be located adjacent to heat-producing equipment to minimize ambient thermal loads.

.1 Thermostatic controls shall be used to operate the ventilation or exhaust systems.

.2 Equipment rooms containing refrigeration equipment shall be ventilated in accordance with ASHRAE Standard 15.

.3 Combustion air for fuel-burning appliances and equipment shall be provided directly from the outside to all equipment rooms with this type of equipment in accordance with BOCA Basic/National Mechanical Code.

8.1.1.9 WASTE HEAT RECOVERY SYSTEMS

Energy conservation-waste heat recovery systems shall be considered and designed according to the procedures outlined in specific chapters of the ASHRAE Fundamentals handbook, the ASHRAE Systems handbook, the ASHRAE Applications handbook, ASHRAE Equipment handbook, ASHRAE Refrigeration handbook, and the SMACNA Energy Recovery Equipment and Systems Manual. The following types of heat-recovery systems shall be considered for incorporation into the building HVAC system design where applicable.

.1 Use of rotary heat exchanger, heat pipe, or coil run-around systems for heating and air-conditioning air handling systems.

.2 Recovery of rejected heat from the condenser systems of central station cooling equipment for use in heating the remainder of the building when the central station cooling equipment must operate during the heating season to cool computer rooms, high internal gain areas, or process requirements.

.3 Use of thermal heat from the condenser systems of continuously operated refrigeration equipment for space heating or domestic hot water heating.

.4 Use of a free cooling system using cooling tower water (water side economizer) when air-side economizer systems are not feasible.

.5 Use of a heat pump run-around loop.

8.1.2 ENERGY EFFICIENCY
After careful study of the facility's requirements as well as day-to-day operation of its various departments, the design professional shall design systems that meet the operating requirements in an energy efficient manner. The health and safety aspects of the operation must retain first priority, however, and cannot be relaxed or traded off for more efficient systems. The design professional shall also contact the local utility companies to investigate the system dollar credits for load shifting to off-peak times.

8.1.3 LABORATORY

8.1.3.1 GENERAL
Laboratory spaces shall be designed with 100% outside air (OSA) ventilation systems. In no circumstances will the air supplied to any laboratory space be recirculated to any other space.

8.1.3.2 LABORATORY PRESSURIZATION
Laboratory spaces shall be designed to maintain a relative pressurization level to other common spaces appropriate to the type of work performed in each laboratory and negative to the laboratory corridor. In general, biology and chemistry laboratories shall be maintained with a relative negative pressurization to common spaces to ensure containment of odors and contaminants. Levels of pressurization shall be project specific.

8.1.4 ENERGY MANAGEMENT CONTROL SYSTEMS

8.1.4.1 GENERAL
This section covers safety and operating controls, automatic temperature and humidity controls, energy monitoring and (central supervisory) control systems, energy conservation requirements for controls, and zoning requirements and restrictions.

.1 Special control requirements shall be indicated in the project-specific criteria. Selection of control system types and associated equipment, shall be based on the most economical and maintainable system.

.2 Control air compressors shall be duplex non-lubricated type with oil lubricated crankcase and distance piece. Air shall be filtered and dried using refrigerated air dryers for dew point of 15°F and regenerative silica type for dew point below 15°F.

.3 Copper piping shall be used for high pressure air in inaccessible locations (plastic piping may be used if installed in conduit). Air leakage shall not exceed 5 percent of pressure in 24 hours. Transmitters shall be capable of field calibration and thermometers or pressure gauge ports shall be provided at transmitters. All controllers and thermostats shall be pilot-bleed type.

8.1.4.2 ZONING

Zoning for automatic control of space temperatures, static pressures, humidities, ventilation, smoke and fire detection shall satisfy health and safety requirements as indicated in the project criteria. Zoning requirements are as follows:

.1 Automatic controls shall be provided to shut off heating or cooling to any individual zone or central air handling unit.

.2 Interior zones shall not be combined with external zones if feasible.

.3 Interior space zones shall be placed on separate air handling systems from external, if cost effective. External space zones shall be selected for each individual exposure.

8.1.4.3 CONTROL SETBACK AND SHUTOFF DEVICES

With the exception of research, process, or other environmentally sensitive spaces identified by the project criteria as requiring constant year-round temperature or humidity control, automatic control setback and shutdown devices with manual override feature shall be provided for all HVAC systems. Use of separate or dual setting thermostats, switches, time clocks, or connections for on/off control through the Energy Management System (EMS) shall be considered for control of air-conditioning to raise cooling setpoint with humidity override during summer unoccupied periods and to control the heating setpoint during winter unoccupied periods.

8.1.4.4 HUMIDITY CONTROL

Summer and winter space or zone humidity control shall be provided only on a space-by-space or zone-by-zone basis and not for the entire central ventilation system unless required for project-specific humidity requirements as stated in the project criteria. No controls shall be provided to dehumidify spaces to below 50-percent relative space humidity or to humidify spaces to greater than 30-percent relative space humidity unless required on a project-specific basis.

8.1.4.5 SIMULTANEOUS HEATING AND COOLING

Simultaneous heating and cooling shall not be used to control comfort conditions within a space by reheating or re-cooling supply air or by concurrent operation of independent heating and cooling systems serving a common zone except under the following conditions.

.1 Renewable energy sources are used to control temperature or humidity.

.2 Project-specific temperature, humidity, or ventilation conditions require simultaneous heating or cooling to prevent space relative humidity from rising above special-space relative humidity requirements.

.3 Project-specific building construction constraints as determined in the project criteria prohibit installation of other types of HVAC systems.

8.1.4.6 MECHANICAL VENTILATION CONTROL

All supply, return, and exhaust ventilation systems shall be equipped with automatic and manual control of fan operation to shut off the fan when ventilation is not required. These systems shall also be provided with manual gravity-operated or automatic control of dampers for outside air intake and exhaust or relief to prevent introduction of outside air when ventilation is not required. Systems that circulate air shall be provided with minimum outdoor air damper position control to assure that the minimum outdoor air quantity is being introduced to the system. Unless required by life safety or the specific project criteria, automatic dampers should fail open for return air and fail closed for outside air.

8.1.4.7 ECONOMIZER CYCLE

Where feasible, all air handling systems that recirculate air and are used for space cooling shall be designed to automatically use outside air quantities up to 100 percent of the fan system capacity for cooling the space. Economizer cycle control shall not be used for air handling systems where introduction of the additional outside air would actually increase energy consumption.

.1 The economizer cycle control system shall have a reset feature.

.2 The economizer cycle control system shall be designed with a relief air control cycle to positively relieve the supply air from the space by sequencing return or relief fans or dampers to maintain a constant room static pressure. Systems using the economizer cycle should be provided with adequate air filtration to handle the quality of the outside air.

8.1.4.8 AUTOMATIC CONTROL DAMPERS

Automatic air control dampers shall be specified to be the low-leakage type with a maximum leakage of 6 CFM/square foot at maximum system velocity of 1500 FPM and 1-inch pressure differential as per AMCA Standard 500. The dampers shall be opposed-blade type for modulating control, but may be parallel-blade type for two position control. Pilot positioners and operators shall be out of airstream.

8.1.4.9 VARIABLE - AIR - VOLUME SYSTEM FAN CONTROL

Variable-air-volume systems shall be designed with control devices to sense ductwork static air pressure and velocity air pressure, and control supply fan airflow and static pressure output through modulation of variable inlet vanes inlet/discharge dampers, scroll dampers, bypass dampers, variable pitch blades or variable frequency electric drive controls as described in ASHRAE Applications Chapter 41 and ASHRAE Systems and Equipment Chapter 18. These control systems shall have a minimum of one static pressure sensor mounted in ductwork downstream of the fan and one static pressure controller to vary fan output either through inlet vane, damper, belt modulator, or speed control. Exhaust fans, supply fans, and return or relief fans shall have control devices that interface the operation of the fans to "track" air volumes and maintain fixed minimum outdoor air ventilation requirements.

8.1.4.10 FIRE AND SMOKE DETECTION AND PROTECTION CONTROLS
All air handling systems shall be provided with the smoke and fire protection controls required by NFPA 101, and 90A.

.1 All supply, return, relief, and exhaust air ventilation systems shall have interlock controls that interface with fire and smoke detection system controls and either turn off or selectively operate fans and dampers to prevent the spread of smoke and fire throughout the building. These controls shall comply with NFPA 90A.

.2 Special exhaust systems shall be designed to include fire and smoke safety controls as required by NFPA 91. Kitchen exhaust ductwork systems shall be designed to include all fire and smoke safety controls as required by NFPA 96.

.3 Engineered smoke pressurization and evacuation systems shall comply with the following:

.3.1 NFPA 90A

.3.2 NFPA 72E

.3.3 ASHRAE Manual, Design of Smoke Control Systems for Buildings

.3.4 ASHRAE Systems handbook

.4 Special hazard protection systems that initiate an alarm shall be in accordance with the EPA's Facility Safety Manual Chapter 6, paragraphs 16.c.(6) and (7)

8.1.4.11 GAS - FIRED AIR HANDLING UNIT CONTROL
Gas-fired air handling units shall be specified with operating limit, safety controls, and combustion control systems. Gas burner and combustion controls shall comply with FM Loss Prevention Data Sheets and be listed in the FM Approval Guide. Gas-fired air handling units shall be specified with controls to lock out the gas supply in the following conditions:

.1 Main or pilot flame failure

.2 Unsafe discharge temperature (high-limit)

.3 High or low gas pressure

.4 No proof of air flow over heat exchanger

.5 Combustion air loss

.6 Loss of control system actuating energy

8.1.4.12 ZONE CONTROL / DISTRIBUTION SYSTEM CONTROL

Each zone or air handling system shall be designed with individual terminal unit valved control. Use of either two-way or three-way valves shall be considered based on part-load pump performance requirements and potential pump bhp savings.

.1 Water systems that vary the load to the terminal by varying water flow rates using two-way control valves shall be provided with differential pressure controls to reduce system pressure build-up and save energy. These controls shall either signal control valves to route water flow around terminal devices, signal variable-speed pumping controls to reduce pump speed, or turn off one or several pumps working in parallel or series.

8.1.4.13 CONTROL VALVE SELECTION

Temperature control valves shall be either two-way or three-way, two-position or proportioning-type valves. Control valves shall be sized for a 3 to 5 psi pressure differential across the valve or a pressure differential of 50 percent of the combined branch piping and coil pressure drop, whichever is greater. Control valves shall use either pneumatic, electric, electronic, or self-contained controllers. Valves in cooling and heating systems shall be fail-safe. Valve operators shall be selected to close against pump shutoff head for two-way valves.

8.1.4.14 TWO - PIPE AND THREE - PIPE COMBINATION HEATING AND COOLING SYSTEMS

Fan coil terminal devices with one coil shall have their control valves operated by a room or coil discharge temperature thermostat that can change from summer to winter operation. Air handling units with heating and cooling coils shall have their control valves controlled by normal sequences of operation, but shall be provided with two-position control valves in the piping entering each coil to prevent hot water from entering the cooling coil and chilled water from entering the heating coil and to sequence on/off and summer and winter operation.

.1 If the two or three-pipe water distribution system is not provided with heat exchangers to isolate the boilers and chillers from the distribution system, a control system using three-way control valves to control and route water around the source devices shall be designed to prevent hot water from entering the chiller and cold water from entering the boiler during the changeover periods from heating to cooling systems.

8.1.4.15 LOAD CONTROL FOR HOT WATER SYSTEMS

The temperature of hot water for building heating systems shall be controlled by a supply temperature sensor that modulates the boiler operating controls. If feasible, the supply delivery temperature shall be reset based on either the temperature outside, lowering the delivery temperature as the outdoor air temperature rises and raising the delivery temperature as the outdoor air temperature falls, or preferably discriminator logic from the control devices.

8.1.4.16 LOAD CONTROL FOR CHILLED WATER SYSTEMS
Central station cooling equipment producing chilled water shall be controlled by a signal from a sensor mounted in the return chilled water piping or preferably the leaving chilled water piping that modulates the chiller to control capacity. Central station cooling equipment shall be provided with controls to limit the current draw of the cooling equipment in periods of high electrical demand.

.1 When appropriate, additional controls and sensors may be added to the central chilled water system to provide chilled water to laboratory equipment which may require it. Additionally, provisions for emergency chilled water to laboratory equipment may be required.

8.1.4.17 COOLING TOWER AND WATER - COOLED CONDENSER SYSTEM CONTROLS
Cooling tower fans shall be designed with consideration for variable speed drives (if feasible) or two-speed motors (if feasible) and on/off controls to reduce power consumption and maintain condenser water temperature. Bypass valve control shall be provided if required to mix cooling tower water with condenser water to maintain the temperature of entering condenser water at the low limit. Condenser water temperature shall be allowed to float to decrease compressor horsepower as long as the temperature remains above a lower limit required by the chiller. The design shall provide basin temperature sensing devices and, if the cooling tower is operated during freezing conditions, additional heat and control system components to maintain cooling tower sump water temperatures above freezing.

.1 When appropriate, additional controls and sensors may be added to the condenser water system to provide condenser water to laboratory equipment which may require it. Additionally, provisions for emergency condenser water to laboratory equipment may be required.

8.1.4.18 CONTROL OF STEAM SYSTEMS
Each zone air handler, heating coil, and individual terminal unit shall be controlled using two-way control valves that actuate either electrically, pneumatically, or through use of self-contained liquid or wax-filled sensing elements. These control valves shall modulate the steam flow to the coil or terminal unit based on space temperature or coil discharge temperature preset by zone temperature requirements. Steam pressure and temperature control valves shall be selected according to the requirements in ASHRAE handbooks.

8.1.4.19 ENERGY MANAGEMENT SYSTEMS (EMS)
Central EMSs shall be provided where feasible. If cost effective, an EMS shall be combined with integral fire and smoke detection supervisory systems and lighting control systems. An EMS shall be specified with the capability to connect to additional building utility systems. When an EMS is contemplated for the future, other building system controls and instrumentation shall be selected that will allow for simple future interfacing.

8.1.4.20 ENERGY METERING

In facilities where the expected energy consumption is expected to exceed 500 million BTU per year, the design professional shall design energy metering systems for all electric, gas, oil, and water incoming utilities that can be monitored and trended by the Energy Management System (EMS). Sub-metering of utilities to various buildings or equipment shall be based on project criteria or sound engineering judgement.

8.1.5 HEATING, VENTILATING, AND AIR - CONDITIONING SYSTEMS (HVAC)

8.1.5.1 GENERAL

Selection of central station cooling systems shall be based on the LCC analysis procedures. Size, selection and design shall be based on ASHRAE Fundamentals handbook, ASHRAE Systems handbook, ASHRAE Applications handbook, and ASHRAE Equipment handbook. Refrigeration equipment shall comply with ARI 520, ARI 550, and ARI 590. The number and size of central station cooling units shall be based on the annual estimated partial-load operation of the plant to assure the most economical operation.

.1 The project design criteria shall provide direction on installed standby chiller capacity. Wherever possible, the central station chilled water equipment shall be designed into the chilled water distribution systems as part of a primary-secondary loop system maintaining chilled water inlet temperature below a maximum predetermined value, preferably with the central station cooling equipment as a secondary portion of the loop.

.2 Temperature-critical areas, as determined by project criteria, such as laboratories and computer centers, shall be provided with independent refrigeration systems with backup systems if involved with vital programs. The design professional shall consider use of off-peak cooling systems in areas having high electric peak demand charges.

8.1.5.2 WATER CHILLERS

The selection of either centrifugal, reciprocating, helical, rotary-screw, absorption, or steam-powered chillers shall be considered based on coefficients of performance at full load and part-load conditions using the LCCA methods. The LCCA shall also consider chilled water and condenser water system pumping energy burdens as part of the evaluation. Compression refrigeration machines shall be designed with the safety controls, relief valves, and rupture disks noted below and in compliance with the procedures prescribed by ASHRAE Standard 15 and UL 207.

.1 Controls shall at a minimum include:

.1.1 High discharge refrigerant pressure cutout switch

.1.2 Low evaporator refrigerant pressure or temperature cutout switch

.1.3 High and low oil pressure switches

.1.4 Chilled water flow interlock switch

.1.5 Condenser water flow interlock switch (on water cooled equipment)

.1.6 Chilled water low temperature cutout switch

.2 Centrifugal compressors shall be designed to operate with inlet control or variable speed control for capacity modulation. Units shall be capable of modulating to 10 percent of design capacity without surge. Reciprocating compressors shall be designed for capacity control by cylinder unloading. Design using hot gas bypass control of compressors for capacity modulation shall not be used except when capacity modulation is required below 10 percent of rated load. Compressor motors for refrigeration equipment shall be selected in compliance with all requirements of the NEC.

.3 Absorption refrigeration machines shall at a minimum be provided with the following safety controls:

.3.1 Condenser water flow switch

.3.2 Chilled water flow switch

.3.3 Evaporation refrigerant level switch

.3.4 Generator high temperature limit switch (gas-fired units)

.3.5 Generator shell bursting disc (high temperature water or steam)

.3.6 Concentration limit controls

.4 Liquid coolers (evaporators) shall be designed to meet design pressure, material, welding, testing and relief requirements of ASHRAE Standard 15 and ASME Boiler and Pressure Vessel Code, Section VIII. The design professional shall select evaporators according to the requirements of ASHRAE Standard 24-78.

8.1.5.3 CONDENSERS / CONDENSING UNITS

Water cooled Condensers shall comply with ASHRAE Standard 15 and ASME Boiler and Pressure Vessel code, Section VIII. Water-cooled condenser shell and tube types shall be designed and specified with removable heads, if available, to allow tube cleaning. The use of marine water boxes on the condenser shall be considered for ease of tube cleaning.

.1 Air-cooled condensers and condensing units shall meet the standard, rating and testing requirements of ARI 460 and ASHRAE Standard 20. The design professional shall locate air-cooled condenser intakes away from any obstructions that will restrict the air flow. Air-cooled equipment shall be located away from noise-sensitive areas, and air-cooled condensers shall have refrigerant low head pressure control to maintain satisfactory operation during light loading.

8.1.5.4 COOLING TOWERS

The design professional shall locate and place cooling towers to avoid problems with water drift and deposition of water treatment chemicals. Cooling towers shall have ample clearance from any obstructions that would restrict air flow, cause recirculation of discharge air, or inhibit maintenance.

.1 The design professional shall specify cooling tower acceptance and factory rating tests conducted in accordance with CTI Bulletin ATC-105.

.2 An automatic-controlled water bleed shall be designed for all cooling towers. A cooling tower water treatment program should be selected by a specialist.

.3 Cooling towers shall be specified with sump water heating systems if they will operate during freezing weather conditions.

8.1.5.5 BUILDING HEATING SYSTEMS

This section applies to heat-generating equipment or heat-transfer equipment and accessories located in individual buildings. The project criteria shall direct the design professional regarding factors to be considered in the selection of heating system capacity, including redundancy, future expansion or building modification, thermal storage or solar assistance, or other project-specific considerations. If maintaining building design temperature is critical, the design professional shall design for a "stand alone" heating system with backup capability with no dependence on other facility systems.

.1 Where buildings are connected to the central plant heat generation/distribution system, one of the following shall be provided:

.1.1 Steam-to-building hot water heat exchanger.

.1.2 HTW-to-building hot water heat exchanger.

.1.3 Steam-pressure-reducing station.

.2 For space heating by hot water, conversion of the central heating plant steam or HTW shall be made to provide a maximum 200°F heating-water supply temperature to serve the building terminal units. For space heating by steam, the building steam supply shall be reduced to 15 psig unless a higher supply is required for process requirements. For process-related or other high temperature requirements, the project criteria shall indicate the capacities and temperate and pressure requirements. For facilities with a central plant condensate return system, a condensate receiver with duplex pumps shall be specified. Steam-to-hot water or HTW-to-building heating water converters shall be selected based on design criteria contained in ASHRAE Systems handbook, ASHRAE Applications handbook and ASHRAE Equipment handbook.

.3 The design professional shall consider the use of direct and indirect gas-fired units, electric heating, heat-pumps (air-cooled and water-cooled), low temperature gas infrared heating, and hot water radiant heating and hot water distribution to terminal units depending on the building type, the facility preference, and LCCA. Office buildings or buildings with occupants sitting near fenestration shall be designed with perimeter finned-tube radiation heating systems or other perimeter heating systems.

.3.1 If the selected fuel is fuel oil, storage tanks installed in accordance with national, state, and local EPA regulation shall provide for 30 days of full heating capacity. Tank shall be fully trimmed for safety and operating conditions and shall include a remote level gauge. Tank shall comply with NFPA 30 requirements.

8.1.5.6 WATER DISTRIBUTION SYSTEMS

The design professional shall select chilled water, hot water, condenser water, boiler feed, and condensate return systems designed for economical pipe sizes based on allowable pressure drop, flow rate, and pump selection criteria as prescribed by the ASHRAE Fundamentals handbook, ASHRAE Equipment handbook, and ASHRAE Systems handbook, ASHRAE Applications handbook. Insulation shall be provided on all water distribution piping and system components. Strainers shall be provided at the suction side of each pump and each control valve. The design professional shall specify flexible connectors to be installed on the suction and discharge piping of base-mounted end suction type pumps, and electronically driven chillers.

.1 Check valves and balancing valves or combination check-shut-off-balance valves shall be installed in the discharge piping of all pumps operating in parallel pumping systems. Balancing valves shall be installed in the discharge piping of all pump systems.

.2 Service valves shall be installed in the suction and discharge piping of all major pieces of equipment. Balancing valves shall be provided in the discharge piping of all coils, and central station cooling equipment.

.3 Air elimination pressure control, venting and automatic filling system (with backflow prevention) shall be provided for each hot water and chilled water distribution system, including provision of water treatment injection if required.

.4 Expansion or compression tanks and fill piping connections shall be located on the suction side of the distribution system pump or pumps. Expansion tanks and air separation devices shall be sized according to the methods in the ASHRAE Systems handbook and specified in accordance with the requirements of ASME B31.1. Gauge glasses, drain valves and vent valves shall be provided for all expansion tank systems.

.5 Water treatment design information for chilled water, hot water, and boiler feed water systems shall be provided by a specialist based on project criteria (tested water condition).

8.1.5.7 PUMPS AND PUMPING SYSTEMS
Pumps for chilled water, hot water, condenser water, boiler feed-water and condensate systems shall be of the centrifugal type selected based on criteria in ASHRAE handbooks. Materials, types of seals, bearings, wear rings, shafts and other features shall be selected based on specific system requirements. The design professional shall consider the use of primary-secondary type pumping systems and high-efficiency motors for pumps for all hot and chilled water distribution systems.

.1 On systems where system pumping horsepower requirements are greater than 20 bhp, the design professional shall consider the use of variable speed drives or parallel pumping arrangement.

.2 Standby pumps shall be provided for all systems as dictated by project-specific criteria.

8.1.5.8 STEAM DISTRIBUTION SYSTEMS
All steam piping shall comply with ASME B31.1 and be a minimum of Schedule 40 black steel. Fittings, valves, and accessories shall be selected based on pipe size and temperature and pressure conditions.

8.1.5.9 AIR HANDLING AND AIR DISTRIBUTION SYSTEMS
The design professional shall consider and design air handling equipment and air distribution systems sized to optimize both initial cost and air handling system operating and maintenance costs. The design professional shall provide all air handling system equipment (fans, terminal units, air handling units, etc.) with vibration isolators and flexible ductwork connectors to minimize transmission of vibration and noise. Systems shall satisfy the NC levels recommended for various types of spaces and vibration criteria as listed in the ASHRAE handbooks. Where air handling equipment and air distribution systems cannot meet these requirements, sound attenuation devices shall be installed in the air handling systems.

8.1.5.10 FANS / MOTORS
Fans shall be designed and specified to assure stable, non-pulsing aerodynamic operation in the range of operation over varying speeds. Fans with motors of 20 hp or less shall be designed with adjustable motor pulley sheaves to assist in air balancing of systems. Fans with motors greater than 20 hp shall use fixed (non-adjustable) drives that can be adjusted by substituting fixed motor pulley sheaves of different diameters. Supply air handling units and return air fans in variable-air-volume systems shall control capacity through the use of variable-speed drives, inlet vanes or scroll bypass dampers. All fans shall comply with AMCA Standard 210, ASHRAE Standard 51, and ASHRAE Equipment handbook.

.1 Fans shall be located within the ductwork system according to the requirements of AMCA Publication 201. Motors shall be sized according to properly calculated bhp fan requirements and shall not use oversized fans and motors to meet future capacity needs unless so directed by the project criteria. The design professional shall consider the selection of fan construction materials based on corrosion resistance and cost. Spark-resistant construction shall be used where required by NFPA. All fans and accessories shall be designed and specified to meet all smoke and flame spread requirements of NFPA 255.

8.1.5.11 COILS
Heating and cooling coils shall comply with ARI 410. Heating or cooling coil selection shall not conflict with ASHRAE Fundamentals handbook or ASHRAE Equipment handbook. The design professional shall specify that coil manufacturers certify coil performance by ARI certification or provide written certification from a nationally recognized independent testing firm that will verify coil performance to be in accordance with ARI 410.

.1 Heating and cooling coils shall be specified of materials appropriate for corrosive atmosphere in which they are contained. Cooling coils shall be designed with a maximum face velocity of 550 fpm. Coils designed with face velocities exceeding 500 fpm shall be specified, if required, with provisions to prevent condensate carryover, or use moisture eliminators. Coils shall be specified with drain feature.

.2 Recirculating air systems with outside air winter design temperatures below freezing shall be designed with a preheat coil located either in the outside air intake or in the mixed air stream upstream of the cooling coil, unless the theoretical mixed air temperature is calculated to be above 35°F. In this case, the preheat coils may be omitted if adequate baffling is provided to guarantee positive mixing of the return and outdoor air. Preheating coils shall be specified and designed to maintain discharge air temperature without modulation of the steam or hot water flow through use of modulating face and bypass dampers. Steam modulation may be used for control of steam coils in moderate climates where proven to be reliable without concern of coil freeze-up.

8.1.6 WALK-IN ENVIRONMENTAL AND COLD STORAGE ROOMS
Walk-in environmental rooms are rooms in which temperature and/or humidity is controlled at a single set condition within specified tolerances regardless of activity in the room. Heat loads, in terms of process loads and ventilation requirements, bear discussion with the end user by the design professional in determining a specified room temperature condition, uniformity, and gradient. Generally, walk-in environmental rooms shall be capable of maintaining 4°C room temperature with a uniformity of ±0.5°C and a maximum gradient of 1°C, or as specified in the program requirements. A walk-in cold storage room shall be capable of maintaining -20°C room temperature with a uniformity of ±1°C and a maximum gradient of 3°C, or unless otherwise specified. Rooms shall feature temperature displays visible from a contiguous hallway and be capable of producing a continuous record of temperature. Alarm systems with manual override capability shall be provided to advise room operators of fault conditions. Doors to rooms shall be provided with a locking mechanism capable of release at all times from the room interior whether or not the door is locked. Walk-in environmental and cold storage rooms shall include shelving and shall be explosion proof.

8.1.7 CENTRAL PLANT HEAT GENERATION / DISTRIBUTION
These criteria shall be applied in the planning and design of steam and HTW generation and distribution systems and co-generation facilities.

8.1.7.1 FACILITY SIZING

Consideration shall be given to a plant design that can be easily expanded should potential future loads in addition to confirmed short-term loads become a reality. Load computations to establish boiler capacity shall be based on the building design heating load as developed in conformance with ASHRAE Fundamentals handbook. To this shall be added process heating loads (if any) and an allowance for piping plants, the process heat losses shall be investigated during the design stage to determine if heat can be recovered, thereby reducing the boiler load.

.1 Modular boiler installation shall be considered for all applications to maintain a high operating plant efficiency throughout the year. Number and size of the boilers shall be based on the number of operable hours at full and p;art load operation, turn-down ratio of the boiler being considered, efficiency at part load, and year round process or summer loads. Use of a baseload boiler shall be considered when a year-round process demand exists. The system shall be designed to satisfy peak demand by operating over its maximum rating for short periods of time.

.2 The possibility of operating small local boilers rather than the central plant to satisfy summer loads shall also be considered. Sufficient capacity shall be furnished to allow one boiler to be down for inspection, maintenance, or on standby, while the remaining boiler(s) maintain normal operations.

.3 The generating facilities shall be located to allow efficient steam/hot water distribution throughout the site and allow for future expansion of the generating and distribution system. The facility shall also be located to minimize problems associated with the following:

.3.1 Noise

.3.2 Dirt

.3.3 Air pollution

.3.4 Harmful effects to adjacent property owners

.3.5 Accommodate fuel deliveries and storage

.3.6 To take advantage of prevailing winds

.4 The installation of one or more satellite boiler facilities rather than a single central boiler complex shall be evaluated when one or more of the following conditions exist:

.4.1 An extensive distribution system connecting several separate steam users is required.

.4.2 Requirements exist for several different steam pressures.

.4.3 Variable steam loadings exist with respect to time or quantity.

.5 The use of a co-generation plant as a possible alternative shall be considered in the planning of any large steam generation facility. The feasibility of co-generation with HTW or HTW boilers or HTW to steam generators shall be considered. In determining the feasibility of co-generation, the following factors shall be considered:

.5.1 Energy demand and cost, peak load, average load, seasonal variations, and utility rate structures.

.5.2 Regulatory concerns: PURPA, relevant environmental regulations, and current local regulations.

.6 Co-generation plants shall be sized to accommodate existing loads.

8.1.7.2 STEAM AND HIGH - TEMPERATURE WATER GENERATION

All boilers shall comply with the ASME Boiler and Pressure Vessel Code.

.1 In determining whether to select a steam or HTW system, the following factors shall be considered as a minimum:

.1.1 Whether the system will be operated intermittently or continuously.

.1.2 Whether fast response to significant load variation is important.

.1.3 Pumping costs.

.1.4 Length, size, and configuration of piping required.

.1.5 In a facility where a few of the processes require steam, the possibility of using HTW to generate the steam at its point of use.

8.1.7.3 STEAM GENERATION UNITS

Boilers shall be designed to provide dry, saturated steam unless specific economic requirements for electric generation, process requirements, or extensive distribution systems require superheated steam. If required for process, the use of high-pressure satellite boilers located close to the high-pressure process requirement shall be considered in lieu of distribution of high pressure steam.

8.1.7.4 HIGH - TEMPERATURE WATER GENERATION UNITS

A HTW system is a system that generates heating or process water in excess of 300°F. HTW boilers shall be of the controlled forced-circulation type, specifically designed for high-temperature water service. Because of costs associated with high-pressure pipe, valves and fittings, HTW systems should not be designed for temperatures and pressures higher than absolutely necessary.

.1 In a gas-pressurized HTW system, an inert gas such as nitrogen shall be used, and the pressurizing tank shall be installed vertically to reduce the area of contact between gas and water, thus reducing the absorption of gas into the liquid. Gas-pressurized systems should be maintained at a pressure well above the pressure at which the HTW will flash to steam. Pump pressurization is generally restricted to small process heating systems. In larger HTW systems, pump pressurization can be combined with gas pressurization.

8.1.7.5 CIRCULATION PUMPS

The energy efficiency of circulation pumps shall be emphasized. Consideration shall be given for the use of variable speed circulation pumps. In steam-pressurized systems, circulating pumps shall be located in the supply lines to maintain pressure above the flashpoint of the hottest water in the distribution system. A mixing connection that bypasses some of the cool return water into the supply line at the pump suction shall be provided to safeguard against flashing or cavitation at the pump(s). In as gas-pressurized HTW system, the circulating pumps may be installed in either the supply or return lines.

8.1.7.6 FUEL STORAGE AND HANDLING SYSTEMS

Control, containment, and treatment of rainwater runoff from coal storage yards shall comply with effluent guidelines and standards for steam-electric power generating point sources, 40 CFR 423. The relative economy of a central natural gas-fired plant compared to a gas distribution system serving the individual requirements of each building shall be considered. The long-range availability of the gas supply and the possible need for a secondary fuel shall be established. The economics of interruptible versus uninterruptible gas service relative to availability of secondary fuel shall be considered.

.1 Fully automatic mechanical-firing equipment and mechanical draft equipment shall be provided. Mechanical-firing equipment shall be specified to develop 100 percent to 125 percent of the boiler capacity.

.2 Ash handling systems shall comply with FCC Technical Report No. 51, Chapter III, Section 3.1. Land availability for storage or disposal, water availability, nearness to residential areas, the possibility of the sale of ash as a means of disposal, and environmental regulations shall be considered. Collection and treatment of ash-carrying liquid effluents shall comply with 40 CFR 423.

.3 The use of underground tanks shall be avoided.

8.1.7.7 BOILER WATER TREATMENT

Boiler water treatment shall be provided to prevent deposits on or corrosion of internal boiler surfaces and to prevent the carry-over of boiler water solids into the steam. A boiler water treatment specialist shall be consulted in determining corrective treatment measures. Water quality measures for the steam plant and other site process water users should be coordinated. The design of the plant shall provide for daily sampling to determine internal water conditions. Provisions shall be made for introducing treatment chemicals into the feed water. The plant shall contain adequate space and equipment for storing, handling, and mixing chemicals. Continuous versus intermittent blowdown operations shall be considered to determine which system will keep the concentration of total solids within acceptable limits. For continuous blowdown operations, the economics of installing a heat recovery system shall be considered.

.1 A minimum of two boiler feed pumps, each sized to handle the peak load, shall be provided to allow one pump to be out of service. Pumps shall be equipped with automatic controls to regulate feed water flow to maintain required water level range, and with a relief valve preset to lift at lower pressure than the boiler safety valve setting plus static and friction heads.

8.1.7.8 BOILER ROOM CONTROLS AND INSTRUMENTATION

Boiler plant instrumentation and control panels shall include devices for monitoring the combustion process and consoles in which such devices are mounted. Boiler room controls and instrumentation shall comply with the appropriate standard from among NFPA 85A, NFPA 85B, NFPA 85D, NFPA 85E.

8.1.7.9 PLANT INSULATION

All hot surfaces within 7 feet of the plant floor on any catwalk shall be insulated to prevent surface temperatures above 140°F where contact would be inadvertent and 120°F where contact is likely or necessary for equipment operation. Insulation shall be in accordance with the manufacturer's recommendations and ASHRAE Fundamentals handbook.

8.1.7.10 STEAM AND HIGH - TEMPERATURE WATER DISTRIBUTION

Steam and HTW distribution systems shall be sized to accommodate future expansion as directed by the project criteria without extensive modification.

.1 When aboveground steam or HTW distribution systems are to be constructed, pipe shall be installed on concrete pedestals, concrete/steel stanchions, or on poles. Where piping crosses over roadways, a minimum of 14 feet of clearance shall be provided.

.2 Provisions shall be made for expansion and contraction in the piping system. Expansion loops shall be provided where space allows. Where space does not allow, expansion joints may be used. Piping shall comply with ASME B31.1

.3 Steam shall be supplied to the distribution system at the lowest pressure that will adequately serve the connected load unless economics dictate otherwise. The economics of higher pressure distribution shall be considered. Processes requiring higher pressures shall be serviced, where practical, by a separate section of the distribution system to avoid operating the entire system at pressures higher than necessary.

.4 Warm-up bypass valves shall be provided at all shutoff valves in steam distribution lines. Steam velocities shall be selected for the type of service being considered, but shall not exceed 10,000 feet per minute.

.5 Steam and condensate pipe shall, where possible, be graded a minimum of 1 inch in 40 feet in the direction of flow. Drip stations and steam traps shall be provided at all low points in steam lines.

.6 To assure tightness of the steam system, all joints to valves and fittings for sizes larger than 1-1/4 inches shall be welded, except in the boiler house, where flanges shall be used to facilitate maintenance of equipment, connections, or valves.

.7 HTW piping shall be sized for an average velocity of 5 feet per second, a maximum velocity of 10 feet per second, and a minimum velocity of 2 feet per second. To assure tightness o the HTW system, all joints to valves and fittings for sizes larger than 1-1/4 inches shall be welded, except in the boiler house, where flanges shall be used to facilitate maintenance at equipment connections and valves.

.8 Unlike steam piping, HTW piping may follow the natural terrain; however, proper provisions shall be made to drain and vent the piping.

8.1.7.11 PIPING INSULATION
Insulation containing asbestos materials shall be prohibited. The possibility that water infiltration will cause physical damage or loss of thermal characteristics of underground pipe insulation shall be considered in the selection of insulation. All insulation installed aboveground, in tunnels, and in manholes shall be provided with a metal jacket, either factory or field installed, or provided with a hard cement finish.

8.2 LOAD CALCULATIONS

8.2.1 GENERAL
Load calculations shall be based on data and procedures outlined in the latest edition of the ASHRAE Guide and Data Books and in accordance with conditions specified herein.

8.2.2 SUBMISSION
A complete set of calculations shall be submitted showing building heating and cooling loads and equipment capacity requirements.

8.2.3 DESIGN
Load calculations may be performed manually or by a nationally recognized computer based load program. Specialty programs not recognized must have prior approval of the Contracting Officer prior to their use.

8.2.4 AIR VOLUME / EXCHANGE
For laboratory spaces, the specific volume of air required to achieve a pre-determined air exchange rate shall be dictated by the type of work being performed in the laboratory.

8.2.5 AUXILIARY AIR
If a separate auxiliary air system is provided, the auxiliary air must be heated and cooled to within 3°F of the room dry bulb temperature. Auxiliary air shall not exceed 70% of total fume hood exhaust requirements.

8.2.6 FUME HOOD EXHAUST
The design professional shall meet the requirements for laboratory fume hood exhaust as indicated in the specific design criteria and NFPA 45. Provisions shall be made in the design of the laboratory supply air system for 25 percent future expansion of fume hoods presently required to meet program design need. Fume hoods and general laboratory exhaust may be combined in a commonly manifolded exhaust duct system for blocks of hoods in coordination with EPA Safety, Health and Environmental Management Division (SHEMD). For additional information see PEA Facility Safety Manual Chapter 5, paragraph 13.j. Make provisions for separate, dedicated duct and exhaust systems for special fume hood exhausts which cannot be combined on a commonly manifolded system, including but not limited to perchloric acid hoods, high-energy radioisotope hoods, and exhausted biological safety cabinets (BSC's).

8.2.7 LABORATORY FUME HOODS
The design professional shall be responsible for determining types and sizes of fume hoods, appropriate to its intended use, with the users of the facility. The requirements of Chapter 5, Paragraphs 13. and 13.a. through 13.m. of the current version of the Facilities Safety Manual shall be followed. The requirements of the EPA fume hood standards titled: Development of Quantitative Containment Performance Tests for Laboratory Fume Hoods (latest edition) shall also be followed. In accordance with the Procedures Manual For Certifying Laboratory Fume Hoods To Meet EPA Standard (latest edition), fume hood face velocity must be provided at 100 linear feet per minute with a uniform face velocity profile of ± 10 percent of the average velocity with the sash fully open to provide protection from operations performed in the hood.

8.2.7.1 HOOD REQUIREMENTS
All hoods called for in the specific design criteria shall have met a rating of 04AAM.04 in accordance with ASHRAE 110-93 fume hood test procedure, EPA Fume Hood Procurement Manual (latest edition) and EPA fume hood standard titled: Development of Quantitative Containment Performance Tests for Laboratory Fume Hoods (latest edition). Exhaust from fume hoods and general laboratory exhausts shall be routed to the exterior of the building at its highest part and position of the exhaust stacks to prevent re-entrainment of fumes at fresh air intake points. Exhaust discharge stacks shall be at least 10 feet above adjacent roofline and so located with respect to openings and air intakes of the laboratory or adjacent buildings as to avoid re-entry of the exhaust discharge. The operational exhaust discharge shall have an exhaust velocity of at least 3,000 feet per minute (recommended to be at least 4,000 feet per minute), and shall conform to ANSI Z9.5 (latest edition). Stacks shall be designed in accordance with ASHRAE and ACGIH Industrial Ventilation Guidelines. All fume hoods shall be installed under the manufacturer's supervision including. In the case of Variable Air Volume (VAV) fume hoods, the hoods shall be installed under the hood manufacturer's and room control systems manufacturer's supervision. All hoods shall be certified per the EPA's certification manual prior to turnover.

.1 Ceiling and wall supply diffusers for the distribution of supply air in the laboratory shall be designed for a maximum of 50 feet per minute at 6 feet above finished floor at the face of the hood.

8.2.7.2 CONSTANT VOLUME BYPASS TYPE FUME HOOD
The laboratory fume hood is often an integral part of the building exhaust system. The volume of air exhausted should be constant, achieved by an airflow bypass above the sash through which room air can pass as the sash is lowered. The bypass sizing and design must be such that the following conditions are met:

.1 The total air flow volume is essentially the same at all sash positions. As the sash is lowered, the face velocity increases to a rate that shall not exceed three times the design velocity for a full open sash position.

.2 The bypass must provide a sight tight barrier between the hood work space and the room when the sash is lowered.

.3 The bypass opening is dependent only on the operation of the sash. Selected sash configurations are listed and described below:

.3.1 Vertical rising fume hood sash to be full-view type providing a clear and unobstructed side-to-side view of fume hood interior and service fitting connections. Sash shall be 1/4 inch laminated safety glass. Sash system shall utilize a single weight pulley cable counterbalance system permitting one finger operation along the length of the sash pull and hold it at any position without creep or prevent sash drop in the event of malfunction or failure of a cable.

.3.2 Combination vertical rising and horizontal sliding fume hood sash shall be similar in design to vertical rising sash type configuration with multiple horizontal sliding sashes of 1/4 inch laminated safety glass panels on multiple tracks within the vertical rising sash frame.

8.2.7.3 RADIOISOTOPE HOODS
Radioisotope hoods shall be similar to fume hood types described above, except that interior liner material shall be Type 304 stainless steel with a Number 4 finish and have vertical and horizontal coved corners with all surfaces free of seams, cracks or crevices. The working surface shall be reinforced from underside with heavy steel grating to provide the necessary strength to hold lead brick radiation protection and/or capable of supporting a minimum of 200 pounds per square foot.

8.2.7.4 PERCHLORIC ACID FUME HOODS
In addition to the features described for fume hoods, perchloric acid hoods must use materials which are non-reactive, acid resistant, and relatively impervious. Type 316 stainless steel with welded joints should be specified, although certain other materials may be acceptable. Corners shall be rounded to facilitate cleaning. Work surfaces shall be water tight with an integral trough at the rear for collection of wash down water.

.1 The hood shall be a variable air volume type, without bypass, with face velocity and exhaust volume adjustable by moving the sash up and down. Average face velocity shall be 100 feet per minute.

.2 A wash down system must be provided which has spray nozzles to adequately wash the entire assembly including the blower, and interior of the hood, with an easily accessible strainer to filter particulate in the water supply that might clog the nozzles. The wash down system shall be activated immediately after the hood has been in use.

.3 Ductwork shall be installed with a minimal amount of horizontal runs, no sharp turns, and must not be shared with any other hood.

.4 Exhaust fans must be of an acid-resistant, non-sparking (AMCA Standard Type A) construction. Lubrication shall be with a fluorocarbon grease only. Gaskets shall be of a tetrafluoroethylene polymer.

.5 Perchloric acid must never be used in hoods not specifically designed for its use. Organic materials, strong dehydrating or desiccating agents, and oxidizing or reducing materials must not be used in a hood used for perchloric acid.

8.2.7.5 SPECIAL PURPOSE HOODS

Special purpose hoods are defined as any hood not conforming to the specific types described in this section. Special hoods may be used for operations for which other types are not suitable (e.g., enclosures for analytical balances, gas vents from atomic absorption or gas chromatography units). Other applications might present opportunities to achieve contamination control with less bench space or less exhaust volume, such as special mixing stations, sinks, evaporation racks, heat sources, and ventilated work tables. Special purpose exhaust hoods shall be designed in accordance with the most current version of ANSI A9.2 and NFPA 45.

.1 Canopy Exhaust (Capture) Hoods: These shall be provided as required for the removal of heat from specific laboratory apparatus, such as furnaces, ovens, and sterilizers, or as otherwise called for in the laboratory program.

.2 Flexible Spot Exhausts (Snorkels): These shall be required to remove chemical fumes or heat from specific laboratory instrumentation, such as high pressure liquid chromatography (HPLC), gas chromatography/mass spectrometry (GC/MS), and atomic absorption (AA) units, and will require an estimated exhaust rate of 100-200 CFM or as appropriate for the intended use.

.3 Gas Cabinets: Special exhaust cabinets will be required to house individual or pairs of toxic/pyrophoric gas cylinders. Leak detectors and low-exhaust flow alarms shall be considered as well as a gas purge system to provide for safe exchange of cylinders. Exhaust for these cabinets is estimated at 50-75 CFM each.

8.2.8 GLOVE BOXES
Glove boxes will be government furnished equipment. These ventilated enclosures are often required by laboratory personnel to ensure containment of chemical and biological airborne contaminants produced during their work in the box without escape into the room, and permits manual manipulations within the box through armholes provided with impervious gloves sealed to the box at the armholes. These types of enclosures have special design requirements that are related to their intended use and must be individually approved by EPA Safety, Health and Environmental Management Division (SHEMD) and Engineering, Planning, and Architecture Branch (EPAB).

8.2.9 BIOLOGICAL SAFETY CABINETS
Laminar flow biological safety cabinets (BSC) shall have passed minimum standards for cabinet classifications as stated in Pamphlet #49 by the National Sanitation Foundation (NSF) for personnel, environmental, and product safety and shall be identified by a distinctive NSF seal. Field re-certification by a competent technician using the procedures outlined in NSF Standard #49 will be required once the cabinet(s) is installed. Cabinet classification shall be determined by the design professional during laboratory programming with the users of the facility. These types of cabinets have special design requirements depending on their intended use (such as protecting personnel from harmful agents inside the cabinet, protecting work product, experiment, or procedure from contaminants outside the cabinet, or protecting the laboratory environment from contaminants inside the cabinet), and must be individually approved by the EPA Safety, Health and Environmental Management Division (SHEMD) and Engineering, Planning, and Architecture Branch (EPAB).

8.2.10 FLAMMABLE STORAGE CABINETS
Cabinets for the storage of Class I, Class II, and Class IIIA liquids shall be provided in accordance with design, construction, and storage capacity requirements stated in the latest edition of NFPA 30, Chapter 4. Venting of storage cabinets is not required for fire protection purposes, but venting may be required to comply with local codes or authorities having jurisdiction.

.1 If cabinet venting is required, the cabinet shall be vented to the outdoors in such a manner that will not compromise the specified performance of the cabinet. The cabinet shall be vented from the bottom with make-up air supplied at the top. Mechanical exhaust ventilation should be provided at a rate of 50 CFM and comply with NFPA 91, Standard for Exhaust Systems for Air Conveying of Materials. Manifolding the vents of multiple storage cabinets is not recommended.

.5 Non-vented cabinets shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer of the cabinet.

8.2.11 LABORATORY SERVICE FITTINGS
Laboratory service fittings are called out for each laboratory space in the room data sheets and shall be compatible with their intended use. All service valves, fittings, and accessories shall be of cast brass with a minimum copper content of 85 percent except for items which are to be brass forged or bar stock and shall be especially designed for laboratory use. All laboratory service fittings shall have an acid and solvent resisting clear plastic coating applied over a clean, polished, chrome-plated surface. Service fittings at fume hoods shall have an acid and solvent resistant plastic coating applied over a fine sandblasted surface, properly cleaned.

8.3 AIR FILTRATION AND EXHAUST SYSTEMS

8.3.1 DRY FILTRATION

Air cleaning equipment for ductwork and equipment installation shall be easily removable, serviceable, and maintainable. Air cleaning equipment shall have face velocities as recommended by the filter manufacturer to achieve the specified efficiency at the lowest possible pressure drop. Filters shall be constructed of noncombustible materials meeting the requirements for UL 900, Class I. Air filters shall be located on the suction side of fans and coils and in other special locations as required for air treatment. Air-filter pressure drop gauges of the diaphragm-actuated, dial-type (preferred) or the inclined manometer type shall be located on all filter assemblies excepting small fan coils, and fan powered VAV terminal units. The ASHRAE dust spot method shall be used in specifying efficiencies required for medium efficiency filters. Filters shall be specified and installed for use as pre-filters, medium-efficiency filters, or high-efficiency filters. These filters shall comply with ARI 850. Pre-filters for high-efficiency filters are normally provided, being either pre-filter or medium-efficiency filters depending on the upstream air particle size distribution.

8.3.2 ABSOLUTE FILTRATION

Absolute filtration, where required on fume hood exhaust systems, will have an efficiency of 99.97% as determined by the DOP aerosol test for absolute filters and shall satisfy specification MIL-F-510686 and ASHRAE Standard 52-76. Filter housing shall be of the "bag-in/gas-out" design.

8.3.2.1 TEST ACCESS

The design professional shall design for a location that facilitates in-place testing of HEPA filters, with particular attention given to plenum hardware provisions that allow for testing of the HEPA filter bank without requiring the testing personnel to enter the plenum. Utility services shall be extended to the plenum location (e.g., electrical receptacles and compressed air) to facilitate testing work. In-place testing design requirements shall meet all the recommendations of UL 586, ASME N510. HEPA filtration systems shall be designed with prefilters installed upstream of HEPA filters to extend the HEPA filter's life. The design professional may eliminate the installation of pre-filters if an analysis of filtration requirements and consideration of the filter assembly justifies omission.

8.3.2.2 FIRE PROTECTION OF HEPA FILTER ASSEMBLIES

In providing fire protection for the HEPA filters, the design shall separate prefilters or fire screens equipped with water spray sufficiently from the HEPA filters to restrict impingement of moisture on the HEPA filters. Under conditions of limited separation, moisture eliminators or other means of reducing entrained moisture shall be provided. Moisture eliminators may be omitted where system design provides sufficient filter redundancy to ensure continued effluent filtration in the event of fire within any portion of the system. The HEPA filter fire protection system shall be activated in manner consistent with the fire protection system in the room or building in which the filters are located.

8.3.3 AIR - CLEANING DEVICES FOR SPECIAL APPLICATIONS

Filters include dry type dust collectors, wet collectors, centrifugal collectors, absorbers, absorbers, oxidizers, and chemical treatment filters that are used primarily in industrial and process-type applications associated with air or gases that have heavy dust loadings in exhaust systems or stack gas effluents. Filters shall be designed according to the requirements given in the project criteria, ASHRAE Equipment handbook, and ACGIH Industrial Ventilation Manual.

8.3.4 OPERATION

All building systems shall be designed for 24-hour operation, seven days a week, unless otherwise specified in the project criteria.

8.3.5 MAINTENANCE ACCESS

The air supply and exhaust plenums shall be designed so that maintenance of motors, bearings, control valves, steam traps, etc., are easily accessible.

8.3.6 LOCATION OF AIR INTAKE

The outside air intake(s) shall be located so as to provide the cleanest possible source of fresh air for the building and shall be located relative to the building's exhausts, vent stacks, etc., so as to prevent entrainment of contaminated air from outside sources including, but not limited to, fume hood exhaust, vehicle exhaust, and exhaust from adjacent structures..

8.3.7 VENTILATION RATES

Ventilation in general shall be those recommended in the ASHRAE Standard 62-1989 or latest edition, and Section 2 - General Facility Requirements; Indoor Air Quality Requirements; Design Process. As a minimum, Table 8.3.7 - SPECIAL VENTILATION RATES shall be accounted for in the design of the system:

TABLE 8.3.7 - SPECIAL VENTILATION RATES

Laboratories	A minimum of eight air changes per hour, single pass air as per ASHRAE 62-1989 or latest edition and EPA's Facility Safety Manual, Chapter 5, paragraph 12.a.
Offices and Administration Spaces	As required for human comfort but with a minimum of 20 cfm of outside air per occupant per ASHRAE 62-1989 or latest edition.
Chemical Storage	Must meet NFPA 30 or 45 requirements according to usage - Minimum 6 to 10 air changes per hour, single pass only.
Smoking Room	The air supply from smoking rooms shall not be recirculated. It should be exhausted to the outside by separate ductwork and exhaust fan. Minimum 60 CFM per person as per ASHRAE 62-1989 or latest edition and per EPA's Facility Safety Manual Chapter 5 para 12.b.

8.3.8 PLUME STUDY (LABORATORY EXHAUST)

The design professional shall be responsible for obtaining a study of prevailing wind patterns for the proposed building site. The study shall be performed to ensure proper design height of the laboratory exhaust stack(s) and fresh air intake locations. Stack design shall consider all elements of the site, including ground-level landscaping, large variations of terrain, complex groupings of adjacent buildings, height and massing of building(s) taking into account exterior details, complex emission geometry, orientation to prevailing winds, nature of discharge particles and volume of discharge. Based on the results of this study, the design professional can recommend optimal building orientation on the site and incorporate structural details that minimize effects on the dispersion of exhaust emissions.

8.3.9 ATMOSPHERIC AIR FLOW CHARACTERISTICS STUDY

8.3.10 EXHAUST STACK DISPERSION PERFORMANCE ANALYSIS

8.4 PLUMBING

8.4.1 PIPING

These criteria apply to interior plumbing systems (fixtures, supply, drain, waste and vent piping, service water heating system, safety devices, and appurtenances) up to 5 feet beyond the building exterior wall. For new systems, domestic water shall be supplied by a separate service line and not be a combined fire protection and potable water service or a combined process water and potable water system within the building. Plumbing shall comply with the NSPC (or other locally adopted nationally recognized plumbing code), ASHRAE Handbooks, and ASHRAE Standard 90.

8.4.1.1 SUPPLY

Type K copper tubing shall be used below grade. Type L copper tubing shall be used above grade. CPVC and PB plastic pipe and tubing may be used in lieu of copper tubing above grade where not subject to impact damage or otherwise prohibited by the project criteria.

.1 Fittings for Type K shall be flared brass, solder-type bronze or wrought copper. Fittings for Type L shall be solder-type bronze or wrought copper. fittings for plastic pipe and tubing shall be solvent cemented or shall use Schedule 80 threaded. No lead solder shall be used for copper pipe in potable water systems.

.2 Stop valves shall be provided at each fixture. Accessible shut-of valves shall be provided at branches serving floors or fixture batteries for isolation, or at risers serving multiple floors. Shut-off valves shall be provided to isolate equipment, valves, or appurtenances for ease of maintenance.

,3 Accessible drain valves shall be provided to drain the entire system. Manual air vents shall be provided at high points in the system.

.4 Provision for expansion compensation shall be included where thermal expansion and contraction cause piping systems to move. The movement shall be accommodated by using the inherent flexibility of the piping system as laid out, by loops, by manufactured expansion joints, or by couplings.

.5 Accessible manufactured water hammer arresters shall be provided. Dielectric connections shall be made between ferrous and non-ferrous metallic pipe.

.6 Where domestic or fire water service lines enter buildings, suitable flexibility shall be provided to protect against differential settlement or seismic activity in accordance with the NSPC or NFPA 13, respectively.

8.4.1.2 DRAIN, WASTE AND VENT

Underground lines that do not service the laboratory areas shall be service weight cast iron soil pipe hub-type (with gasket); hubless cast iron soil pipe may be used in locations where piping is accessible. Aboveground (above grade) lines that are 1-1/2 inch in diameter and larger shall be either hubless or hub-type (with gasket) service weight cast iron pipe. Lines 1-1/2 inch through 6 inch in diameter may be ABS or PVC plastic pipe where allowed by the project criteria. Pipe and fittings shall be joined using solvent cement or elastomeric seals. Lines smaller than 1-1/2 inch in diameter shall be either 1) Type L copper with solder-type bronze or wrought copper fittings or 2) galvanized steel with galvanized malleable iron recessed threaded and coupled fittings. Cast iron soil pipe fittings and connection shall comply with CISPI guidelines. Provisions for expansion compensation shall be included as above. Underground lines servicing the laboratory area shall be Acid Resistant Sewer pipe ANSI/ASTM D2146-69 - Polyethylene Plastic Pipe and Fittings, Schedule 40, ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR), ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe. Welded together following ANSI/AWS D1.1 - Structural Welding Code, ASTM D2241, and ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

8.4.1.3 TRAP SEAL PROTECTION

A trap primer valve and floor/funnel drain with trap primer valve discharge connections shall be used where there is the possibility of the loss of the seal in floor/funnel drain traps.

8.4.1.4 STERILIZATION

New supply systems or rehabilitation to existing supply systems shall require sterilization as per AWWA C652, AWWA C5186, or local governing plumbing code.

8.4.1.5 MISCELLANEOUS

Access panels shall be provided where maintenance or replacement of equipment, valves or other devices are necessary. Escutcheons shall be provided at wall, ceiling, and floor penetrations of piping in occupied areas.

8.4.2 PLUMBING FIXTURES

Fixtures and appurtenances suitable for use by handicapped persons shall comply with the American Disabilities Act (ADA). Fixtures shall contain no lead. Self-contained mechanical-refrigerated coolers shall be provided wherever a need for drinking fountains exists. Ratings shall be based on ARI 1010. Electrical equipment shall be UL listed.

8.4.3 BACKFLOW PREVENTERS

Backflow preventers of the reduced pressure zone type shall be provided on any domestic water and fire protection lines serving the building. All domestic water lines shall be provided with water hammer suppresser and vacuum breakers at high points of supply lines or at the fixture.

8.4.4 SAFETY DEVICES

Tempering valves shall be the fail-safe pressure balance type. Hot water generation equipment shall be provided with ASME code-stamped tanks, when of sufficient capacity, water temperature, or hot input rate to be within the jurisdiction of the ASME Boiler and Pressure Vessel Code. Approved relief devices, combination temperature-pressure or separate units, depending on the application, shall be provided. Backflow preventers and air gaps shall be used to prevent cross-connection (contamination) of potable water supplies. Vacuum breakers (to prevent back-siphonage) shall be used only in conjunction with administrative controls.

8.4.4.1 PRESSURE REDUCING VALVES

Pressure-reducing valves shall be provided where service pressure at fixtures or devices exceeds the normal operating range recommended by the manufacturer. Wherever a pressure-reducing valve's failure may cause equipment damage or unsafe conditions, a pressure-relief valve shall be provided downstream of the reducing valve.

8.4.5 EMERGENCY EYEWASH UNITS

Emergency eyewash units or combination eyewash/safety shower type units shall be provided in all work areas where, during routine operations or during foreseeable emergencies, the eyes of an individual may come into contact with a substance which can cause corrosion, severe irritation, permanent tissue damage or which is toxic by absorption. Eyewash units shall be designed to flush both eyes (double headed) simultaneously, and to provide hands-free operation. They shall be placed in a location away from potential sources of hazard (i.e., fume hoods), and near the exit door. The eyewash units chosen should provide protection of nozzle area with pop-off covers, etc., to prevent contamination of the flushing system. Design, operation, flow, water temperature, etc., shall meet the criteria established in ANSI Z358.1-1990, or latest edition, and shall be serviced by the potable water system. Eyewash units shall be in accessible locations that require no more than 10 seconds to reach and should be within a travel distance of no greater than 100 feet from the hazard. The location shall be standardized in all laboratory spaces to the degree possible in a well lighted area, and shall be clearly identified with a highly visible sign. Final location shall be approved by the EPA project officer during the design phase.

8.4.6 EMERGENCY SAFETY SHOWERS

Emergency safety showers or combination safety shower/eyewash units shall be provided in areas where, during routine operations or during foreseeable emergencies, areas of the body may come into contact with a substance which is corrosive, severely irritating to the skin or which is toxic by skin absorption. Combination safety shower/eyewash units shall be installed with a flexible hand-held drench hose mounted on a rack. All piping for the emergency safety showers shall be above the ceiling except for the shower head and pull bar connection. Design, operation, flow rates, etc., shall meet the criteria in ANSI Z358.1-1990, or latest edition, and shall be serviced by the potable water system. Rigid pull bars of stainless steel should be used to activate the shower and extend within 54" of the floor. The floor area of the emergency safety shower shall be textured, well lighted, identified with a highly visible sign and maintained free of items which obstruct its use. A water flow alarm shall sound when the safety shower is activated. Location of safety showers shall be standardized as much as possible. Emergency safety showers in laboratories shall be located at the room entrance on the right hand side of the exit door (hinge side); instrument laboratories and laboratory support spaces shall have showers located in the corridor at the pull side of the room door.

8.4.7 GLASSWARE WASHING SINKS

Sinks dedicated to the purpose of washing laboratory glassware shall have a high or telescoping spigot with a swing-type gooseneck to accommodate large pieces of glassware. Large sinks shall be provided with a hand-held sprayer whose weight is supported for ease of operation. All glassware washing sinks shall be ventilated at a rate of 280-300 CFM with an exhaust air duct connection at the top of the sink below the bench top.

8.5 COMPRESSED AIR SYSTEMS

Provide one or more compressed air system with oil and water traps, dryer and all controls. Unless specified in the project criteria, each compressed air system shall have duplex compressors (one redundant) with automatic lead/lag switch and a single compressor tank. Compressed air systems for processes shall be completely independent of the compressed air system for the HVAC controls. The compressed air system shall provide a water trap and pressure regulation at each laboratory. An audible alarm and remote annunciation shall be provided to alert personnel of a loss of air pressure. Air compressors shall use vibration pads and springs as needed to substantially diminish vibration/sound generated by compressors. Further, their location should be such as not to transmit vibration/sound to the building or rooms they service.

8.6 VACUUM SYSTEMS

A laboratory vacuum system composed of several vacuum pumps is required to evacuate air at a regulated suction of 25 inches of mercury or as specified in the project criteria. Storage volume and number of pumps shall be determined at the design stage as needed to meet laboratory benchwork requirements. Unless otherwise specified in the project criteria, each vacuum system shall have duplex pumps, an automatic lead/lag switch and a single tank. An audible alarm and remote annunciation shall be provided to alert personnel of a loss of vacuum. Vacuum pumps shall use vibration pads and springs as needed to substantially diminish vibration/sound generated by the pumps. Further, their location should be such as not to transmit vibration/sound to the building or rooms they service.

8.7 CENTRALIZED LABORATORY WATER SYSTEMS

8.7.1 DEIONIZED WATER (DI) SYSTEM

Unless specified in the project criteria, the central deionized water system shall have a resistivity greater than 10 mega ohms at the tap in each laboratory. Water quality shall conform to ASTM Type I requirements for reagent quality water and APHA ASTM Type I requirements for reagent quality water and APHA requirements for water used in microbiological testing. Type I water is typically prepared by distillation of feed water having a maximum conductivity of 20 mega ohms/cm (25° C), followed by polishing with mixed bed deionizers and passage through a 0.2 micron membrane filter. Pipes and fittings for DI system shall be PVDF schedule 80 or unpigmented / polypropylene.

8.7.2 HOT / COLD WATER - POTABLE

Refer to paragraph 8.4.1.1 of this section. Laboratory potable water supply shall be piped in type K or type L copper. Potable water shall be used for emergency eyewash or emergency showers only.

8.7.3 INDUSTRIAL HOT / COLD WATER - NON - POTABLE

Laboratory non-potable water supply, identified as industrial hot/cold water,shall be piped in type K or type L copper. Approved back-flow prevention devices shall isolate the laboratory water system from the potable water system. Hot water supply shall be insulated and recirculated to conserve energy.

8.7.4 CULTURE WATER SYSTEM

Culture water system piping shall be schedule 80 unpigmented polypropylene and shall have no metal in contact with the water. Holding tank shall be lined with unpigmented polypropylene. Transfer pumps shall be solid unpigmented polypropylene.

8.8 NATURAL GAS DISTRIBUTION SYSTEM

Unless otherwise specified in the project criteria, each laboratory is required to have a Natural Gas Distribution System.

8.9 NON - FLAMMABLE AND FLAMMABLE GAS SYSTEMS

8.9.1 GENERAL

Special gas services for flammable and non-flammable gases shall be provided to all laboratories requiring their use. Gases shall be stored and piped in accordance with NFPA 45 Chapter 8, or latest edition.

.1 Gas cylinders for non-flammable gases, both in-use and stand-by, shall be manifolded from a remotely located space central to the laboratory section areas served and accessible from the main storeroom or loading/receiving dock area. This space shall be designed and ventilated in accordance with code requirements.

.2 Flammable gas cylinders shall be provided at point-of-use only and be housed in ventilated cabinet enclosures with leak detection and alarm monitoring devices.

8.9.2 DISTRIBUTION SYSTEMS

For all laboratories, except for metals analysis laboratories, a seamless copper piping gas distribution system for non-flammable gases shall be provided from the space identified in paragraph 8.9.1.1 to all of the designated laboratories. Ideally, the length of gas distribution lines should not exceed 100 feet to avoid the necessity for connections. If connections are required due to length, prior approval of the EPA is required. Each copper line of this system shall be placed inside a PVC pipe of larger diameter and vented to the outside of the building. Regulator valves and other auxiliary equipment, required to furnish gas at the required pressures, shall be provided. Pipe sizes shall be coordinated to ensure proper velocity of gas from cylinders(s) to point of application. The number and type of gas outlets in each room is provided in the Room Data Sheets. Exact and final location in each laboratory must be approved by the EPA during design phase. They system design shall include capability for individual room cutoff.

8.9.3 DISTRIBUTION TO METALS LABORATORIES

For all laboratories used for metals analysis, a seamless Teflon piping gas distribution system for gases shall be provided from this room to all of the metals laboratories. The Teflon lines shall be placed inside a larger PVC pipe vented to the outside of the building. Each Teflon line of this system shall be equipped at both ends with regulator valves, and other auxiliary equipment required to furnish gas at required pressures. Other gas distribution systems other than Teflon may be utilized if approved by the Contract Officer. Pipe sizes shall be coordinated to ensure proper velocity or gas from cylinder(s) to the point of use.

8.9.4 PIPING EXIT CORRIDOR RESTRICTION

Piping from any of these systems shall not be run above or in the exit corridors.

8.9.5 BOTTLE GAS SUPPLY

The bottle gas supply shall be provided with duty and standby sets with automatic change over valves and controls. An indicator panel shall be installed close to the point of use in each of the laboratories, for all gases. Rooms may be clustered in the panel so long as a minimum distance of 75 feet between point of use and the panel is not exceeded. See room data sheet requirements for the types, volumes, and other design information.

8.9.5.1 MULTI-POINT GAS ANALYZER AND ALARM SYSTEM

A multi-point gas analyzer and alarm system shall be provided to monitor the presence of toxic and explosive gases within the space. This system shall consist of gas sensors/transmitters, wiring and a micro-processor based monitoring and alarm control panel. The number and type of sensors/transmitters shall be determined by the specific application. Each sensors/transmitters shall transmit a frequency signal proportional to the gas concentration and have a special amplifier to eliminate the effects of radio frequency interferences. The control panel shall be capable of monitoring and alarming different types of gases in different zones and have an audible and visible alarm. The control panel shall have a factory wired terminal strip to interface with the Energy Management System for remote monitoring and alarms.

8.9.6 LIQUID NITROGEN AND LIQUID ARGON

Liquid nitrogen and liquid argon must be delivered to point of use in liquid form. Insulation in the delivery system must be sufficient to prevent evaporation losses of liquid nitrogen. Location of the gas distribution room for these two gases shall be as close as possible to the laboratory rooms where the gases are used, preferably adjacent to them and directly accessible from the outside of the building without use of the laboratory corridors. One large tank for each gas shall be provided and permanently fixed in the room. The tanks shall be outfitted with necessary valves and controls as required by the gas supplier.

8.9.7 TESTING AND PURGING

Before acceptance the distribution system must be pressure tested and purged. The required level of purity specified at point of use shall be maintained at all points in the system during testing and purging.

8.10 NON-SANITARY LABORATORY WASTE

All non-sanitary laboratory waste waters from the laboratories are required to pass through an acid neutralization system prior to discharge into the local publicly owned treatment works. The system shall be designed and constructed in accordance with EPA standards for waste water neutralization. The system shall have the capability of continuous pH flow monitoring and recording. The recorders shall be located in the facility's engineer's office, or other suitable area. Sampling capability is required to allow for routine monitoring of facility waste water effluent..

8.11 CODES AND STANDARDS

The Codes and Standards of the organizations indicated in Table 8.11 - CODES AND STANDARDS, shall apply to all mechanical and plumbing systems, equipment and piping whether or not they are specifically listed the Mechanical Section. In the event of conflict between the Codes and Standards of the organizations listed and others that may be listed elsewhere in this documents, the more stringent shall govern.

TABLE 8.11- CODES AND STANDARDS

AGA:	American Gas Association
ARI:	Air-Conditioning and Refrigeration Institute
ADC:	Air Diffusion Council
ASHRAE:	American Society of Heating, Refrigerating and Air Conditioning Engineers
ACGIH:	American Conference of Governmental Industrial Hygienists
CGA:	Compressed Gas Association
AMCA:	Air Moving and Conditioning Association
AABC:	Associated Air Balance Council
NEMA:	National Electrical Manufacturers Association
ASME:	American Society of Mechanical Engineers
ASTM:	American Society for Testing Materials
ANSI:	American National Standards Institute
AWWA:	American Water Works Association
NEC:	National Electric Code
NFPA:	National Fire Protection Association
NSF:	National Sanitation Foundation
OSHA:	Occupational Safety and Health Act
SMACNA:	Sheet Metal and Air-Conditioning Contractors National Association
UL:	Underwriters Laboratories, Inc.
	National Safety Code
	Owners Insurance Underwriters
	Uniform Building Code Congress
	Other Federal, State and Local Authorities having jurisdiction.

8.12 TESTING AND BALANCING

8.12.1 INDEPENDENT CONTRACTOR

The successful contractor shall procure the services of an independent air balance and testing agency (Testing Agency), which specializes in the balancing and testing of heating, ventilating, and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution system, water system, gas, and compressed air piping systems required in the solicitation.

8.12.2 CONTRACTOR CREDENTIALS

The independent contractor shall be an organization whose activity is testing and balancing of environmental systems, and a member of the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB) and shall have satisfactorily balanced at least three (3) systems of comparable type and size as this project.

8.12.3 CONTRACTOR REGISTRATION
The independent Testing and Balancing Contractor shall be registered in the State of the project.

8.12.4 SCOPE OF WORK
The test and balancing work shall include, but not necessarily be limited to the following items:

.1 All air-conditioning supply and return systems
.2 Air exhaust systems
.3 Hood supply and exhaust systems (include certification and performance testing)
.4 All hydronic systems
.5 Gas and compressed air systems

8.12.5 TESTING AND BALANCING DEVICES
HVAC air and water distribution systems shall be provided with permanently installed calibrated testing and balancing devices and access as needed to accurately measure and adjust water flows, pressures, or temperatures as required. The design professional shall provide as a minimum the balancing devices in Table 8.12.5.1 - REQUIRED BALANCING DEVICES FOR WATER AND STEAM DISTRIBUTION SYSTEMS and Table 8.12.5.2 - REQUIRED BALANCING DEVICES FOR AIR DISTRIBUTION SYSTEMS. Test devices shall be located and installed according to AABC Volume A-82.

Table 8.12.5.1 - REQUIRED BALANCING DEVICES FOR WATER AND STEAM DISTRIBUTION SYSTEMS

SYSTEM COMPONENTS (WATER)	REQUIRED SYSTEM DEVICES
Pump suction and discharge piping	Manifold pressure gauge with pressure taps
Pump discharge piping	Flow measuring device (type depending on accuracy required) or inlet and discharge pressure gauges
Chiller evaporator water suction and discharge piping	Thermometer/test well and pressure gauge and gaugecock.
Boiler or heat exchanger suction and discharge piping	Same devices as required for chiller evaporator piping
Heating or cooling coil (AHU) suction and discharge piping	Thermometer/test well; pressure gauge/pressure tap
Heating or cooling coil (AHU) discharge piping	Presettable calibrated balancing valve with integral pressure test ports
Reheat coil, fan coil unit, unit heater, ports and finned tube radiation, convector: 1) discharge piping 2) suction piping	1) Presettable calibrated balancing valve with integral pressure test ports 2) temperature test 3) pressure tap
Three-way control valves (each port) suction and discharge piping	Pressure tap
SYSTEM COMPONENTS (STEAM)	**REQUIRED SYSTEM DEVICES**
Boiler discharge piping	Flow measuring device (orifice or venturi type)

Table 8.12.5.12- REQUIRED BALANCING DEVICES FOR AIR DISTRIBUTION SYSTEMS

SYSTEM COMPONENTS	REQUIRED SYSTEM DEVICE
Diffusers, grilles, registers	Round butterfly or square/rectangular opposed blade volume damper, either integral with device or in spin-in take offs
Branch ductwork runs	Rectangular/square or round (with more than one opposed blade damper and terminal device). Sealed test hole for pitot tube traverse
Fan discharge ductwork	Sealed test holes for pitot tube traverse. Sealed test hole for static pressure measurements
Fan suction ductwork	Sealed test hole for static pressure measurement
Cooling coil suction and discharge airstreams	Duct-mounted airstream thermometer
Heating coil suction and discharge airstreams	Duct-mounted airstream thermometer
Mixed air plenum airstream	Duct-mounted airstream thermometer

8.12.6 REPORTING

The testing and Balancing Contractor approved by the Contracting Officer shall, at the completion of the balancing work, submit a complete report to the EPA for approval. The report shall be delivered at least 15 days prior to final inspection of the building.

8.13 DUCTWORK

8.13.1 GENERAL

Provide all ductwork including that required for air supply and exhaust return of laboratory fume hoods and equipment. Ductwork systems shall be designed for efficient distribution of air to and from the conditioned spaces with consideration of noise, available space, maintenance, air quality, air quantity, and an optimum balance between expenditure of fan energy (annual operating cost) and duct size (initial investment).

8.13.2 FABRICATION

Ductwork for air supply, return air and general exhaust shall be fabricated of galvanized sheet metal. Laboratory fume hood and equipment exhaust shall be PVC coated galvanized sheet metal or Type 316 welded stainless steel, depending on the specific laboratory function and type of process being exhausted. Polypropylene and glass duct material shall be considered for highly corrosive exhaust applications.

8.13.2.1 COMPLIANCE

Ductwork systems shall be designed to meet the leakage rate requirements of SMACNA HVAC Air Duct Leakage Test Manual. Ductwork, accessories, and support systems shall be designed to comply with the following:

.1 ASHRAE Fundamentals handbook

.2 SMACNA HVAC Duct Construction Standards - Metal and Flexible

.3 SMACNA Fibrous Glass Duct Construction Standards

.4 SMACNA Round Industrial Duct Construction Standards

.5 SMACNA HVAC Duct Design Manual

.6 ACGIH Industrial Ventilation Manual

.7 NFPA 45 - Fire Protection for Laboratories Using Chemicals

.8 NFPA 90A - Installation of Air Conditioning and Ventilation System

.9 NFPA 91 - Installation of Exhaust Systems for Conveying of Materials

.10 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations

8.13.2.2 SPECIAL APPLICATIONS

.1 Ductwork shall also be designed to comply with NFPA 90A, including specifications and installation of smoke and fire dampers at rated wall penetrations and smoke pressurization/containment dampers as required for smoke pressurizations/evacuation systems. Fire dampers shall not be used on the exhaust system ducting if it is required to maintain confinement of hazardous materials during and after a fire event.

.2 Ductwork shall be designed to resist corrosive contaminants if present. Exhaust ductwork from laboratory fume hoods shall not be of spiral construction and shall be sloped toward the fume hood for drainage of condensation. Laboratory ductwork shall be in accordance with the requirements of NFPA 45.

.3 Ductwork that handles moisture laden air exhausted from areas such as shower rooms, dishwashing areas, or other areas where condensation may occur on the duct interior, shall be of aluminum construction, have welded joints and seams, and provide drainage at low points.

.4 Penetrations of ductwork through security barriers shall be minimized. Such penetrations, more than 96 square inches in area and six inches in minimum dimension, shall provide a penetration delay equal to that required for the security barrier. The physical attributes, intended service of the ductwork, and the axial configuration of the barrier penetration shall be considered in the design of the penetration delay.

8.13.3 ACCESS PANELS
All ductwork shall have an access panel as required for access to each operating part, including:

.1 Splitter dampers
.2 Manual volume dampers
.3 Motorized volume damper
.4 Fire dampers

8.13.4 INSULATION
All supply air ductwork shall be insulated with a vapor barrier unless otherwise dictated by the project criteria. Supply air ductwork installed below ceilings and in conditioned spaces may not require insulation if the surrounding air has a low dewpoint and condensation will not occur. Return and exhaust air ductwork may be insulated when condensation may occur when routed through non-conditioned areas.

8.13.5 FIRE DAMPERS
Fire dampers shall be provided in accordance with codes, except in the laboratory areas exhaust systems.

8.14 DRINKING FOUNTAINS
The design professional shall provide a minimum of one drinking fountain on each block of space so no person will have to travel more than 150 feet to reach it. The water shall be chilled. The refrigeration coils shall not be assembled using lead solder nor shall these coils contain lead as a lining. All drinking fountains and locations for drinking fountains shall comply with the Americans with Disabilities Act (ADA).

8.15 TOILETS, SINKS AND LAVATORIES

8.15.1 GENERAL
Separate toilet facilities for men and women shall be provided. The facilities must be located so that employees will not be required to travel more than 150 feet to reach the toilets. Each toilet room shall have a sufficient number of water closets with a minimum of two per toilet room for each men's room and four water closets for each women's room enclosed with modern stall partitions and doors. It should also have a minimum of two urinals in each men's room. The number of women's water closets in each room shall be no less than the sum of water closets plus urinals of the adjacent men's room. The toilet

room's hot water should be set at 105 degrees Fahrenheit, or as per the project criteria. Water closets and urinals shall not be visible when the entry door is open.

8.15.1.1 ACCESSORIES
Each main toilet room shall contain:

.1 A soap dispenser, shelf and mirror above the lavatory

.2 A toilet paper dispenser in each water closet stall

.3 A coat hook on the inside face of door to each water closet stall and on the wall immediately inside the door of the toilet room.

.4 At least one modern paper towel dispenser and waste receptacle for every two lavatories

.5 A coin operated sanitary napkin dispenser in women's toilet rooms with waste receptacle for each water closet stall

.6 Ceramic tile or comparable wainscot from the floor to a minimum height of 4 feet 6 inches

.7 A disposable toilet seat cover dispenser

.8 A convenience outlet located adjacent to one mirror in each rest room.

.9 A small covered container located inside each toilet partition enclosure in the women's toilet room for the disposal of used sanitary napkins.

8.15.2 TOILET STALL ACCESSIBILITY
All public toilet rooms shall be located along an accessible path of travel and must have accessible fixtures, accessories, doors and adequate maneuvering clearances. The interior shall allow an unobstructed floor space of 5 feet in diameter, measured 12 inches above the floor.

8.15.2.1 DIMENSIONS
All toilet rooms designated for public access shall have one toilet stall that:

.1 Is 60 inches wide

.2 Has a minimum depth of 56 inches when wall mounted closets are used or 59 inches when floor mounted sets are used

.3 Has a clear floor area

.4 Has a door that is 32 inches wide and swings out

.5 Has handrails on each side, (front transfer stall) or on the side and back (side transfer stall). They shall be 33-36 inches high and parallel to the floor, 1-1/4 to 1-1/2 inches in outside diameter, with 1-1/2 inch clearance between rail and wall, and fastened securely at ends and center.

.6 They shall have no sharp edges and must permit the continuous sliding of hands and

.7 Has a water closet mounted at a height from 17 to 19 inches, measured from the floor to the top of the seat. Hand operated or automatic flush controls shall be mounted no higher than 44 inches above the floor.

8.15.2.2 ALTERNATE
A stall measuring 36" or 48" wide by 66", but preferably 72" deep may be acceptable as determined by the Agency.

8.15.3 LAVATORY ACCESSIBILITY
Accessibility shall comply with the Americans with Disabilities Act (ADA). At least one lavatory shall be mounted with a clearance 29 inches from the floor to the top of the bottom of the apron. The height from the floor to the top of the lavatory rim shall not exceed 34 inches. Faucets shall be lever operated, push type or electronically activated for one hand operation without the need for tight pinching or grasping. Drain pipes and hot water pipes under a lavatory must be covered, insulated or recessed far enough so that wheelchair individuals without sensation will not burn themselves.

8.15.4 ACCESSIBLE MIRRORS, URINALS, AND ACCESSORIES
Accessibility shall comply with the Americans with Disabilities Act (ADA). One mirror with shelf shall be provided above the lavatory at a height as low as possible and no higher than 40 inches above the floor, measured from the top of the shelf and the bottom of the mirror. A common mirror provided for both the able and disabled must provide a convenient view for both. Toilet rooms for men shall have wall mounted urinals with elongated lips, with the basin opening no more than 17 inches above the floor. Accessible floor mounted stall urinals with basins at the level of the floor are acceptable. The toilet room shall have at least one towel rack, towel dispenser and other dispensers and disposal units mounted no higher than 48 inches from the floor or 54 inches if a person in a wheelchair has to approach it from the side.

8.15.5 TOILET SCHEDULE
The number of water closets, urinals, and lavatories shall comply with all state and local codes and as per the project criteria. If a conflict exists between the project criteria and the state and local codes, the more stringent shall apply or as directed by the contracting officer.

8.15.6 WATER CONSERVING WATER CLOSETS, SINKS AND LAVATORIES
Flow control devices shall be installed (unless otherwise dictated by the project criteria) on all water closets, sinks and lavatories. Devices shall limit water closet flow to 1.5 gallons per flush; public lavatories to 0.5 gallons per minute and regular lavatories to 1.5 gallons per minute.

8.16 SHOWER STALLS
Stalls shall be of fiberglass construction, complete with door, soap ledge, shower head, separate hot and cold water knobs, non-skid floor finish and standard 2" floor drain. Shower stalls shall also provide a small change area with lockers. Emergency shower deluge heads shall not be used in regular shower stalls. For emergency showers see 8.4.6. Accessibility shall comply with the Americans with Disabilities Act (ADA).

8.17 HOSE BIBBS

Provide 3/4" hose bibbs on exterior walls of the building(s), 30" above grade. A minimum of one hose bibb shall be installed on each wall. When exterior wall exceeds 75 feet in length, additional bibbs shall be installed so that distance between bibbs does not exceed 75 feet. Based on the geographical location of the facility, the design professional shall use freeze-proof type hose bibbs.

8.18 FIRE PROTECTION

8.18.1 GENERAL

The decision to sprinkle the facility shall be based on NFPA 101, 45, the EPA Facility Safety Manual, state and local codes and the project criteria whichever is more stringent. All sprinkler systems shall comply with NFPA 13 and be approved by Factory Mutual or any other nationally recognized insurance company. Special protection systems may be used to extinguish or control fire in easily ignited, fast-burning substances such as flammable liquids, some gases, and chemicals. They shall also be used to protect ordinary combustibles in certain high-value occupancies especially susceptible to damage. Special protection systems supplement automatic sprinklers as described by NFPA and shall not be used to substitute for them except where water is not available for sprinkler protection. Halon systems shall not be used unless directed by the project criteria.

8.18.2 SIZE AND ZONING

Sprinkler system main shall be sized to meet the fire flow and pressure requirements of the local authority. Fire pump(s) shall be provided, if needed, and they shall be installed in a separate room along with the sprinkler system main valves. Sprinkler system protection zones shall have the same boundaries as the fire alarm system fire zones. Each sprinkler system protection zone shall be equipped with electrically supervised control valve and water flow alarm switches connected to the fire alarm system.

8.18.3 SYSTEMS

8.18.3.1 WET PIPE

Sprinkler systems shall normally be wet pipe using pipe schedule sizes listed in NFPA 13 for ordinary installations. Hydraulic designs shall be performed for all systems.

8.18.3.2 DRY PIPE

In unheated areas or other areas subject to freezing temperatures, dry pipe systems shall be provided. Because of the time delays associated with release of the air in the system, water demands for dry pipe systems shall be computed over areas 30 percent greater than for comparable wet pipe systems. Where the unheated area is small, it may be cost effective to install an antifreeze system or small dry pipe system supplied from the wet pipe system in the main heated area.

8.18.3.3 PREACTION
A preaction system shall be used where it is particularly important to prevent the accidental discharge of water. Need for a preaction system shall be based on review by and recommendation of a professional fire protection engineer. The detection system chosen to activate the preaction valve shall have high reliability and a separate alarm/supervisory signal to indicate status. The detection system must be designed to be more sensitive than the closed sprinklers in the preaction system, but should not be so sensitive as to cause false alarms and unnecessary actuation of the preaction valve.

8.18.3.4 DELUGE
For extra hazard areas and specific hard-to-extinguish fuels such as explosives and pyrophoric metals, a deluge system with open sprinkler heads may be used to wet down the entire protected area simultaneously. Deluge systems shall comply with NFPA 13. If quick response is required, deluge system piping may be primed with water. The nozzles must be provided with blow-off caps for water-filled deluge systems.

8.18.3.5 SELF - RESTORING
Self-restoring sprinkler systems, such as the on-off multicycle system or systems using individual on-off sprinkler heads, shall be considered where the water from sprinklers will become contaminated by contact with room contents, where there is a concern for water damage, or where water supply or storage volume is marginal.

8.18.3.6 QUICK - RESPONSE
Where there are high-value concentrations (values per square foot), quick-response sprinklers shall be considered in lieu of conventional sprinklers.

8.18.3.7 WATER SPRAY
Installation of water spray systems shall comply with NFPA 15.

8.18.3.8 CARBON DIOXIDE
Agent quantity requirements and installation procedures shall comply with NFPA 12.

8.18.3.9 DRY CHEMICAL
Systems shall comply with NFPA 17.

8.18.3.10 FOAM
Foam systems shall comply with NFPA 11, NFPA 11A, NFPA 16, NFPA 16A, NFPA 409.

8.18.3.11 STANDPIPES AND HOSE SYSTEMS
Installation of standpipe systems shall comply with NFPA 14.

8.18.3.12 PORTABLE FIRE EXTINGUISHERS
Portable fire extinguishers shall comply with NFPA 10 except that halon extinguishers shall not be placed in any EPA Facility.

8.18.4 OPERATION
Operation and maintenance instructions and system layouts shall be posted at the control equipment. All personnel who may be expected to inspect, test, maintain or operate fire protection apparatus shall be thoroughly trained and kept trained in the functions they are expected to perform.

8.18.5 CODES
In addition to the code requirements mentioned in the above sections, the design professional's design shall comply with the local authority having jurisdiction of the project.

8.19 REFERENCE MANUALS
All work done in this section shall comply with all applicable federal, state, city and local codes, regulations, ordinances, publications and manuals. When codes or publications conflict, the more stringent standard shall govern.

END OF SECTION

SECTION 9

ELECTRICAL REQUIREMENTS

SECTION 9

ELECTRICAL REQUIREMENTS

9.1 GENERAL

9.1.1 CODE COMPLIANCE
All work done in this section shall comply with the applicable requirements of the latest edition of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), standards of the National Electrical Manufacturer's Association (NEMA), Insulated Power Cable Engineer's Association (IPCEA), the Institution of Electrical and Electronic Engineers (IEEE), National Fire Protection Association (NFPA), and all applicable federal, state, city, and local codes, regulations, ordinances, publications and manuals. All new manufactured equipment shall be listed by the Underwriter's Laboratory (UL) or a similar testing laboratory acceptable to EPA. When codes conflict, the more stringent standard shall govern.

9.1.2 ENERGY CONSERVATION IN DESIGN
After careful study of the facility's requirements as well as day-to-day operation of its various departments, the design professional shall design systems that meet the operating requirements in an energy efficient manner. The health and safety aspects of the operation must retain first priority, however, and cannot be relaxed or traded off for more efficient systems. System and lighting design shall comply with the requirements of ASHRAE 90, the most current version of Facilities Management and Services Division (FMSD) Energy Conservation Planning Handbook, the most current version of EPA's Green Lights - Partner Supports Programs, and any state or local energy conservation codes or recommendations.

9.1.2.1 LOCAL ENERGY CONSERVATION PROGRAMS
The design professional shall contact the local utility company to investigate any energy conservation programs that they may have in effect. The economic validity of pursuing these programs shall be presented to EPA in the early design phase of the project, and if deemed viable they shall be incorporated into the design for the project.

9.1.2.2 COST CONSERVATION FOR INTERRUPTIBLE SERVICE
The design professional shall also contact the local utility to investigate the money savings that could be realized for the project in operating costs if an interruptible service is brought to the facility. If the facility can still perform its mission with an interruptible power service, the design professional shall present to EPA in the early design stage of the project, what the potential dollar savings could be.

9.1.2.3 LOAD SHEDDING / PEAK SHAVING
The design professional shall investigate the payback involved if a load shedding/peak shaving system is introduced into the design of the facility. If the payback is sufficient to warrant the initial capital expenditure, with the approval of EPA, this type of system shall be included in the design of the project. If a generator is involved in this system, careful consideration should be given to the rating of the generator and the type of duty it will be subject to.

9.1.2.4 DEMAND SIDE MANAGEMENT SYSTEM
The design professional shall investigate a demand side management system to keep the peak demand for the facility below a pre-determined level. An economic analysis shall be done to determine the payback on such a system (if demand rates are very low, this type of system may not be economically feasible).

9.1.3 COORDINATION OF WORK
The design professional shall provide a coordinated set of documents (i.e., coordination between architectural, electrical, HVAC, plumbing, equipment and structural systems for bidding). Documentation shall clearly identify the division of work among the trades and delineate the coordination responsibilities for the Contractor. Special attention shall be given to "designed-in" equipment and equipment to be provided by the program occupants.

9.1.3.1 CALCULATIONS
The design professional shall provide short circuit, load and lighting calculations early in the design phase.

9.1.4 POWER FACTORS
Electrical utilization equipment rated greater than 100 volts, as well as all lighting equipment, shall have a power factor of not less than 85 percent under rated load conditions. If the equipment to be used for this project cannot be obtained with the above power factor, power factor correction devices shall be installed to bring the building system power factor up to 85 percent. All devices required shall be switched with the utilization equipment, unless this results in an unsafe condition.

9.1.5 ACCESSIBILITY REQUIREMENTS
The facility shall also comply with the electrical requirements of the Uniform Federal Accessibility Standards (1984) adopted by GSA in 41-CFR-101-19.6, as well as the Americans with Disability Act (ADA), and all state and local laws and standards for buildings and facilities requiring accessibility and usability for physically handicapped people. The most stringent of these codes shall be applicable.

9.1.6 MATERIAL AND EQUIPMENT STANDARDS
All specified materials and equipment shall be standard products of manufacturers regularly and currently engaged in production of such items. Items that are obsolete or to be discontinued by the manufacturer, as well as materials and equipment of an experimental nature (or where this project would be the first time such products have been installed in a facility), are not acceptable and will not be permitted. All material and equipment shall be specification grade, new, free from defects, and high quality and entirely suitable for these specific facilities.

9.1.7 ENVIRONMENTAL REQUIREMENTS
The design professional shall give careful consideration in the design to the type of materials to be used for the project as they relate to the environment in which they will be installed. Exterior equipment may be subject to different types of corrosive atmospheres. Interior equipment in laboratories, testing and storage areas may also be subject to corrosive conditions. All equipment and material shall be suitable for the environment in which it will be installed.

9.2 PRIMARY DISTRIBUTION

9.2.1 DUCTBANKS AND CABLE

All primary cable shall be run underground in ductbanks for new building sites. For extension of or addition to existing buildings where primary cabling will be used as an extension of an existing system to a new substation(s), primary cabling may be run within the building provided that it is installed in a raceway system (conduit) appropriate for the installation.

9.2.1.1 DUCTBANK ENCASEMENT

All underground ductbanks shall be concrete encased for primary circuits (600 volts and above) and where secondary service reliability is a prime consideration. Minimum duct size shall be two inches. A minimum of 25% spare ducts (but not less than two spare ducts) shall be provided in each duct run. Spare ducts shall by plugged or capped to prevent contamination. Design professional shall investigate the locations where manholes are to be included to insure that they will drain properly. Ductbank runs shall be located in the exterior utility corridors established in the master plans. Locations shall be carefully coordinated with other site utilities in the corridor to avoid any conflicts.

9.2.2 SWITCHES

When a new or extension of a "campus-type" utility distribution system is a part of the project, a loop system shall be considered. This system shall have sectionalizing primary switches. Primary switches shall be of the load break design. All switches shall be pad mounted. Enclosures for switches shall be suitable for the environment in which they will be located. Where switches are to be located indoors, they shall be physically isolated from any emergency electrical equipment and be located in electrical rooms only.

9.2.3 OVERHEAD

Overhead power supply lines can be used where service is to be installed in remote, unsettled, or industrial areas. Maximum use shall be made of single-pole structures. Overhead power supply lines may also be used for feeders to small single phase loads or buildings. Careful consideration shall be given to the location of overhead lines in relation to future planned land use development.

9.2.3.1 POWER AND COMMUNICATION POLES

Joint use of poles for power and communications distribution shall maintain safety standards and shall limit electrical interference to communications services. In joint use of poles, either for multiple electrical distribution systems, or for both electrical distribution and communication lines, underbuilt lines or cables shall be of vertical construction. Use of double-stacked crossrun construction shall be allowed only where proper clearances for hot-line maintenance work can be insured. Clearances shall comply with ANSI-C2.

9.3 SERVICE ENTRANCE

9.3.1 OVERHEAD SERVICES

Where electrical service to the building is by overhead lines, proper dip poles, weatherheads and supports shall be provided. Main service switch, panelboard or switchboard shall be located immediately adjacent to the entrance of feeders into the building. Code required clearances shall be maintained under all overhead lines. The openings necessary to bring conductors into buildings shall be grouted or otherwise fire-stopped.

9.3.2 UNDERGROUND SERVICES

To the maximum extent possible, public utility transformers shall be located outside of the actual building. Due to site constraints if public utility transformers must be located within buildings, they shall be installed in standard transformer vaults conforming to the requirements of the NEC. These vaults shall not be located adjacent to or directly beneath any exit from the building.

9.3.3 SERVICE CAPACITY

Provide incoming transformers, as required, of sufficient capacity to accommodate the full design load. In calculating the design load, use a demand factor of 100% for lighting and fixed mechanical equipment loads and use 75% demand factor for all other loads. The incoming service shall have sufficient capacity for full design load plus 30% additional capacity for future growth.

9.3.4 METERING

Where medium voltage power is brought to the facility, electrical energy metering (KWH) shall be furnished at each substation of 500 KVA or larger capacity. Demand metering (KWD) shall be furnished as required for load management purposes.

9.3.4.1 LOCAL UTILITY COMPANY

If low voltage or medium voltage is purchased from the local utility company, metering provisions shall be in accordance with the power company's requirements.

9.3.5 SERVICE ENTRANCE EQUIPMENT

Service entrance equipment shall consist of a main switch, main switches, a main circuit breaker, main circuit breakers, or a main switchboard or panelboard. The design professional shall give careful consideration to the short circuit current available at various points in the proposed distribution system in making the determination of whether or not the service entrance equipment should be of the fused or circuit breaker type.

9.3.5.1 SPECIFIC REQUIREMENTS

All service entrance equipment shall have copper bussing. If the main service consists of a switchboard or panelboard, it shall have at least 10% of the switchboard rating as spare breaker or switches and 20% of the rating as bussed spaces. The electrical system shall be properly coordinated for selective tripping in order to remove only that portion of the system that has experienced a fault or overload condition.

9.3.5.2 RENOVATION
If this project is the extension of an existing building (or renovation), the history of the loads shall be carefully studied to insure that the existing service entrance equipment has sufficient capacity to handle the loads of the addition/renovation with spare capacity for future loads.

9.4 INTERIOR ELECTRICAL SYSTEMS

9.4.1 BASIC MATERIALS AND METHODS
Electrical systems shall be designed so that all components operate within their capacities for initial and projected loads. Preferred standard voltages in conformance with ANSI C84.1 shall be used, with a single voltage level characteristic in any classification, to minimize stocks of spare equipment and to standardize operating and maintenance practices and procedures. On-site acceptance testing shall be required for each major electrical system. Tests shall be performed in the presence of EPA personnel. Copies of all test results shall be submitted for approval. All receptacles, switches and wiring devices shall be specification grade. All safety switches shall be heavy duty. All equipment shall be new.

9.4.2 SERVICE EQUIPMENT
All service entrance equipment shall be UL listed for use as service entrance equipment. All components shall be factory wired for switchboards, panelboards or unit substations prior to shipment. Service entrance equipment shall be physically isolated from all emergency power systems so that a failure in either system will not affect the operation of the other system. All service switchboards shall have factory installed ammeters and voltmeters.

9.4.3 CONDUCTORS
All conductors (wire and cable) shall be copper. All conductors for systems operating at 480 volts and below shall have 600 volt insulation with distinctive markings as required by UL for identification in the field. All conductors shall be continuous without splices. All conductors 600 volts and above shall be insulated and shall have the appropriate voltage and insulation ratings as required by where they are located in the system and in the facility. Branch circuit wiring shall not be smaller than No. 12 AWG. All conductors shall be color coded to identify each phase and the neutral. The grounding conductor shall be green or bare.

9.4.4 RACEWAYS
All conductors shall be installed in raceways. Minimum size conduit shall be 3/4 inch. Conduits installed in stud partitions or above lay-in ceilings, may be EMT. Conduit concealed in floor slab, concrete masonry walls or run exposed 5'-0" above finished floor shall be rigid galvanized steel. PVC conduit may be used underground to feed site lighting and site power circuits, remainder of outdoor conduits shall be PVC coated rigid galvanized steel.

9.4.4.1 CONDUIT
Service entrance conduits shall be concrete-encased PVC or PVC coated rigid galvanized steel. Rigid galvanized steel conduit shall be used in hazardous areas as described by the NEC, unless the environment is corrosive for steel conduit, then PVC conduit can be used. Aluminum conduit shall be used for high frequency circuits where steel will cause magnetic problems or in atmospheres where steel conduit is unsuitable. Aluminum conduit shall not be used underground, encased in concrete, or where atmosphere is corrosive to aluminum.

9.4.4.2 FLEXIBLE METAL CONDUIT
Liquid-tight flexible metal conduit shall be used for connections to meters, transformers pumps and other equipment as required by the National Electrical Code where vibration or movement can be a problem, and to provide required protection from liquids, vapors or solids.

9.4.4.3 RATED ASSEMBLIES
Raceways that penetrate fire rated assemblies shall be non-combustible. Openings shall be sealed to maintain the established fire ratings as defined by UL.

9.4.4.4 SURFACE METAL RACEWAYS
Surface metal raceways shall be used to provide receptacles with power and for low potential services (data, telecommunications, etc. wiring) in the laboratories themselves. The design professional shall review and make recommendations to the Agency for the type of surface metal raceways appropriate to the project. The design professional shall review single-compartment surface metal raceways (2-5/8"H x 1-3/4" D, minimum size) where only power receptacles are required and double compartment surface metal raceways (4-3/4" H x 2-1/4" D, minimum size) where both power receptacles and telco/data outlets are required. Raceway covers shall be precut to 12" sections. The raceway shall be capable of being divided into two or three separate wiring components to facilitate installation of power or low potential wiring. The material and color of the raceway shall be appropriate for the atmosphere in which it will be installed.

9.4.5 HARMONICS
The design of the electrical distribution (both normal and emergency power) shall consider the effects that harmonics from non-linear loads can produce on the system. Harmonics from non-linear loads can affect the sizes of the neutral conductor, panelboards, phase conductors and emergency generators. "K" rated transformers shall be used where the associated panelboards are feeding a large quantity of non-linear loads. Special attention shall be given to the harmonics produced by variable speed and variable frequency drive units for control of HVAC equipment.

9.4.6 DISTRIBUTION EQUIPMENT
The facility may have special requirements for ground fault protection on the main switchboard (such as two levels of ground fault). Check with the facility for any special requirements above those required by the National Electrical Code. The use of ground fault protection shall be included in all laboratory areas where personnel are operating electrical equipment and are exposed to electrical shock hazards during this type of operation. Ground fault protection systems shall also be installed in areas required by the EPA Facility Safety Manual.

9.4.6.1 DRY TYPE TRANSFORMERS

Dry type transformers shall be provided with four 2-1/2% taps, two above and two below rated primary voltage. All transformers shall be designed for continuous operation at not more than 150°C temperature rise, above 40°C ambient. All transformers shall conform to the design, temperature rises, tests, etc., specified by ASA, NEMA, and IEEE standards, and shall have a rated sound level of 45 decibels or below. To ensure against objectionable noise being transmitted through the building, the dry type transformers shall be mounted on approved vibration eliminating mountings. Connection to transformers shall be made employing flexible steel conduit (Greenfield) with grounding jumper. All transformers shall comply with the requirements of the EPA Facility Safety Manual. All dry type transformers shall be designed for non-linear loads.

9.4.6.2 PANELBOARDS

Panelboards shall comply with UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker equipped. Design shall be such that any individual breaker can be removed without disturbing adjacent units or with loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for the future installation of a breaker sized as indicated. All panelboard locks included in the project shall be keyed alike.

Directories shall be typed to indicate load served by each circuit and mounted in a holder behind transparent protective covering. Support bus board on bases independent of the circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide an isolated neutral bus in each panel for connection of circuit neutral conductors. Provide a separate ground bus marked with a yellow stripe along its front and bonded to the steel cabinet for connecting grounding conductors. Provide a separate ground bus marked with green strip along its front, isolated from the panel cabinet for connecting isolated insulated ground wires.

9.4.6.3 CIRCUIT BREAKERS

Circuit breakers shall comply with Fed. Spec. W-C 375 and be thermal magnetic type with interrupting capacity of 10,000 amperes symmetrical minimum. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers are not acceptable. Provide common-trip type multiple breakers with a single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any adjacent breaker poles are connected to Phases A, B, and C respectively. Provide circuit breaker with ground fault interrupter (UL 1053 and NFPA 70). Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.

9.4.6.4 SHUNT TRIP BREAKERS

Shunt trip breakers shall be provided in branch circuit panelboards designated by EPA to remove power to laboratory modules upon the activation of the fire sprinkler system in the immediate area.

9.4.6.5 LABORATORY MODULE

Each laboratory module (11' - 0" wide) shall be provided with a separate 120/208 volt, 3 phase, 4 wire panelboard. The branch circuit system shall be as flexible as possible for any type of laboratory alteration. Additionally, each laboratory module shall be provided with emergency power from and emergency power panelboard; the panelboard may serve more than one laboratory module.

9.4.6.6 WIRE CLOSETS

Wire closets which leave passages between floors constitute shafts and shall be protected in accordance with local building codes and the EPA Facility Safety Manual. In any case where wire closet ventilation arrangements or other features cannot conform to the requirements for a shaft, all openings through the floor shall be fire-stopped (grouted). In any building where smoke control systems are likely to be involved, such additional fire-stopping or other methods to increase the smoke passage resistance of openings around doors or through wire passes shall be provided as necessary to meet the needed level of efficiency for smoke control systems.

9.4.7 MOTOR CONTROLLERS / DISCONNECTS

Motor controllers/starters shall be provided for all motors and equipment containing motors. All controllers shall have thermal overload protection in each phase. Magnetic-type motor controllers shall have under voltage protection when used with momentary-contact pushbutton stations or switches and shall have under voltage release when used with maintained-contact pushbutton station or switches. When used with a pressure, float, or similar automatic-type or maintained-contact switch, the controller shall have a hand-off-automatic selector switch. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the "hand" position. All safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in the motor circuit in both the "hand" and the "automatic" positions. Control circuit connections to any hand-off-automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with an indicated, or a manufacturer's approved, wiring diagram. The selector switch shall have means for locking in any position. For each motor not in sight of the controller, the controlled disconnecting means shall be capable of being locked in the open position or a manually operated, nonfused switch which will disconnect the motor from the source of supply shall be placed within sight of the motor location. Overload protective devices shall give adequate protection to the motor windings, be of the thermal inverse-time-limit type, and include a manual-reset type pushbutton on the outside of the motor controller case. The cover of a combination motor controller and manual switch or circuit breaker shall be interlocked with the operating handle of the switch or circuit breaker so that the cover cannot be opened unless the handle of the switch or circuit breaker is in the off position.

9.4.7.1 CONTROL EQUIPMENT

Control equipment shall comply with the NEMA ICS standards and UL 508. Single-phase motors may be controlled directly by automatic control devices of adequate rating. Polyphase motors controlled automatically and all polyphase motors rated greater than 1 hp shall have magnetic starters. Control devices shall be of adequate voltage and current rating for the duty to be performed. Pilot control circuits shall operate with one side grounded, at no greater than 120 volts. Where control power transformers are required, they shall be located inside the associated motor starter housing, shall be protected against faults and overloaded by properly sized overcurrent devices, and shall be of sufficient capacity to serve all devices connected to them without overload. Reduced-voltage starters shall be provided for larger motors where starting the motor may result in unacceptable voltage dip.

9.4.7.2 SAFETY DISCONNECT SWITCHES
Safety disconnect switches shall be provided for all hard-wired electrically operated equipment and motors in locations as required by code. Switches shall meet the requirements of Federal Specification W-S-865c and NEMA type HD. Enclosure shall be NEMA I for indoor use and NEMA 3R for exterior use. All safety switches shall be horsepower rated. The switches shall be of the quick-make quick-break type, and all parts shall be mounted on insulating base to permit replacement of any part from the front of the switch. All current carrying parts shall be of high rated load without excessive heating. Contacts shall be plated to prevent corrosion and oxidation and to assure suitable conductivity.

9.4.7.3 MOTOR CONTROL CENTER
Where a group of several motors (all of larger than fractional horsepower) are located in one room or space, a motor control center should be used. Arrange bussing in the control center so that the center can be expanded from both ends. Bus shall be silver-plated copper. Interconnecting wires shall be copper. Terminal blocks should be of the plug-in type, so that controllers may be removed without disconnecting individual control wiring.

9.4.8 GROUNDING
The grounding system for the facility shall be permanent, effective, and complete from service entrance to most electrical devices. The grounding system shall conform to the NEC article 250 mandatory and applicable advisory rules. In addition, green insulated copper ground wire shall be connected between each lab electrical outlet and the feeder panel isolated ground bus. This conductor shall be sized in accordance with NEC Table 250-95. Grounding systems shall comply with NFPA 70 and IEEE 142. A separate ground conductor shall be used. Raceway systems shall not be used as ground path.

9.4.8.1 LABORATORY BUILDING MODULE GROUNDING
In addition to the grounding indicated above, all laboratory building modules shall have a bare earth copper ground grid or field direct buried outside to provide an isolated ground for instrumentation grounds only. This ground system (as well as any other isolated ground system required for special areas) shall be clearly identified and protected against improper usage. All building ground systems shall be tied together as required by NEC article 250.

9.4.8.2 GROUND BUS
Every panelboard and switchboard in the facility shall be provided with a ground bus.

9.4.9 LABORATORY POWER REQUIREMENTS
See the Room Data Sheets for the individual specific and/or typical generic laboratory room requirements. Specific and general electrical requirements are indicated for most spaces. However, the design professional must review, verify and test these requirements with the appropriate representatives for the design of the new facility during the Program Verification and Design Phase and gain approval from EPA.

.1 All 120 volt general convenience receptacles shall be rated a minimum of 20 amperes and shall be grounding type (NEMA 5-20R), specification grade.

.2 120 volt circuits shall have a minimum rating of 20 amperes.

.3 A maximum of four general convenience receptacles shall be connected to a circuit.

.4 Equipment such as refrigerators, freezers, centrifuges, etc. shall each have their own dedicated circuits.

.5 Receptacles for 6-foot or longer fume hoods shall be alternately wired for two circuits.

.6 Receptacles located within six feet of a sink shall be ground fault interrupter type.

.7 All branch circuits or panelboard feeder conduit runs shall be provided with separate equipment grounding conductors sized per NEC Table 250-95.

.8 Each laboratory shall be provided with a separate dedicated 120/208 volt, 3 phase, 4 wire panelboard at a minimum spacing of one panelboard every two modules. Additional panelboards shall be provided as required by electrical usage or as directed by the EPA project officer.

.9 Each laboratory panelboard shall be provided with a separate ground bus.

.10 Receptacles above wall or island benches and at equipment spaces shall be in surface metal raceways wherever possible. Raceways shall be single or double compartment (for both power and telco/data) as directed by the EPA project officer.

.11 30A, 125/250 volt, single phase receptacles (NEMA 14-30R) will be provided for 30A, 208 Volt, 1-phase equipment.

.12 One receptacle on a dedicated 20A, 120 volt emergency power circuit shall be provided in each laboratory. Emergency power shall also be provided for special equipment requiring such power.

.13 Uninterruptible Power Supply (UPS) systems within the computer/data processing rooms/laboratories and their supply and output circuits, shall comply with Section 645-10 of the National Electrical Code (NEC).

9.5 INTERIOR LIGHTING SYSTEM

9.5.1 ILLUMINATION LEVELS

The minimum acceptable levels of maintained illumination shall be as indicated in Table 9.5.1 - ILLUMINATION LEVELS for the particular areas. (These values represent general illumination 30 inches above the floor). For areas not listed in Table 9.5.1, the recommendations of the IES handbooks shall be followed.

TABLE 9.5.1 - ILLUMINATION LEVELS

FUNCTION	FOOTCANDLES
Private Offices	50
Animal Room	70
Autopsy	100
Boiler Room	20
Corridors	25
Emergency Lighting (General)	3
Emergency lighting in laboratory blocks	5
Examination	100
Laboratories (dual switching)	50/100
Loading Dock	20
Lobby	50
Locker Rooms	20
Shops (dual switching)	50/100
General Office and Record Rooms	50
Parking, Driveway and Walkways	1-2
Stairways	20
Storage	
Inactive	5
Rough Bulky	10
Medium	20
Fine	50
Telephone Equipment Room	70
Toilets	30
Exterior Entrances	5
Desk Level (Task lighting)	50-70
Utility Rooms	20
X-ray	10
Parking Decks	5
Library-Conference Rooms (dual switching)	35/70

9.5.2 LIGHTING CONTROLS

Switches shall be provided to control lighting in all areas. Large rooms (over 200 square feet) shall have multiple switching to reduce the lighting level by approximately half.

9.5.2.1 DAYLIGHT LEVEL SENSORY CONTROLS

In areas of buildings (over 200 square feet), with the exception of laboratories, that will have a large contribution of natural daylight, the use of daylight level sensory controls to control the lighting levels of these spaces shall be included.

9.5.2.2 BUILDING AUTOMATION SYSTEMS

In buildings with building automation systems (BAS), the BAS (in addition to light switches) shall control overall building lighting. Each floor shall be a separate control zone with appropriate subzoning of each floor for special functions.

9.5.2.3 OCCUPANCY SENSORS

Occupancy sensors shall be provided (in addition to switches) to control lighting in offices and smaller rooms.

9.5.3 LAMPS AND BALLASTS

Electrical discharge lamps and HID lamps should be the primary lamps for consideration in the selection of the illumination concept and the use of energy efficient lamps and ballast. The use of filament light sources should be kept to an absolute minimum, i.e., only in spaces not having a requirement for high levels of illuminations, whose occupancy is normally for short durations and for which discharge lamps are not suitable. Where fluorescent lamps will be utilized, these lamps shall be of the T-8 or T-12 type to conserve energy.

9.5.3.1 INDOOR HID LIGHTING

When using HID lighting indoors, careful consideration of the required color rendition shall be made from visual and health safety perspectives.

9.5.3.2 BALLASTS

All ballasts to be used on this project shall be of the energy saving type (electronic ballasts shall be used in all possible locations).

9.5.3.3 LIGHT FIXTURE SELECTION

The selection of light fixtures should involve the careful consideration of the quality of construction, ease of maintenance, ease of re-lamping, efficiency, illumination characteristics, mounting technique, and special purpose characteristics (vapor-proof, explosion proof, elimination of radio frequency interferences, etc.).

9.5.4 EMERGENCY LIGHTING (BATTERY UNITS)

An emergency lighting system shall be provided and so arranged to provide a minimum of 3 foot-candle illumination (measured at floor level) throughout the entire path of egress, including exit access routes, exit stairways, or other routes such as exit passageways to the outside of the Building. Laboratories, large open areas such as cafeterias, assembly areas, large mechanical, electrical, and storage rooms, and open plan office spaces where exit access is normally through the major portion of these areas, shall be provided with emergency lighting. The type of system used shall be such that it will operate in the event of any failure of a public utility or internal disruption of the normal power distribution system in a building, except that in buildings seven stories or below, the system may be powered from connections to two separate substations from a reliable public utility. Automatic transfer switching shall be provided for the emergency power supply. Provide emergency lighting systems in laboratories, mechanical/electrical rooms, storage rooms, any location where chemicals are stored, handled, or used, and large computer rooms. The emergency lighting in laboratory rooms should provide at least 5 foot candles of illumination, measured at the face of the hood and at the exit door. Connect the emergency lighting to a generator, when a generator is provided. In buildings where there would be no emergency generator, battery back-up shall be provided for egress and emergency lighting. This battery back-up may be by either unit-type battery fixtures, battery packs in fluorescent fixtures or by the use of inverters. Where HID lamps are used, (and connected to a generator), a standby lighting system shall be provided to meet emergency lighting requirements during HID lamp restrike periods.

9.5.5 ENERGY CONSERVATION

The EPA seeks to offset a large proportion of energy use dedicated to electric lighting and resulting cooling loads through proper use of natural lighting in this facility. In effect, it seeks a well integrated lighting system for its new building that makes optimum use of both natural and artificial lighting sources and balances of building's heating/cooling needs. A lighting power budget shall be determined in conformance with ASHRAE standard 90, and strictly adhered to in the design of the lighting for the facility. This budget may be exceeded in laboratory areas and shops where a higher level of illumination is required due to the work being done in these areas.

9.5.6 GREEN LIGHTS

EPA has also introduced a program called "Green Lights". All design of lighting for EPA facilities shall be done in accordance with this program.

9.5.7 GLARE

The selection of the type of diffuser and lens to be used on the lighting fixtures shall take into account the glare that can be produced on the working surface. All lighting design shall minimize the effects of glare on the task surface.

9.5.7.1 LIGHT FIXTURE LOCATION

In locating lighting fixtures, the design professional shall consider the fact that many of the surfaces in the facility (especially in laboratory areas), have highly reflective materials at the task location and locate the fixtures to keep glare to a minimum.

9.5.8 ADP AREAS

Lighting fixture types, location, and illumination levels shall be coordinated with the equipment and functions of telecommunications, alarm, and ADP centers to provide the required illumination without:

.1 Interfering with prompt identification of self-illuminated indicating devices.

.2 Creating reflecting glare that might detract from adequate observations of essential equipment.

.3 Creating electrical or electromagnetic interference detrimental to proper operation of equipment.

9.6 EXTERIOR LIGHTING SYSTEM

9.6.1 GENERAL

Exterior lighting systems shall comply with IES Lighting handbook. System control shall use time clock and/or photocell to provide illumination only when needed. In buildings with a BAS (Building Automation System), exterior lighting shall be switched by photocells in series with timers and the BAS system.

9.6.1.1 EXTERIOR LIGHT GLARE

Light glare shall be kept to a minimum in those situations where it would impede effective operations of protective force personnel, interfere with rail, highway, or navigable water traffic, or be objectionable to occupants of adjacent properties.

9.6.1.2 HIGH EFFICIENCY HID

Maximum use shall be made of high-efficiency HID (High Intensity Discharge) lamps such as metal halide or high-pressure sodium vapor lamps.

9.6.1.3 EARLY HOURS LIGHTING

Consideration shall be given to reducing the amount of light in parking lot areas during times (early morning hours 12:00 am to 4:30 am) when it is very unlikely that the lots will be in use. EPA personnel at the site shall be contacted before making this time a part of the design.

9.6.2 PARKING LOT LIGHTING

Lighting over driveways and parking areas shall consist of a complete HID lighting system, including control equipment, underground wiring, luminaries and all necessary accessories for a complete and functioning system. The maintained level of illumination shall be a minimum of 1-2 footcandles.

9.6.3 BUILDING FACADE LIGHTING

Appropriate lighting shall be provided at each exterior door and for functional and security illumination of exterior programmed areas.

9.6.4 TRAFFIC CONTROL LIGHTING
If this facility is on a site where traffic controls will not be provided by the local municipality or state transportation authority, the design professional shall design a complete traffic control system for the facility including all stop lights, directional lights, controls, wiring etc. for a complete operating system.

9.6.5 ROADWAY LIGHTING
All new access roadways or continuation of loop or access roadways and driveways shall be lighted. The maintained level of illumination shall be a minimum of 1-2 footcandles on vehicular roadways and pedestrian walkways. Same type of lighting (HID source) shall be used for roadways as is being used for parking lots.

9.6.6 EXTERIOR ELECTRIC SIGNS
All exterior electric signs and non-electric signs shall be integrated into the total design of the facility by the design professional and approved by the contract officer.

9.7 EMERGENCY POWER SYSTEM

9.7.1 GENERAL
The design professional shall design and provide for an emergency power system for all Administrative and Laboratory space. The systems shall provide electric power in case of the loss of normal power and a means of providing emergency power to emergency and egress lighting, as well as to critical equipment during planned outages for maintenance programs. Emergency power system shall comply with NFPA 37, NFPA 70, NFPA 101, NFPA 110, IEEE 446, and the EPA Facility Safety Manual. See Chapter Six of the EPA Facility Safety Manual to determine the type of emergency power to be provided.

9.7.1.1 BATTERY TYPE LIGHTING
In smaller buildings when the emergency power system is primarily installed for egress lighting purposes, battery type lighting units shall be used.

9.7.1.2 EMERGENCY POWER
In facilities where the emergency levels are larger than can be handled by battery packs, an emergency generator shall be supplied. This emergency power system shall be comprised of a diesel engine driven generator complete with phase synchronized automatic transfer switch or switches and necessary controls for automatic operation. If permissible by the loads and availability of natural gas, a natural gas generator shall be considered. All automatic transfer switches shall be of the isolation/bypass type. The generator(s) shall transfer and pick-up the critical load(s) within ten seconds. The system shall be capable of carrying a continuous full load for not less than 24 hours. The exhaust and fuel pipe vents shall be arranged and located away from fresh air intakes. The exhaust shall be located where maximum dilution can be accomplished. The generator shall be designed to handle non-linear loads, plus 25% spare capacity. the generator shall be water cooled.

9.7.1.3 EMERGENCY GENERATOR LOCATION
The preferable location for the generator is outdoors. The location should be such that it will be aesthetically hidden from view and to the rear of the main facility. It should be placed over vibration isolators and make use of noise dampers and other devices as required to substantially attenuate noise and vibration resulting from operation of the generator. The generator shall be equipped with a low noise exhaust silencer (hospital or critical type) and weatherproof housing.

9.7.1.4 ECONOMIC ANALYSIS
For all installations where a generator is provided, an economic analysis shall be made to determine the economic feasibility of including load shedding or peak shaving equipment as part of the installation. EPA will instruct the design professional on the inclusion of this item on the project after examination of the economic analysis has been completed.

9.7.1.5 FUEL STORAGE TANK
If the generator is of the diesel type, the system shall be provided with a fuel storage tank which is capable of carrying a continuous full load for not less than 24 hours. The preferred type of tank is an above ground storage tank. If instructed by EPA, the tank may be installed underground. If so, the tank shall be of double wall construction of non-corrosive material with interstitial monitoring capabilities. Tank shall meet all of the interim prohibition (40 CFR 280.1) requirements or the latest promulgated rules effective on the date of installation. Cathodic protection shall be considered for protecting all metal parts of underground fuel storage tanks.

9.7.2 EMERGENCY LOADS
In addition to the loads required by NFPA 101 and 70, and the room data sheets, the following loads shall be connected to the emergency power system:

.1 One receptacle in each laboratory
.2 Fire alarm system
.3 Exit lights
.4 Emergency lighting system - 2 FC minimum for egress; 10 FC at switchboards
.5 Special laboratory equipment
.6 Telephone relay system
.7 Controlled temperature rooms
.8 Certain HVAC systems (as required by the applicable state and local codes and as directed by EPA)
.9 Critical sump pumps and other associated mechanical equipment and controls
.10 All animal care facilities
.11 Local HVAC air compressors for special rooms
.12 Paging system
.13 Selected elevators (as required by the applicable state and local codes and as directed by EPA)
.14 Gas chromatograph
.15 Selected refrigerators and freezers (as directed by EPA)
.16 Incubators
.17 X-ray fluorescent analyzer
.18 UPS System
.19 Air conditioning system associated with computer rooms and environmental rooms

.20 Security systems
.21 Safety alarm systems

9.8 LIGHTNING PROTECTION SYSTEM

9.8.1 MINIMUM SCOPE
A lightning protection system shall be provided for all facilities containing laboratory modules, as well as for facilities containing radioactive or explosive materials.

9.8.2 ADDITIONAL SCOPE
For building types not in the above description, a risk assessment shall be performed using the guide in NFPA 78 to determine the risk of loss due to lightning.

9.8.3 MASTER LABEL
For buildings described in paragraph 9.8.1 and for facilities with a strong risk potential (per NFPA 78), furnish and install equipment, accessories, and material necessary for a complete "Master" labeled lightning protection system to protect all building components. The system shall comply with all the requirements of the National Fire Protection Association (NFPA No. 78), the Underwriter's Laboratories, Inc., (UL 96A), and the Lightning Protection Institute (LPI 175). All cables, lightning rods, and accessories shall be copper. All connections and splices shall be of the exothermic weld type.

9.8.3.1 MINIMUM REQUIREMENTS
Completed installation shall present an unobtrusive appearance, with conductors built into the building during construction to conceal all conductors, and it shall be properly flashed and watertight. Installation shall be made in conformance with shop drawings prepared by supplier and approved by the Government.

9.8.3.2 CERTIFICATION DELIVERY
Before the lightning protection system is accepted, the contractor shall obtain and deliver to the supervising architect, the "Master Label" of the Underwriters Laboratories, Inc., or an equivalent certification.

9.9 SEISMIC REQUIREMENTS

9.9.1 SEISMIC REVIEW
Several state, local and municipal building codes require seismic protection of electrical components. After the seismic zone for the site has been determined, the design professional shall research all codes to determine if seismic protection is required. If seismic protection is required, all electrical gear, raceway and equipment (including lighting) supports shall be designed in accordance with the applicable code requirements.

9.10 UNINTERRUPTIBLE POWER SUPPLY

9.10.1 GENERAL

An uninterruptible power supply (UPS) system shall be provided for those loads requiring guaranteed continuous power. Application of UPS systems shall comply with IEEE 446. The UPS equipment can be of the rotary or stationary type. The design professional is to make a recommendation as to the appropriate type of system for a particular facility. The UPS equipment shall be provided with multiple power supplies (normal power, static switch bypass power, and total system bypass power). The UPS system shall be sized to provide a minimum of 5 minutes protection upon loss of normal power. Total system bypass power shall include an isolation transformer. All components shall be UL listed. The supplied UPS system shall be specified to operate properly with an emergency generator.

9.10.1.1 MINIMUM REQUIREMENTS

The UPS system shall be of continuous duty, and it shall operate in conjunction with the existing building electrical system to provide precise power for critical equipment loads. The static system shall consist of a solid state inverter, rectifier/battery charger, a storage battery, a static bypass transfer switch, synchronizing circuitry and an internal maintenance bypass switch. The rotary system shall include a solid state inverter, battery charger, a storage battery, an automatic transfer assembly, an internal (automatic) bypass switch and a low voltage transient synchronous generator. The UPS system, along with the supporting equipment, shall be housed in dedicated room(s) with controlled environmental conditions to meet manufacturer's recommendations and code requirements.

9.10.1.2 CODES, STANDARDS AND DOCUMENTS

The UPS shall be designed in accordance with the applicable sections of the following documents:

.1 NEMA
.2 IEEE Inverter Standards
.3 ASA
.4 ASME
.5 National Electric Code (NFPA-70)
.6 OSHA
.7 Local Codes

9.10.1.3 ON - LINE - REVERSE TRANSFER SYSTEM

The UPS shall be designed to operate as an on-line-reverse transfer system in the following modes:

.1 Normal (static) - The critical load shall be continuously supplied by the inverter. The rectifier/battery charger shall derive power from the utility AC source and supply DC power to the inverter while simultaneously float charging the battery.

.2 Normal (rotary) - The critical load shall receive power from the utility company to the motor-generator set which powers the critical load and charges the batteries.

.3 Emergency (static) - Upon failure of the utility AC power source the critical load shall be supplied by the inverter, which without any switching, obtains its power from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the utility AC source.

.4 Emergency (rotary) - Upon failure of the utility AC power source, the control logic shall turn on the inverter and provide AC power from the battery to the motor-generator set and from the motor-generator set to the critical load. The inverter shall be capable of full power operation within 50 milliseconds after loss of utility power.

.5 Recharge - Upon restoration of the utility AC source (prior to complete discharge of the battery), the rectifier/battery charger powers the inverter and simultaneously recharges the battery. This shall be an automatic function and shall cause no interruption to the critical load.

.6 Bypass Mode - If the UPS must be taken out of service for maintenance or repair of internal failures, the static by-pass transfer switch shall be used to transfer the load to the alternate source without interruption. Automatic re-transfer or forward transfer of the load shall be accomplished after the UPS inverter synchronizes to the alternate bypass AC input source. Once the sources are synchronized, the static bypass transfer switch shall forward transfer the load from the by-pass input source to the UPS inverter output by paralleling the two load and then disconnecting the bypass AC input source. Overlap shall be limited to one half cycle maximum.

.7 Maintenance Bypass/Test Mode - Internal switches shall be provided to isolate the UPS inverter output and static bypass transfer switch output from AC bypass input source and the load. The switches, in conjunction with the static bypass transfer switch, shall enable the load to be reverse transferred from the UPS inverter output to the bypass AC input source without interruption. The switches shall enable the UPS inverter and static bypass transfer switch to be tested without effecting load operation.

.8 Downgrade - If the battery only is to be taken out of service for maintenance, it shall be disconnected from the rectifier/battery charger and inverter by means of an external battery disconnect. The UPS shall continue to function as specified herein, except for power outage protection and transient characteristics.

9.10.1.4 UPS OUTPUT

The UPS output shall have the following characteristics:

.1 Frequency: 60 Hz nominal +0.5 Hz (when synchronized to the bypass AC input source).

.2 Output Voltage Transient Characteristics for:

a. 25% load step change +4%
b. 50% load step change +6%
c. 100% load step change +10/-8%

.3 Output voltage Transient Response - The system output voltage shall return to within +1% of the steady state value within 30 milliseconds.

.4 Output voltage Regulation - The steady state output voltage shall not deviate by more than +1.0% from no load to full load.

9.10.1.5 OUTPUT FREQUENCY REGULATION
Output Frequency Regulation - The UPS shall be capable of providing the nominal output frequency +0.1% when the UPS inverter is not synchronized (free running) to the AC bypass input line.

9.10.1.6 SYSTEM OVERLOAD
System Overload - 125% of the system rating for a period of 10 minutes and 150% current for one minute. Overloads in excess of 170% of the UPS rating on an instantaneous basis or in excess of the overload time periods previously stated shall cause the static bypass transfer switch to reverse transfer and allow the AC bypass input source to supply the necessary fault clearing current required. After approximately five seconds, the static bypass transfer switch shall automatically forward transfer and normal UPS operation shall resume. If the overload still exists after the five second period, the static bypass transfer switch shall automatically reverse transfer the load to the AC bypass input source and the UPS inverter shall turn off. The system shall require manual restart after this sequence.

9.10.1.7 SYSTEM EFFICIENCY
System Efficiency - The overall efficiency, input to output, shall be at least 95% with the battery fully charged and the inverter supplying full rated load.

9.10.2 LOCATIONS / LOADS
UPS system shall be located in special rooms or in the same room as computer equipment. These rooms shall have special HVAC equipment to maintain the proper environmental conditions for the UPS system and its batteries (during a power outage).

9.10.2.1 UPS LOAD
The UPS load will consist of equipment and outlets designated for UPS power connection in the room data sheets.

9.10.2.2 BATTERY ROOM
The battery room for the UPS shall be well ventilated so as to not cause an explosive mixture of hydrogen to accumulate. These rooms shall be ventilated in accordance with the EPA Facility Safety Manual and shall contain all devices required by this Manual (including mechanical ventilation and an emergency eyewash station, fire/smoke sensing device, etc.).

9.11 AUTOMATIC DATA PROCESSING (ADP) POWER SYSTEMS

9.11.1 ADP ISOLATION
Adverse effects of voltage level variations; transients, and frequency variations on ADP equipment shall be minimized. ADP equipment shall be isolated as needed for protection. UPS or power conditioners (PDU's) may be used for isolation.

9.11.2 COMPUTER POWER
All computer power shall enter the UPS or computer room at 480 volts and feed 120/208 volt UPS or PDU units with monitoring capabilities with some transient protection. PDU shall limit the cable runs to 100 feet maximum from PDU unit to the ADP equipment. The user will provide a list of equipment cable types and plug types. All circuits to have separate neutrals. All UPS(s) and PDU(s) shall be connected to a central monitoring /control system.

9.11.3 POWER PANELBOARDS AND DISTRIBUTION PANELS

All individual power panelboards not exceeding 200 amps shall have meters for the main breaker with readouts on panel. All main distribution panels shall have meters on all breakers. Non-UPS/PDU outlets shall be spaced every twenty feet around the computer room for utility use (vacuums, drills, etc.).

9.11.4 LIGHTING

Under floor lights with cutoff timer(s) shall be installed in computer room(s). Room lighting for computer rooms shall be either indirect lighting to reduce glare on terminal screens or overhead lighting of the parabolic type to reduce eye strain.

9.11.5 GROUNDING

All computer power shall be grounded to a large single point ground along with the raised floor system grid (bolt-in-type).

9.12 CATHODIC PROTECTION

9.12.1 INVESTIGATION AND RECOMMENDATION

The design professional shall investigate and determine whether cathodic protection is required for buried utilities. If a cathodic protection system is required, the design professional shall recommend a system to satisfy the local conditions. The cathodic protection system shall be designed by a design professional who is NACE certified with 2-3 years experience in similar installations.

9.13 ENVIRONMENTAL CONSIDERATIONS (RACEWAYS, ENCLOSURES)

9.13.1 CORROSIVE ATMOSPHERE

Special consideration shall be given to the type of raceways to be used in corrosive environments (such as chemical storage areas, some laboratories, near air handling exhausts for areas with corrosive fumes, etc.,). All raceways to be used in corrosive atmospheres shall be deemed suitable by the raceway manufacturer to be suitable for the atmosphere in which they will be installed.

9.13.1.1 EQUIPMENT ENCLOSURES

The enclosures for electrical equipment (panels, switches, breakers, etc.,) shall have the proper NEMA rating for the atmosphere in which they are being installed.

9.13.2 SALT WATER ATMOSPHERE

Careful consideration shall be given to the type of materials to be used for exterior electrical work (including lighting) when the facility is located near or at a coastal area. Corrosion from salt air can have a detrimental effect on steel and any painted electrical surfaces. Consideration should also be given to the use of EMT or any thin wall raceways to be used on the interior of the building due to the fact that storage of these materials, prior to installation, on the exterior of the building could corrode these materials prior to their installation or prior to the building being totally enclosed.

9.13.3 EXTREME COLD TEMPERATURES
Electrical equipment such as emergency generators, transformers and switchgear installed in weatherproof enclosures on the exterior of the facility that are subject to extreme cold temperatures should be provided with supplemental heating.

9.13.4 EXPLOSIVE ATMOSPHERE
For all areas containing combustible materials in the air, all electrical equipment including raceways, fittings, and boxes shall be designed in accordance with Article 500 of the NEC. Positive steps shall be taken to control or eliminate static electricity in areas where materials that are ignitable by static spark discharge are processed or handled. This includes spark-sensitive explosives, propellants, and pyrotechnics as well as solvent vapors and flammable gases. Electrical wiring, fittings, boxes, and devices located at exhaust fans that are exhausting areas containing combustible materials shall also be designed in accordance with Article 500 of the NEC.

9.13.5 FLOODPLAIN AREAS
Electrical equipment shall not be located below grade in facilities that are located in floodplain areas. Emergency generators shall be located in such a manner that they are not subject to water damage due to flooding. Normal power equipment (floor mounted) located at grade level in floodplain areas shall be located on minimum six inches high housekeeping pads (higher if water level will reach the equipment while on six inch pads).

9.14 COMMUNICATION SYSTEMS

9.14.1 TELECOMMUNICATION / DATA SYSTEMS
Telephone service entrance cables will be provided by the telephone company to the EPA site. The design professional shall design a raceway system from a point on site designated by the telephone company into the main telephone room in the facility. All conduit shall be concrete encased when run underground. Twenty-five percent (25%) spare conduit(s) shall be included in the service entrance run. While the telephone service will be provided by the Telephone Company, all telephone equipment will be provided by the government. All new EPA facilities will be pre-wired with EPA contracting directly with a design/installer for design and installation of all cabling.

9.14.1.1 GENERAL DESIGN
Design shall include the provision of required electrical components and a complete raceway system for telecommunications wiring. EPA will furnish and install all cabling. The inclusion of cabling details should guide the Contractor in the design and placement of conduits, raceways, wiring ducts, and similar delivery means for telecommunications services; the conceptual framework described is considered critically important to the overall design of the facility to insure delivery of requirement services. The incoming telephone service raceways and primary communications room shall be kept separate from the electrical service raceways and main electrical equipment room. These services must remain separate through to the final point of delivery in user areas. Metallic conduit raceway shall be provided from the main telephone equipment rooms to the vertical riser closets. Sleeves will be provided through the floors of the vertical riser closets.

9.14.1.2 VERTICAL RISER CLOSETS
Vertical riser closets shall be stacked throughout the building. Concourse, ground, and mezzanine floors may require the closets to be offset due to floor usage.

9.14.1.3 TELEPHONE, MICROWAVE, RADIO, AND SATELLITE
The new facility will be serviced by twisted pair and fiber optic cabling from the local telephone company and may also require microwave, radio and satellite communications. The new facility must be designed to accommodate these types of transmissions. If there are multiple buildings or pods, they will be interconnected by dedicated cable passageways which connect the Main Distribution Frame (MDF) with the campus sub-MDF's.

9.14.1.4 MAIN ENTRANCE FRAME
All cables entering the facility from the outside will enter the primary Main Entrance Frame (MEF). Entering cables will be provided with appropriate protection against lightning and other electrical surges. The MEF will be the termination point/point of presence for all carriers entering the facility. To provide alternative routing, two MEFs should be provided with connections to diverse carrier outside locations with the number of twisted pair and fiber optic cabling evenly split between the two MEFs.

9.14.1.5 MAIN DISTRIBUTION FRAME
The Main Distribution Frame (MDF) will be located adjacent to the MEF and will be the primary interface to the carrier connectivity in the MEF. The MDF will be controlled by the EPA. If the facility is accommodated by two or more buildings/pods, the wiring for the complex will originate in the main MDF(s) ; building/pods other than the one housing the main MDF(s) will be provided with sub-MDFs connected to the main MDF(s) by dedicated cable passages.

9.14.1.6 TELECOMMUNICATIONS WIRING PLANT
The telecommunications wiring plant is to be installed so that the number of intra-building connections (e.g., through punchdowns and patch panels) is kept to a minimum. Between workstations and the MDF(s), the only break in copper/fiber transmission medias should be the telecommunications closet on the same floor as the workstation, where routing can be done through patch panels.

9.14.1.7 MEF / MDF / SUB MDF
If the facility consists of multiple building/pods, the main MEF/MDF(s) will be connected to the sub-MDF(s) in other buildings/pods by passageways which permit ready installation of cable in continuous trays which do not require end-to-end threading.

9.14.1.8 TELECOMMUNICATIONS CLOSET RISERS
On each floor, adjoining one wall of each Telecommunications Closet (TC), no fewer than six 6" riser sleeves serving telecommunications purposes only shall be provided. These risers shall provide 50% surplus capacity following the initial installation of two 4 pair twisted pair cable, 6 strands of fiber optic cable and one IBM Type 1 cable to each workstation.

9.14.1.9 SECURITY SENSITIVE CABLE
In addition to the above, provision will be made in each telecommunications riser for the installation of up to five 2" conduits for security sensitive cables. These conduits shall terminate in a lockable strip cabinet on each floor.

9.14.1.10 HORIZONTAL RACEWAYS
If horizontal raceways are required to connect a set of risers to the MDF or sub-MDF, these raceways will be designed to permit ready installation of cables so as not to require end-to-end threading. Telecommunications personnel will have direct access to all cable using these raceways. Work in raceways will be performed without requiring access to office and/or lab space. Adjacent to the main raceway, provide five 2" conduits for security sensitive cables.

9.14.1.11 CONGRUENT, STACKED TELECOMMUNICATIONS CLOSETS
Telecommunications Closets (TC) in a building will be located directly above one another and will be congruent. Telecommunications Closets will be designed to house telephone key service units; 3270 controllers; patch panels for Type 1 cable and fiber optic cable; LAN equipment including, but not limited to, fiber optic repeaters and associated fiber communications equipment; and telecommunications test equipment.

9.14.1.12 SIZE AND DESIGN MINIMUMS FOR TCS
Telecommunications Closets provided shall be at least 150 square feet and serve approximately 250 workstations or standard offices and labs. Telecommunications closets serving more than 250 workstations or standard offices and labs shall be proportionately larger. Telecommunications Closets will be as close to square as practicable, and will be entered from public corridors through securable doors at least 42: in width. In no case will a TC be smaller than 150 square feet and 80" high. Each TC will be provided with a unique identification number.

9.14.1.13 MAXIMUM CABLE RUN FROM TC
The number of TCs on a given floor shall be such that a cable run from a TC to an outlet at a workstation or standard office or lab will not exceed 300 linear feet. Walls should be covered with plywood mounting boards of "fire treated" plywood at least 3/4" thick.

9.14.1.14 ADDITIONAL MINIMUM TC REQUIREMENTS
Each TC will be provided with sufficient patch panels for terminating voice and data cabling to each services workstation with at least 50% initial surplus capacity. In addition, locations for additional equipment racks will be designated in each TC design. Each TC will be provided with a minimum of five dedicated 20 amp circuits, each labeled by circuit number. Each circuit will terminate in two duplex outlets. In addition, there will be a.least one 30 amp general use circuit, marked with a different color wall plate, and terminating in a duplex outlet on each wall.

9.14.1.15 MULTIPLE TELECOMMUNICATIONS CLOSETS
If a floor requires multiple TCs, they will be linked by a direct raceway with a minimum width of 18". The raceway will enter each TC so that cables can be terminated on the plywood-mounted punchdown blocks. Each TC will be provided with a punchdown blocks for termination of twice the amount of cable initially installed to the workstations and to the building's Main Distribution Frame (MDF). Each installed cable will be continued through the appropriate patch panel.

9.14.1.16 TC SPACE LAYOUT AND ENVIRONMENTAL CONTROL

Each TC will be designed to provide telecommunications technicians ample room for installing, removing and troubleshooting all cable terminations and equipment. The TC will be laid out to permit technicians access to all terminations in standing or squatting position, and provide sufficient illumination for detailed work. Temperature in each closet will be maintained between 65 and 85 degrees Fahrenheit 24 hours a day, 7 days a week. The equipment which will be located in the TC will generate an estimated 8,000 BTUs/hour. The HVAC system shall be designed to efficiently cool the space in the off hours.

9.14.1.17 TELECOMMUNICATION SERVICES

Provide one of each of the following telecommunications services to each workstation or standard offices and labs identified in the new facility:

.1 Voice service to each workstation will be provided through an RJ11 or RJ45 connection and 4 pair, 24 AWG unshielded twisted pair (UTP) standard telephone wire. These circuits will be terminated in the serving TC in modular integrated punchdown/patch blocks. Cable feed to panel will be through an appropriate rack-mounted cable management trough/panduit.

.2 Data service through a square plug type connector and 2 pair, 24 AWG shielded twisted pair wire These circuits will be terminated in the TC in a rack-mounted IBM distribution panel. Cable feed to panel will be through an appropriate rack-mounted cable management trough/panduit.

.3 Data service through two RJ45 connectors and two 4 pair, 24 AWG UTP wire. These circuits will be terminated in the serving TC in modular integrated punchdown/patch blocks. Cable feed to panel will be through an appropriate rack-mounted cable management trough/panduit.

.4 Data service through 6 strand (four active, two spare) multi-mode 62.5/1265 micron fiber optic cable terminating in the serving TC in appropriate fiber optic patch panels. Cable feed to panel will be through an appropriate rack-mounted cable management trough/panduit.

.5 Provision will be made to extend the cable described above to the MDF for connective/cross-connect to the telephone company provided entrance telephone circuits; to extend the cables described above to the telecommunications facility (data) located in the main computer center. The extension of these data cables to the telecom/computer room will be through the data backbone facility described in the next section.

.6 The method of installing the telecommunications cables from the TC to the workstation can either be plenum type cable in the hung ceiling using cable trays or in-slab cells or below raised floors if provided.

9.14.1.18 BACKBONE WIRING FACILITY
The following describes the backbone wiring facility to connect the TCs to the MDF for voice and the Telecommunication area in the computer room for data:

.1 Provide sufficient cable pairs from the TCs to the MDF to support all voice requirements supported by the TC to its attached work areas. An additional 20% pairs shall be installed from each TC to MDF for growth over the life of the building.

.2 Provide a 96 strand 62.5/125 micron multi-mode fiber optic cable backbone through each TC terminating in the telecommunications area of the computer facility.

.3 Provide a 100 pair, 24 AWG UTP cable from each TC terminating on integrated punchdown/patch blocks in the telecommunications area of the computer facility.

.4 Provide two Ethernet thick wire coaxial cables (RG59) to connect all TCs in each building/pod. In addition, provide two of these types of Ethernet coaxial cable between the TC which is located on the same floor as the telecommunications area in the computer room to this telecommunications area.

9.14.1.19 VIDEO CONFERENCE ROOMS
Designated video conference rooms must be supported by communication wiring specified in AT&Ts Technical Advisory-T1.5 Premise Wiring Requirements and "FTS-2000 Switched Digital Video Guidelines for EPA Video Teleconference Facilities", dated January 2, 1991. These requirements suggest that CVTS communication wiring be limited to 300 unrepeated cable runs. The network interface (service delivery point) to support CVTS rooms will be located in the Network Control Facility (NCF); therefore, CVTS room locations must be within 300 cable feet of the NCF and have conduit access for 22 gauge shielded solid copper twisted pair wire. Longer runs may require repeaters and incur additional expenses, but must remain within the 1.5 dB loss specifications of the Technical Advisory manuscript concerning the wiring.

9.14.2 RADIO COMMUNICATIONS
An area on site or on the roof of the building shall be designated to allow for radio antennas for radio communications. A special room shall be provided to house receiver and transmitter equipment. Cable raceways shall be provided from the antenna location to the transmitter/receiver locations and from there to the telecommunications operations center. All equipment and cable will be furnished by EPA. Emergency power shall be furnished for all equipment. In determining the power supply requirements, it shall be assumed that all transmitters are keyed simultaneously while associated receivers and other equipment are in operation.

9.14.3 PUBLIC ADDRESS / PAGING SYSTEMS
Furnish all accessories, material and other equipment for a complete public address system. The system shall be accessed via the telephone system and may be located in the main telephone equipment room for convenience of interfacing. Purchase of Public Address System must be coordinated with the Government's purchase of a telephone system. System must be sized to be audible at all points throughout the facility. System can be accessed through individual telephone handsets as well as through PBX switch. System shall provide hands free talk back capabilities in lab areas.

9.14.3.1 MINIMUM SEPARATE PAGING ZONES
At a minimum, separate paging zones shall be provided for the following areas: Administrative offices, Chemical labs, Biological labs, General office areas, Hazardous storage areas, Parking lots, and Exterior secured areas. In multi-floor facilities, further zoning will be required. Controls for individual speaker units shall be wall mounted and include volume control and on/off switching.

9.14.4 INFORMATION TV SYSTEMS
A complete raceway system and required power outlets shall be provided for an information TV system. The system may be via a master antenna, satellite dish or from subscription to a local cable company. Outlet boxes at each location shall be two-gang (one gang with receptacle, one gang for cable jack). Cable, head-in equipment, antenna(s), devices, dish(es) and cable jacks will be furnished by EPA. Careful coordination with equipment manufacturer or cable vendor is necessary, so that proper power, raceways, and cabinets can be supplied. Raceways shall be complete from antenna/dish head-in equipment to splice cabinets to outlet boxes.

9.14.5 RECORDING SYSTEMS
In areas where conferences are to be recorded, built-in microphones shall be provided along with a closet containing the recording equipment. Wiring shall be installed from microphone (omnidirectional)to recorders for a complete system.

9.14.6 SATELLITE DISHES
An area shall be designed for the installation of satellite dishes that will be used for telecommunications, TV reception or data transmission purposes. An area shall also be designed for location of satellite dish head-in equipment (receivers and transmitters). Where use of satellite dish is required, power shall be furnished for all head-in equipment. Cable raceways shall be provided from the satellite dish(es) location to the room for the head-in equipment and from the head-in equipment to each outlet served and to the controller location for the dish(es). All equipment and cable will be furnished by EPA.

9.14.7 TV BROADCAST SYSTEMS
In facilities where a local or national television station will be broadcasting meetings or press conferences live from the facility, furnish a complete raceway (or cable-tray) system to allow the TV station(s) to run cables from the designated TV van(s) parking areas to the conference/press room. If cable-tray is provided, it shall be completely accessible its entire length.

9.14.7.1 WEATHERPROOF RECEPTACLES / DISCONNECT SWITCHES
In addition, provide weatherproof receptacles or disconnect switches (fused) at the van parking areas to allow each van to receive power from the building.

9.14.8 MICROWAVE COMMUNICATIONS
Where required, an area shall be designed for the installation of a microwave dish(es) that will be used for telecommunications or data transmission purposes. An area shall also be designed for the location of microwave head-in equipment. Power shall be furnished for all head-in equipment. Cable raceways shall be provided from the microwave dish(es) location to the room for the head-in equipment to the room where the controller(s) will be located. All equipment and cables will be furnished by EPA.

9.14.9 OTHER
In general, furnish a complete raceway system for other communication/data systems (not otherwise mentioned in section 9.14) including raceways, outlet and junction boxes and power connections (direct or receptacle) for all associated equipment to be located in the facility. Unless otherwise directed by EPA, all cabling and equipment for other systems will be furnished by EPA.

9.15 FIRE ALARM SYSTEM

9.15.1 CODE COMPLIANCE - MANUAL SYSTEM
The design professional shall design a complete, code complying fire alarm system. For small buildings, and where allowed by code, the system may be a manual system only. The manual system shall include manual stations, fire alarm annunciator signals and an annunciator panel indicating the zone where the alarm was initiated. The alarm shall be sent to the local fire station.

9.15.2 CODE COMPLIANCE - AUTOMATIC SYSTEM
In large facilities, or where required by code, the systems shall be automatic and include smoke detectors, manual pull stations, rate of rise detectors, alarm bells or horns and strobe lights, sprinklers, and a central annunciator panel. Smoke detection devices shall not activate the sprinkler system. Suppression systems shall be tied to the central annunciator panel. The fire alarm system shall be tied to the local fire station in the area. Smoke detectors shall be provided in all corridors and designated laboratory modules.

9.15.3 GENERAL
The fire protection system shall be in compliance with the latest codes and publications as listed in Table 9.15.3 - CODES AND PUBLICATIONS (see other sections for additional codes and standards):

TABLE 9.15.3 - CODES AND PUBLICATIONS

Sprinkler Systems, NFPA 13
Standpipe and hose Systems, NFPA 14
Local Protective Signaling Systems, NFPA 72A
Auxiliary Protective Signaling Systems, NFPA 72B
Remote Station Protective Signaling Systems, NFPA 72C
Proprietary Protective Signaling Systems, NFPA 72D
Automatic Fire Detectors, NFPA 72E
NFPA 72F
NFPA 72G
NFPA 72H
GSA PBS 5900.2B
Installation, Maintenance, and Use of Central Station Signaling Systems, NFPA 71
ADA Requirements
EPA Facility Safety Manual (Chapter six, paragraph 16)

9.15.4 CENTRAL, LOCAL, PROPRIETARY ALARM SYSTEM
The building(s) shall be protected by a central, local, proprietary type fire alarm system. Location of pull stations, bells, automatic fire detectors and other pertinent equipment to the fire alarm system shall be installed in accordance with the referenced NFPA codes and local codes. When there is a difference between the NFPA and local codes, compliance with the most stringent code will be required. Visual alarms are required throughout the facility for handicapped fire warning. System shall meet GSA requirements for fire alarm and communication systems as contained in Chapter 18 (Electrical) of the GSA Fire Safety Criteria.

9.15.5 CENTRAL STATION SERVICE
The building(s) shall be protected by local fire alarm system(s) (NFPA Standard No. 72A to 72H) connected to either a UL listed Central Station Service or Central Station Service (NFPA Standard No. 71).

9.15.6 SYSTEM GENERAL REQUIREMENTS
Pull stations shall be installed adjacent to all exit stair doors for egress from the building. Actuation of a manual station shall alarm the building as required by criteria and shall send a manual station alarm signal to the local fire department through a Central Station Service. Actuation of any suppression system (sprinkler, dry/wet chemical) protecting the building and its occupants shall alarm as prescribed for pull stations, except it shall send a suppression signal to the Central Station Service. All valves on the buildings' sprinkler system and/or standpipe systems shall be supervised by the fire alarm control panel. The closure of a valve shall initiate a supervisory signal to the buildings' fire alarm control panel and to the Central Station Service. Low air pressure switches on dry pipe sprinkler systems and low nitrogen pressure switches on preaction sprinkler systems shall be supervised by the buildings' fire alarm control panels. The closure of these normally-open supervisory switches shall initiate a supervisory signal to the buildings' fire alarm control panels and to the listed Central station Service. Elevator lobby smoke detection system(s) shall be incorporated into a zone(s) labeled "Elevator Smoke Detector" and shall actuate a prealarm signal in the fire alarm control panel and send a prealarm signal to the Central Station Service. Likewise, elevator lobby smoke detectors shall be monitored for trouble by the building fire alarm system. Smoke detector systems/subsystem(s) shall be connected to actuate a prealarm signal to a Central Station Service. These panels shall also be monitored for trouble by the building fire alarm system. Visual and audible alarm signals are required throughout the facility.

9.15.7 FIRE ZONES
Building(s) shall be subdivided into fire zones as recommended by NFPA and local codes. Graphic annunciators shall be provided at the Main Entrance(s), and Security Control Center clearly showing the outline of the buildings, the fire zones and the alarm initiating desires. Alarm signals shall be transmitted directly to a UL listed central services station.

9.15.8 WIRE CLASS AND CIRCUIT SURVIVABILITY
The fire alarm system initiating device circuits shall be wired Class A (NFPA Standard No. 72A - Style D) and alarm indicating circuits (visual and audible) shall be wired Class A (NFPA Standard No. 72). All initiating and indicating circuits shall be wired so as to be survivable as defined in Paragraph 13.i of Chapter 18 of the GSA Fire Safety Criteria.

9.15.9 CONTROL CENTER

Building(s) must have a control center where fire-related control panels are located. This control center must be located next to the main entrance and shall be separated from the rest of the building by 1-hour fire resistant construction. Emergency lighting must be provided. Air handling, lighting, and fire protection systems for the emergency control center must be arranged to operate independently of the effects of fire anywhere in the building.

9.15.10 SYSTEM AND OPERATION STANDARDS AND CODES

The fire alarm system and its operation shall be in accordance with NFPA standards, local codes and the requirements of GSA Handbook PBS P 5900.2B, Building Fire Safety Criteria.

9.15.11 SIGNAL DEVICES

Signal devices shall include pull stations, heat and smoke detectors, and signals from the sprinkler system fire pump (if required). Smoke detectors shall be provided in spaces as described above and in all corridors, elevator lobbies, in air handling equipment and ductwork, and in special spaces as described in the Room Data Sheets. Heat detectors shall be provided in all mechanical Equipment Rooms, and in Electrical Rooms. All signal devices shall be addressable type, i.e., each device shall have its own address which shall report to monitoring devices in the English language for clear and quick identification of the alarm source. The fire alarm central panel shall report the various signals, defined to suit smoke purge requirements, to the DDC portion of the BAS which, in turn, will sequence fans and smoke dampers to meet the smoke control requirements. The fire alarm central panel shall be able to adjust the sensitivity of all smoke detectors.

9.15.12 HELD OPEN FIRE DOORS

Fire doors that are normally held open by electromagnetic devices should be released by the action of any automatic detection, extinguishing or manual alarm signaling device. Maintenance, operation, testing, and equipment shall conform to National Fire Protection Association Standard No. 72A and Chapter 4 of NFPA 72H, Guide for Testing Procedures for Local, Auxiliary Remote Station and Proprietary Signaling Systems.

9.15.13 ELECTRICAL SUPERVISION / EMERGENCY POWER

The fire alarm wiring and equipment must be electrically supervised. Emergency power must be provided. It must be able to operate the system in the supervisory mode for 48 hours and operate all alarm devices and system output signals for at least 90 minutes. All alarm initiating devices, except smoke detectors must be capable of signaling an alarm during a single break or a single ground fault.

9.16 SAFETY ALARM SYSTEM

9.16.1 ANNUNCIATOR PANEL

The design professional shall design a central safety alarm system annunciator panel for the facility that will indicate any abnormal condition. The annunciator panel shall include all relays, switches, controls, etc., as required for system operation. The basic operation of the panel shall indicate any abnormal condition in a function supervised by the annunciator system causing the associated indication to flash and the common audible signal to sound continuously. The audible signal can be silenced at any time by the operation of an acknowledge push button. The audible signal will automatically sound again with any new indication. The visual signal shall become steady when acknowledged.

9.16.2 INDICATING PLATES

Indicating plates shall be red with filled-in place characters. All lamps in the annunciator are tested simultaneously by pressing the remotely mounted "Lamp Test" push button. The annunciator shall indicate the following systems and equipment status:

- .1 Fire Alarm Initiation
- .2 HVAC System Motors Alarms
- .3 Emergency Generator Running
- .4 Freezers/Cold Boxes Temperature Alarms
- .5 UPS System Failure
- .6 Fume Hoods / Bio-Safety Cabinets Alarms (critical low-flow)
- .7 Location of activated detection, extinguishing or manual alarm device
- .8 Exhaust Hoods / Ventilated Cabinets Failure Alarms (critical low-flow)
- .9 Exhaust Systems for Instruments and Safety Cabinets Failure Alarms (critical low-flow)
- .10 Acid Neutralization System Alarms
- .11 Power Failure
- .12 Incubator Temperature Alarm
- .13 Gas Alarm
- .14 Sensor (gas) alarm
- .15 Laboratory negative pressure failure alarm
- .16 Additional Systems to be Identified by Agency

9.17 SECURITY SYSTEMS

9.17.1 GENERAL

The design professional shall design a complete security system for the facility. All security systems shall be operated and monitored from a central point as selected by EPA. All security systems shall have a primary and an emergency power source.

9.17.1.1 STANDBY BATTERIES

Furnish standby batteries or UPS to power the system automatically in the event of commercial power failure. If the facility has a generator, batteries shall ensure no loss of power to central equipment until the generator takes over. Alarm shall not be generated when the equipment transfers from AC to DC operation as from DC to AC operation. If the facility does not have an emergency generator, sufficient batteries shall be provided to power the controller and necessary devices to prevent unauthorized entry to the building (electronic locks shall stay in locked position upon power loss). Batteries shall be chargeable. If batteries lose charge, an alarm condition shall so indicate this at the control console.

9.17.1.2 CONDUIT OR RACEWAY

All wiring shall be in conduit or surface metal raceway.

9.17.2 ACCESS SYSTEMS

Design professional shall design a complete building access system of the on-line type which reports into a central controller. Design professional shall have a minimum of 2-3 years experience in the design of similar installations.

9.17.2.1 KEY CARD CONTROL

Provide key card control for all entry to the facility. The key card reader should read key cards with numbering encoded within the card. The card reader shall be capable of operating in an off-line mode to allow persons to enter and exit without recording of card numbers. The card reader shall be capable of operating also in an on-line mode which causes the card reader to report into a central controller which provides additional security checks on the key card and provides a printout of time, date, card number etc., for the person entering or leaving the premises. System shall be of the anti-passback type. In addition, furnish one key access lock and card reader inside the building for every 5,000 square feet of gross floor area, in addition to the vestibules and at entry to controlled computer areas.

9.17.2.2 COMPUTERIZED ACCESS CONTROL SYSTEM

The computerized access control system shall have the capability to program access cards by hour and day. The system shall be designed with 50% spare capacity for both card readers and number of cards to be on the system. Key cards, once removed from the system, shall be replaceable without lowering the integrity of the system or reducing the capacity of the system.

9.17.2.3 PROXIMITY TYPE CARD READERS

Card readers shall be of the proximity type and be suitable for the environment in which they will be located.

9.17.2.4 PROGRAMMABLE KEY PAD - SMALL FACILITIES

For very small facilities, a programmable keypad may be used at each entry to control access to the system. Keypad shall be suitable for the environment in which it will be located.

9.17.3 INTRUSION DETECTION SYSTEMS

The design professional shall design a complete intrusion detection system. The design professional shall have a minimum of 2-3 years experience in the design of similar installations. The intrusion detection system shall protect all grade level doors, operable windows and openings leading into the facility as well as roof hatches and roof access doors. Operable windows shall be lockable and accessible windows shall be alarmed. Roof access doors or hatches shall be secured with heavy duty hardware and alarmed. All floor telecommunications closets shall be locked with dead bolt locking devices. In addition to perimeter protection, alarm a minimum of ten interior doors as designated by EPA. Door switches shall be of the balanced magnetic type.

9.17.3.1 CENTRAL CONTROL / REMOTELY MONITORED

The entire system shall be monitored at the central control desk of the facility and remotely monitored either on the campus, by an alarm company, or the local law enforcement agency.

9.17.4 SITE ACCESS SYSTEMS

Provide one alarm zone with an infrared beam to monitor vehicles passing through the gate of the fenced area. Position beam to monitor entire length of fence on side with gate. The alarm zone shall be monitored at the central alarm desk (as part of the intrusion detection system) with remote monitoring of the same type as the intrusion detection system. Provide one zone and an infrared beam detection system for each location where there is a gate in the fenced in area of the site.

9.17.5 CCTV SYSTEMS

The design professional shall design a complete closed circuit television security (CCTV) system. The design professional shall have a minimum of 2-3 years experience in the design of similar installations. Conduit and wiring shall be installed for the system and a camera shall be installed at all entrance and exit areas. The location of the camera shall be suitable for monitoring people movement when entering or leaving the building and an emergency circuit shall provide power for each camera location. Conduit, wiring, cameras, etc., shall also be installed in all parking lots, loading docks, and computer areas to provide monitoring.

9.17.5.1 CAMERAS - FIXED OR PAN - TILT - ZOOM

Cameras shall be of the fixed or pan-tilt-zoom type as required for each specific location. Cameras shall be housed in proper enclosures for the environment in which they are to operate (e.g., defrosters, heaters, weatherproof enclosures, corrosion resistant or vandal proof enclosures, etc.).

9.17.5.2 CAMERAS - MONITORED / CONTROLLED

All cameras shall be monitored/controlled at the facilities central control station. Monitors shall be event driven. A VCR shall be provided to record unauthorized access (control by guard). A 120 volt single duplex receptacle (emergency power) shall be provided immediately adjacent to all CCTV camera locations.

9.17.5.3 CCTV CAMERAS - LOADING DOCKS

CCTV cameras shall be provided to monitor entry and exiting from the loading dock areas. CCTV monitors (in addition to that at the central console for the loading dock areas), shall be provided in the loading dock office to provide identification of delivery vehicles prior to opening the loading dock doors.

9.17.6 PERIMETER SYSTEMS

The design professional shall design a complete grade level perimeter intrusion detection system. This system shall be in addition to the intrusion detection system described above and shall be monitored at the same control panel provided for the intrusion detection system.

9.17.6.1 ULTRA SONIC PROTECTION

Furnish ultrasonic protection to protect the grade level, glass enclosed, office area and any other area which contains exterior glass at grade level. The Ultrasonic Control Panel shall be the type which controls nominally 20 pairs of transmitters and receivers. Connect as a separate zone input into the main alarm panels. Install sufficient transmitter/receiver pairs to protect the entire office area and other grade level areas with exterior glass.

9.17.7 DATA PROCESSING

The design professional shall design a complete access/intrusion detection system for all data processing areas. A card reader and balanced magnetic switch shall be provided at each door leading into the data processing areas. Card readers shall be of the proximity type. System shall be monitored at the central control station for the facility. Control computer shall be capable of programming access cards by hour and day. Central controller shall furnish a printout of time, date, card member etc., for the person entering or leaving the data processing area. System shall be of the anti-passbook type.

9.17.7.1 COMPUTER AREA DOORS
If a card access system is being furnished for other doors in the facility, the same cards shall work for the computer area doors (if so encoded for certain personnel only).

9.17.7.2 CENTRAL CONTROL DOOR MONITORING
The door shall be monitored at the central control station in case it is left open or the card access system is bypassed.

9.17.8 PARKING CONTROLS
The parking facility(s) shall be enclosed and equipped with a perimeter sensor system and lockable gates. The gates shall be equipped with a computerized access control system. EPA card readers shall be installed in parallel with any other card readers (if required) on all the access roads.

9.17.8.1 ACCESS SYSTEM
The parking control access system shall have all the components discussed above for access systems. For very small facilities, programmable keypad may be used in lieu of a card reader. The same cards used for building access shall operate the parking controls (if so encoded).

9.18 DISASTER EVACUATION SYSTEM
The design professional shall include a "warning" / "evacuation" alarm system for the building where the facility is located in an area that is tornado or hurricane prone. The system shall provide for building evacuation in accordance with the facility's emergency preparedness plan and shall be coordinated with the community's emergency preparedness plan.

END OF SECTION

SECTION 10

LEASE ADMINISTRATION

SECTION 10

LEASE ADMINISTRATION

NOTE: THE INFORMATION IN THIS SECTION 10 SHALL BE PROVIDED BY EPA AND IS NOT A PART OF THE SCOPE FOR THIS DELIVERY ORDER NO. 6 - STANDARDS

10.1 DEFINITION OF GROSS AREA

10.2 NET USABLE SQUARE FEET

10.2.1 GENERAL

10.2.2 SQUARE FEET

10.2.3 APPURTENANT AREAS AND FACILITIES

10.3 VENDING FACILITIES

10.4 JANITORIAL SERVICES

10.5 MAINTENANCE AND TESTING OF SYSTEMS

10.5.1 GENERAL

10.5.2 TESTING

10.5.3 WATERTIGHT INTEGRITY

10.5.4 ADDITIONAL REQUIREMENTS

10.6 FLAG DISPLAY

10.6.1 GENERAL

10.6.2 DISPLAY

10.7 SAFE AIR CONTAINMENT LEVELS

10.7.1 GENERAL

10.7.2 ASBESTOS

10.7.2.1 GENERAL

10.7.3 POST-ASBESTOS-ABATEMENT MONITORING

10.7.4 ABATEMENT ACTIONS OTHER THAN REMOVAL

10.7.5 NON-FIREABLE ASBESTOS

10.7.6 ABATEMENT PLAN

10.7.7 INSPECTION AND TESTING

END OF SECTION

APPENDIX A

CODES, REGULATORY REQUIREMENTS, REFERENCE STANDARDS, TRADE ORGANIZATIONS, AND GUIDES

APPENDIX A

CODES
REGULATORY REQUIREMENTS
REFERENCE STANDARDS
TRADE ORGANIZATIONS
AND GUIDES

FOR ALL DOCUMENTS LISTED IN THIS APPENDIX, THE LATEST EDITION SHALL BE USED UNLESS INDICATED OTHERWISE BY THE EPA CONTRACTING OFFICER.

AA — **Aluminum Association**
900 19th St., NW
Washington, DC 20006

AAA — **American Arbitration Association**
140 W. 51st. St.
New York, NY 10020

AABC — **Associated Air Balance Council**
1518 K. Street, NW
Washington, DC 20005

AAMA — **Architectural Aluminum Manufacturers Association**
2700 River Rd., Suite 118
Des Plaines, IL 60018

AASHTO — **American Association of State Highway and Transportation Officials**
444 N. Capital St., NW, Suite 225
Washington, DC20001

ABC — **Associated Builders and Contractors, Inc.**
729 15th St. NW
Washington, DC 20005

ABC — **Association of Bituminous Contractors**
2020 K. St., NW, Suite 800
Washington, DC 20006

ABCA — **American Building Contractors Association**
11100 Valley Blvd., Suite 120
El Monte, CA 91731

ABMA — **American Boiler Manufacturers Association**
950 North Glebe Road
Suite 160
Arlington, VA 22203

ACI — **American Concrete Institute**
22400 W. Seven Mile Rd.
Detroit, MI 48219

ACCA — **Air-Conditioning Contractors of America**
1513 16th St.
Washington, DC 20036

ACEA — **Allied Construction Employers Association**
180 N. Executive Drive
Brookfield, WI 53008

ACEC — **American Consulting Engineers Council**
1015 15th St., NW, Suite 802
Washington, DC 20005

ACGIH — **American Conference of Governmental Industrial Hygienists**
6500 Glenway Avenue, Building D-7
Cincinnati, OH 45211

ACPA — **American Concrete Pavement Association**
3800 N. Wilke Rd., Suite 490
Arlington Heights, IL 60004

ACPA — **American Concrete Pipe Association**
8320 Old Courthouse Rd.
Vienna, VA 22180

ACPA — **American Concrete Pumping Association**
P.O. Box 4307
1034 Tennessee St.
Vallejo, CA 94590

ACSM — **American Congress on Surveying and Mapping**
210 Little Falls Street
Falls Church, Va 22046

ADA — **Americans with Disabilities Act**

(For employment questions)
U.S. Equal Employment Opportunity Commission
ADA Legal Services
1801 L St. N.W.
Washington, DC 20507

Americans with Disabilities Act (Cont.)

(For transportation questions)
U.S. Department of Transportation
Office of Assistant General Counsel for Regulation and Enforcement
400 Seventh St. S.W.
Washington, DC 20590

(For public accommodations question)
U.S. Department of Justice
Office of Americans with Disabilities Act
P. O. Box 66118
Washington, DC 20035-6118

(For telecommunications questions)
Federal Communications Commission
Consumer Assistance
1919 M St. N.W.
Washington, DC 20554

(For architectural accessibility questions)
Access Board
1331 F St. N.W., Suite 1000
Washington, DC 20004-1111

AGA — **American Gas Association, Inc.**
1515 Wilson Blvd.
Arlington, VA 22209

AGC — **Associated General Contractors of America**
1957 East St. NW
Washington, DC 20006

AHA — **American Hardboard Association**
520 N. Hicks Rd.
Palantine, IL 60067

AHLI — **American Home Lighting Institute**
435 N. Michigan Ave., Suite 1717
Chicago, IL 60611

AHMA — **American Hardware Manufacturers Association**
931 N. Plum Grove Rd.
Schaumburg, IL 60173

AI — **Asphalt Institute**
Asphault Institute Building
College Park, MD 20740

AIA — **American Institute of Architects**
1735 New York Ave., NW
Washington, DC 20006

AIA / NA — **Asbestos Information Association / North America**
1745 Jefferson Davis Hwy., Suite 509
Arlington, VA 22202

AIC — **American Institute of Constructors**
20 S. Front St.
Columbus, OH 43215

AISC — **American Institute of Steel Construction, Inc.**
400 N. Michigan Ave.
Chicago, IL 60611

AISI — **American Iron and Steel Institute**
1133 15th St., NW, Suite 300
Washington, DC 20005

AITC — **American Institute of Timber Construction**
11818 S.E. Mill Plain Blvd.
Vancouver, WA 98684

ALSC — **American Lumber Standards Committee**
P.O. Box 210
Germantown, MD 20874

AMCA — **Air Movement and Control Association**
30 West University Drive
Arlington Heights, IL 60004

ANL — **Argonne National Laboratory**
9800 South Cass Avenue
Argonne, IL 60439

ANS — **American Nuclear Society**
555 North Kensington Avenue
LaGrange Park, IL 60525

ANSI — **American National Standards Institute**
1430 Broadway
New York, NY 10018

APA — **American Plywood Association**
P.O. Box 11700
Tacoma, WA 98411

APA — **Architectural Precast Association**
825 E. 64th St.
Indianapolis, IN 46220

API — **American Petroleum Institute**
1220 L. Street, NW
Washington, DC 20037

APFA — **American Pipe Fitting Association**
8136 Old Keene Mill Rd. #B-311
Springfield, VA 22152

ARI — **Air-Conditioning and Refrigeration Institute**
1501 Wilson Blvd. 6th Floor
Arlington, VA 22209

AREA — **American Railway Engineering Association**
50 F Street, NW, Suite 7702
Washington, DC 20001

ARMA	**Asphalt Roofing Manufacturers Association** 6288 Montrose Road Rockville, MD 20852
ARTBA	**American Road and Transportation Builders Association** 525 School St. SW Washington, DC 20024
ASA	**Acoustical Society of America** 500 Sunnyside Blvd. Woodberry, NY 11797
ASA	**American Subcontractors Association** 1004 Duke St. Alexandria, VA 22314
ASC	**Adhesive and Sealant Council, Inc.** 1500 Wilson Blvd., Suite 515 Arlington, VA 22209-2495
ASC	**Associated Specialty Contractors** 7315 Wisconsin Ave. Bethesda, MD 20814
ASCE	**American Society of Civil Engineers** 345 E. 47th St. New York, NY 10017
ASCC	**American Society of Concrete Construction** 426 S. Westgate Addison, IL 60101
ASHRAE	**American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc.** 1791 Tulie Circle, NE Atlanta, GA 30329
ASID	**American Society of Interior Designers** 1430 Broadway New York, NY 10018
ASME	**American Society of Mechanical Engineers** United Engineering Center 345 E. 47th St. New York, NY 10017
ASPE	**American Society of Professional Estimators** 3617 Thousand Oaks Blvd. Suite 210 Westlake, CA 91362
ASSE	**American Society of Sanitary Engineers** P.O. Box 40362 Bay Village, OH 44140
ASTM	**American Society for Testing and Materials** 1916 Race Street Philadelphia, PA 19103
AWI	**Architectural Woodwork Institute** 2310 S. Walter Reed Dr. Arlington, VA 22206
AWS	**American Welding Society, Inc.** 550 N.W. LeJeune Rd. Miami, FL 33126
AWCI	**Association of the Wall and Ceiling Industiries International** 25 K. St., NE Suite 300 Washington, DC 20002
AWWA	**American Water Works Association** 6666 West Quincy Avenue Denver, CO 80235
BHMA	**Builder's Hardware Manufacturers Association, Inc.** 60 E. 42nd St., Room 511 New York, NY 10165
BIA	**Brick Institute of Amerca** 11490 Commerce Park Dr., Suite 300 Reston, VA 22091
	Building Materials Research Institute, Inc. 501 5th Ave., #1402 New York, NYH 10017
BOCA	**Building Officials and Code Administrators International** 4051 W. Flossmoor Rd. Country Club Hills, IL 60477
BRB	**Building Research Board** 2101 Constitution Ave., NW Washington, DC 20418
BSC	**Building Systems Council** 15th and M St., NW Washington, DC 20005
BSI	**Building Stone Institute** 420 Lexington Ave., Suite 2800 New York, NY 10170
	Congressional Acts Superintendent of Documents Government Printing Office Washington, DC 20402
	Corps of Engineers / U.S. Department of the Army 20 Massachusetts Ave., NW Washington, DC 20314
CABO	**Council of American Building Officials** 5203 Leesburg Pke, Suite 708 Falls, Church, VA 22041

CDA	**Copper Development Association, Inc.** Greenwich Office Park 2 51 Weaver St. Grant, CT 06836
CERC	**Coastal Engineering Research Center** U.S. Army Corps of Engineers P.O. Box 631 Vicksburg, MA 39180
CFR	**Code of Federal Regulations** Superintendent of Documents Government Printing Office Washington, DC 20402
CGA	**Compressed Gas Association** Crystal Gateway One, Suite 501 1235 Jefferson Davis Highway Arlington, VA 22202
CIEA	**Construction Industry Employers Association** 625 Ensminger Rd. Tonawanda, NY 14150
CIMA	**Construction Industry Manufacturers Association** 111 E. Wisconsin Ave., Suite 940 Milwaukee, WI 53202-4879
CISCA	**Ceilings and Interior Systems Construction Association** 104 Wilmot, Suite 201 Deerfield, IL 60015
CISPI	**Cast Iron Soil Pipe Institute** 1499 Chain Bridge Rd., Suite 203 McLean, VA 22101
CLFMI	**Chain Link Fence Manufacturers Institute** 1776 Massachusetts Ave., NW, Suite 500 Washington, DC 20036
CMAA	**Crane Manufacturers Association of America** 1326 Freeport Road Pittsburgh, PA 15238
CPMA	**Construction Products Manufacturing Council** P.O. Box 21008 Washington, DC 20009-0508
CRA	**California Redwood Association** 405 Enfrente Dr., Suite 200 Nevato, CA 94949
CRI	**Carpet and Rug Institute** P.O. Box 2048 Dalton, GA 30722-2048
CRSI	**Concrete Reinforced Steel Institutes** 933 N. Plum Grove Rd. Schaumburg, IL 60195
CSI	**Construction Specifications Institute** 601 Madison St. Alexandria, VA 22314
CTI	**Ceramic Tile Institute** 700 N. Virgil Ave. Los Angeles, CA 90029
CTI	**Cooling Tower Institute** P.O. Box 73383 Houston, TX 77273
DFI	**Deep Foundations Institute** P.O. Box 359 Springfield, NJ 07081
DHI	**Door and Hardware Institute** 7711 Old Springhouse Rd. McLean, VA 22101-3474
DIPRA	**Ductile Iron Pipe Research Association** 245 Riverchasse Parkway E., Suite 0 Birmingham, AL 35244
DOE	**U.S. Department of Energy** 1000 Independence Avenue, SW Washington, DC 20585
DOE / OSTI	**DOE / Office of Scientific and Technical Information** P.O. Box 62 Oak Ridge, TN 37831
	Executive Orders **National Archives and Records Administration** 8th Street and Pennsylvania Avenue, NW Washington, DC 20408
EIA	**Electronics Industries Association** 2001 Eye Street, NW Washington, DC 20006
EIMA	**Exterior Insulation Manufacturers Association** Box 75037 Washington, DC 20013
EPA	**Environmental Protection Agency** 401 M. St., SW Washington, DC 20460
ESCSI	**Expanded Shale, Clay and Slate Institute** 6218 Montrose Rd. Rockville, MD 20852

FAA	**Federal Aviation Administration** U.S. Department of Transportation 400 7th Street, SW Washington, DC 20590	
FCC	**Federal Construction Council** Building Research Board National Research Council 2101 Constitution Avenue, NW Washington, DC 20418	
FEMA	**Federal Emergency Management Agency** Federal Center Plaza 500 C. Street, SW Washington, DC 20472	
FGMA	**Flat Glass Marketing Association** White Lakes Professional Building 3310 Harrison Street Topeka, KS 66611	
FHA	**Federal Housing Administration** 451 7th St., SW, Rm. 3158 Washington, DC 20410	
FIPS	**Federal Information Processing Standards** National Bureau of Standards Room 64-B, Technology Gaithersburg, MD 20899	
FM	**Factory Mutual Engineering and Research** 1151 Boston Providence Turnpike Norwood, MA 02062	
FPRS	**Forest Products Research Society** 2801 Marshall Ct. Madison, WI 53705	
FR	**Federal Register** Superintendent of Documents U.S. Government Printing Office 710 North Capitol Street, NW Washington, DC 20402	
FS	**Federal Specifications** Attention: NPFC Code 1052 Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120-5099	
FTI	**Facing Tile Institute** P.O. Box 8880 Canton, OH 44711	
GA	**Gypsum Association** 1603 Orrington Ave., Suite 1210 Evanston, IL 60201	
GBCA	**General Building Contractors Association** 36 S. 18th St. P.O. Box 15959 Philadelphia, PA 19103	
GSA	**General Services Administration** Public Buildings Service Office of Government-wide Real Property Policy and Oversight 19th and F Streets, NW Washington, DC 20405	
HES	**Health Education Services** P.O. Box 7282 Albany, NY 12224	
HPMA	**Hardwood Plywood Manufacturers Association** P.O. Box 2789 Reston, VA 22090	
	Internationl Association of Bridge, Structural and Ornamental Iron Workers 1750 New York Avenue, NW, Suite 400 Washington, DC 20006	
IAEA	**International Atomic Energy Agency** Vienna International Center Wagranerstrasse 5 Post Fach 100 A-1400 Vienna, Austria	
IALD	**International Association of Lighting Designers** 18 E. 16th St., Suite 208 New York, NY 10003	
IAPMO	**International Association of Plumbing and Mechanical Officials** 20001 Walnut Drive S Walnut, CA 91789	
ICAA	**Insulation Contractors Associaiton of America** 15819 Crabbs Branch Way Rockville, MD 20855	
ICEA	**Insulated Cable Engineers Association** P. O. Box P South Yarmouth, MA 02664	
ICRP	**International Commission on Radiological Protection** Maxwell House Fairview Park Elmsford, NY 10523	
ICBO	**International Council of Building Officials** 5360 S. Workman Mill Rd. Whittier, CA 90601	
IEEE	**Institute of Electrical and Electronics Engineers** 345 E. 47th St. New York, NY 10017	

IES **Institute of Environmental Sciences**
940 East Northwest Highway
Mount Prospect, IL 56056

IESNA **Illuminating Engineering Society of North America**
345 E. 47th St.
New York, NY 10017

IFI **Industrial Fasteners Institute**
1505 E. Ohio Building
Cleveland, OH 44114

IHEA **Industrial Heating Equipment Association**
1901 N. Moore St.
Arlington, VA 22209

IILP **International Institute of Lath and Plaster**
795 Raymond Ave.
St. Paul, MN 55114

ILIA **Indiana Limestone Institute of America**
Stone City Bank Building, Suite 400
Bedford, IN 47421

IMI **International Masonry Institute**
823 15th St., NW, Suite 1001
Washington, DC 20005

IRF **International Road Federation**
525 School St., SW
Washington, DC 20024

ISDSI **Insulated Steel Door Systems Institute**
712 Lakewood Center North
14600 Detroit Avenue
Cleveland, OH 44107

LANL **Los Alamos National Laboratory**
P.O. Box 1663
Los Alamos, NM 87545

LBL **Lawrence Berkeley Laboratory**
1 Cyclostron Road
Berkeley, CA 94720

LLNL **Lawrence Livermore National Laboratory**
Livermore, CA 94550

LPI **Lightning Protection Institute**
48 North Ayer Street
Harvard, IL 60033

Manufacturers Standardization Society of the Valve and Fittings Industry
127 Park St., NE
Vienna, Va 22180

MBMA **Metal Building Manufacturers Association**
1230 Keith Building
Cleveland, OH 44115

MIA **Marble Institute of America**
33505 State St.
Farmington, MI 48024

MCAA **Mason Contractors Association of America**
17W 601 14th St.
Oakbrook Terrace, IL 60181

MCAA **Mechanical Contractors Association of America**
5410 Grosvenor, Suite 120
Bethesda, MD 20814

MFMA **Maple Flooring Manufacturers Association**
60 Revere Dr., Suite 500
Northbrook, IL 60062

MLSFA **Metal Lath / Steel Framing Association**
600 S. Federal, Suite 400
Chicago, IL 60605

National Building Material Distributors Association
1701 Lake Ave., Suite 170
Glenview, IL 60025

National Forest Products Association
1250 Connecticut Ave., NW, Suite 200
Washington, DC 20036

National Housing Rehabilitation Association
1726 18th St., NW
Washington, DC 20009

National Particleboard Association
2306 Perkins Pl.
Silver Spring, MD 20910

National Wood Window and Door Association
205 Touhy Ave.
Park Ridge, IL 60068

NAAMM **National Association of Architectural Metal Manufacturers**
600 South Federal Street
Chicago, IL 60605

NACE **National Associaton of Corrosion Engineers**
P.O. Box 218340
Houston, TX 77218

NADC **National Association of Demolition Contractors**
4415 W. Harrison St.
Hillside, IL 60162

NADC **National Association of Dredging Contractors**
1625 I St., NW, Suite 321
Washington, DC 20006

NAEC	**National Association of Elevator Contractors** 4053 LaVista Rd., Suite 120 Tucker, GA 30084	
NAFCD	**National Association of Floor Covering Distributors** 13-126 Merchandise Mart Chicago, IL 60654	
NAHB	**National Association of Home Builders** 15th and M St., NW Washington, DC 20005	
NAHRO	**National Association of Housing Redevelopment Officials** 1320 187th St., NW Washington, DC 20036	
NAPA	**National Asphalt Pavement Associaton** 6811 Kenilworth Ave., Suite 620 P.O. Box 517 Riverdale, MD 20737	
NAPHCC	**National Association of Plumbing, Heating, and Cooling Contractors** P.O. Box 6808 Falls Church, VA 22046	
NARSC	**National Association of Reinforcing Steel Contractors** 10382 Main St. P.O. Box 225 Fairfax, VA 22030	
NASA	**National Aeronatics and Space Administration** 300 East Street SW Washington, DC 20546	
NAVFAC	**U.S. Naval Facilities Engineering Command** Attention Cash Sales/Code 1051 Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120-5099	
NAWIC	**National Association of Women in Construction** 327 S. Adams St. Fort Worth, TX 76104	
NBMA	**National Building Manufacturers Association** 142 Lexington Ave. New York, NY 10016	
NBS	**National Bureau of Standards (currently National Institute of Standards and Technology)** Gaithersburg, MD	
NCA	**National Constructors Association** 1101 15th St., NW, Suite 1000 Washington, DC 20005	
NCSBCS	**National Conference of State Building Codes and Standards** 481 Carlisle Dr. Herndon, VA 22070	
NCMA	**National Concrete Masonry Association** P.O. Box 781 Herndon, VA 22070	
NCRP	**National Council on Radiation Protection and Measurement** 7910 Woodmont Ave., Suite 800 Bethesda, MD 20814	
NEC	**National Electric Code** National Fire Protection Agency Batterymarch Park Quincy, MA 02269	
NECA	**National Electrical Contractors Association** 7315 Wisconsin Ave. 13th Floor, West Building Bethesda, MD 20814	
NEMA	**National Electrical Manufacturers Association** 2101 L St., NW, Suite 300 Washington, DC 20037	
NESC	**National Electrical Safety Code** Institute of Electrical & Electonics Engineers, Inc. 345 East 47th Street New York, NY 10017	
NFPA	**National Fire Protection Agency** Batterymarch Park Quincy, MA 02269	
NGA	**National Glass Association** 8200 Greesnsboro Dr., Suite 302 McLean, VA 22101	
NIH	**National Institute of Health** **Public Health Service** **U.S. Department of Health and Human Services** Bethesda, MD 20205	
NIJ	**National Institute of Justice** 633 Indiana Avenue, NW Washington, DC 20531	

NIOSH	**National Institute of Occupational Safety and Health** **U.S. Public Health Service**
NKCA	**National Kitchen Cabinet Association** P.O. Box 6830 Falls Church, VA 22046
NLA	**National Lime Association** 3601 N. Fairfax Dr. Arlington, VA 22201
NLBMDA	**National Lumber and Building Material Dealers Association** 40 Ivy St., SE Washington, DC 20003
NOAA	**National Oceanic and Atmospheric Administration** Washington Science Center, Building 5 6010 Executive Blvd. Rockville, MD
NOFMA	**National Oak Flooring Manufacturers Association** P.O. Box 3009 Memphis, TN 38173-0009
NPCA	**National Paint and Coatings Association** 1500 Rhode Island Ave., NW Washington, DC 20005
NPCA	**National Precast Concrete Association** 825 E. 64th St. Indianapolis, IN 46220
NRC	**U.S. Nuclear Regulatory Commission** Publications Division Washington, DC 20555
NRCA	**National Roofing Contractors Association** 1 O'Hare Center 6250 River Rd. Rosemont, IL 60018
NRMCA	**National Ready Mixed Concrete Association** 900 Spring St. Silver Spring, MD 20910
NSA	**National Stone Association** 1415 Elliot Pl., NW Washington, DC 20007
NSA	**National Security Agency / Central Security Service** Fort Meade, MD 20755
NSF	**National Sanitation Foundation** P.O. Box 1468 34 Plymouth Road Ann Arbor, MI 48015
NSPE	**National Society of Professional Engineers** 1420 King St. Alexandria, VA 22314
NTIA	**National Telecommunications and Information Administration** Main Commerce Building Washington, DC 20230
NTIS	**National Technical Information Service** 5485 Port Royal Road Springfield, VA 22161
NTMA	**National Terrazzo and Mosiac Association** 3166 Des Plaines Ave., Suite 132 Des Plaines,, IL 60018
NWMA	**National Woodwork Manufacturers' Association** 400 W. Madison St. Chicago, IL 60606
NWWDA	**National Wood Window and Door Association** 1400 East Touhy Avenue Des Plaines, IL 60018
OMB	**Office of Management and Budget** Old Executive Office Building Washington, DC 20503
OPCMIA	**Operative Plasterers' and Cement Masons' International Association of the United States and Canada** 1125 17th St., NW, 6th Floor Washington, DC 20036
OSHA	**Occupational Safety and Health Administration** **U.S. Department of Labor** **200 Constitution Avenue** **Washington, DC 20201**
	Pipe Line Contractors Association 4100 First City Center 1700 Pacific Ave. Dallas, TX 75201
PCA	**Portland Cement Association** 5420 Old Orchard Rd. Skokie, IL 60077
PCI	**Prestressed Concrete Institute** 175 W. Jackson Blvd., Suite 1859 Chicago, IL 60604

PDCA	**Painting and Decorating Contractors of America** 7223 Lee Hwy. Falls Church, VA 22046
PDI	**Plumbing and Drainage Institute** 1106 W. 77th St. S. Dr. Indianapolis, IN 46260
PHCIB	**Plumbing-Heating-Cooling Information Bureau** 303 E. Wacker Dr., Suite 711 Chicago, IL 60601
PMI	**Plumbing Manufacturers Institute** 800 Roosevelt Rd., Building C, Suite 20 Glen Ellyn, IL 60137
PPI	**Plastics Pipe Institute** 355 Lexington Ave. New York, NY 10017
PSIC	**Passive Solar Industries Council** 2836 Duke St. Alexandria, VA 22314
PTI	**Post-Tensioning Institute** 1717 W. Northern Ave., Suite 218 Phoenix, AZ 85021
RCRC	**Reinforced Concrete Research Council** 5420 Old Orchard Rd. Skokie, IL 60077
RCSHSB	**Red Cedar Shingle and Handsplit Shake Bureau** 515 116th Ave., NE, Suite 275 Bellevue, WA 98004
RFCA	**Resilient Flooring and Carpet Association, Inc.** 14570 E. 14th St., Suite 511 San Landro, CA 94570
RFCI	**Resilient Floor Covering Institute** 966 Hungerford Dr., Suite 12B Rockville, MD 20850
	Scientific Apparatus Makers Association 225 Reinekers Lane Suite 625 Alexandria, VA 22314
SBA	**Systems Builders Association** P.O. Box 117 West Milton, OH 45383
SBCCI	**Southern Building Code Congress International, Inc.** 900 Montclair Rd. Birmingham, AL 35213
SCS	**Soil Conservation Service, U.S. Department of Agriculture** 14th and Independence Avenue, SW Washington, DC 20250
SDI	**Steel Deck Institute** P.O. Box 9506 Canton, OH 44711
SDI	**Steel Door Institute** 712 Lakewood Center N. 14600 Detroit Ave. Cleveland, OH 44107
SIGMA	**Sealed Insulating Glass Manufacturers Association** 111 E. Wacker Dr., Suite 600 Chicago, IL 60601
SJI	**Steel Joist Institute** 1205 48th Ave., N, Suite A Myrtle Beach, SC 29577
SMA	**Screen Manufacturers Association** 655 Irving Park, Suite 201 Chicago, IL 60613-3198
SMA	**Stucco Manufacturers Association** 14006 Ventura Blvd. Sherman Oaks, CA 91423
SMACNA	**Sheet Metal and Air Conditioning Contractors National Association, Inc.** 8224 Old Courthouse Rd. Vienna, VA 22180
SMWIA	**Sheet Metal Workers International Association** 1750 New York Ave., NW Washington, DC 20006
SNL	**Sandia National Laboratories** P.O. Box 5800 Albuquerque, NM 87185
SPRI	**Single Ply Roofing Institute** 104 Wilmot Road, Suite 201 Deerfield, IL 60015-5195
SSFI	**Scaffolding, Shoring, and Forming Institute, Inc.** 1230 Keith Building Cleveland, OH 44115
SSPC	**Steel Structures Painting Council** 4400 5th Ave. Pittsburgh, PA 15213
SWI	**Sealant and Waterproofers Institute** 3101 Broadway, Suite 300 Kansas City, MO 64111

SWI	**Steel Window Institute** 1230 Keith Building Clevaland, OH 44115
TCA	**Tile Council of America** P.,O. Box 2222 Princeton, NJ 08542
TCA	**Tilt-up Concrete Association** 5420 Old Orchard Rd. Skokie, IL 60077
TCAA	**Tile Contractors Association of America, Inc.** 112 N. Alfred St. Alexandria, VA 22314
TIMA	**Thermal Insulation Manufacturers Association** 7 Kirby Plaza Mount Kisco, NY 10549
	U.S. Department of Labor/Occupational Safety and Health Administration 200 Constitution Ave., NW Washington, DC 20210
	U.S. Forest Products Laboratory One Gifford Pinchot Dr. Madison, WI 53705-2398
UBC	**Uniform Building Code** International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601-2298
UL	**Underwriters' Laboratories Inc.** 333 Pfingsten Rd. Northbrook, IL 60062
USAF	**U.S. Department of the Air Force** Manuals may be ordered from headquaters of any Air Force Base
USDOT	**United State Department of Transportation** 400 7th Street SW Washington, DC 20590
VMA	**Valve Manufacturers Association of America** 1050 17th St., NW Suite 701 Washington, DC 20036
WMA	**Wallcovering Manufacturers Associaton** 355 Lexington Ave. New York, NY 10017
WPCF	**Water Pollution Control Federation** 601 Wythe Street Alexandria, VA 22314-1994
WRC	**Water Resources Council, Hydrology Committee** U.S. Department of the Interior C Street between 18th and 19th Streets, NW Washington, DC 20240
WRI	**Wire Reinforcement Institute** 8361-A Greensboro Dr. McLean, VA 22102
WWPA	**Western Wood Products Association** Yeon Building 522 S.W. 5th Ave. Portland, OR 97204

APPENDIX B

INDOOR AIR QUALITY (IAQ) REQUIREMENTS

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INDOOR AIR QUALITY (IAQ) REQUIREMENTS

B.1 DESIGN PROCESS

The Indoor Air Quality Requirements are organized to correspond to the design and construction process. This section addresses the design process.

B.1.1 GENERAL

A new facility using good building practice in indoor air quality design and operation is required. It is also the intent that IAQ be achieved without sacrificing other important aspects of the facility. A facility is required in which indoor air quality is maintained at the best practicable level using currently available knowledge and proven technology which is cost effective and is consistent with the normal function of a laboratory facility with related office space. As a result, a Quality Assurance/Quality Control Manual shall be produced. The Indoor Air Quality Control Plan referenced throughout this document shall be contained in this Manual. The IAQ Plan shall address in detail building materials selection, minimizing introduction of outdoor air pollution, pre-occupancy procedures to accelerate off-gassing, and operations and maintenance procedures which limit introduction of harmful chemicals. A number of considerations are presented here to emphasize the significance in achieving acceptable Indoor Air Quality (IAQ). These considerations are followed by primary strategies for IAQ control. They are listed below and discussed in more detail at various points throughout this IAQ section.

B.1.1.1 CONSIDERATIONS FOR ACCEPTABLE INDOOR AIR QUALITY.

Refer to the publication: Building Air Quality: A Guide for Building Owners and Facility Managers DHH (NIOSH) Pub. No. 91-108.

.1. The most effective means of indoor air pollution control is to eliminate, reduce or contain the sources of indoor air pollution. The design professional must provide evidence that this strategy has been applied to every aspect of the building design, construction requirements and operational requirements. It must include control strategies for outdoor sources, building materials and equipment, furnishings, occupants and maintenance including housekeeping activities which occur indoors.

.1.1 Training of operations and maintenance personnel, as well as occupants in HVAC operations, is a requirement.

.2 Proper operation and maintenance of the facilities and its HVAC system are critical to maintaining IAQ. Training of operations and maintenance personnel, as well as occupants in HVAC operations, is a requirement. Explicit assumptions regarding operation and maintenance must be made during design and they must be documented in a facilities operation manual. They must reflect a clear intent to maintain indoor air quality at the highest practicable level.

.3 Required ventilation air must be delivered to occupants' "breathing zone." This requires careful attention to the design and installation of the air distribution system and its controls, particularly at the local level. Innovative approaches are sought to achieving improved "ventilation efficiency" in order to minimize wasteful and ineffective space air distribution. A clear presentation of the ventilation system space air distribution concept is a part of the design professional's responsibilities. (For definition of "breathing zone" and ventilation efficiency" see 2.5 - Supplemental Indoor Air Quality Information.)

.4 ASHRAE's Standard 62-1989, Ventilation for Acceptable Indoor Air Quality is to be considered a part of these requirements.

B.1.1.2 PRIMARY STRATEGIES FOR IAQ CONTROL

.1 Source control.

.2 Ventilation controls.

.2.1 Outside air supply.

.2.2 Air cleaning.

.2.3 Space air distribution.

.3 Operation and maintenance

B.1.2 SOURCE CONTROL

While it shall be required that all of the above listed strategies be employed to control IAQ, source control is considered the most effective control method for most pollutants. Effective source control requires that potential sources be clearly identified and addressed. The design professional shall demonstrate that their design involves thorough consideration of sources of indoor pollutants and their control. The discussion on source control is organized to cover outdoor sources and indoor sources of indoor air pollutants. The design professional shall demonstrate that their design involves thorough consideration of sources of indoor pollutants and their control. The design professional shall examine potential pollutant sources at each stage of the building design and development process and utilize effective control strategies.

B.1.2.1 OUTDOOR POLLUTANT SOURCES

.1 The sources of air pollutants which must be considered are adjacent and nearby stationary pollution sources, for example, exhausts from other research facilities or from commercial buildings such as dry cleaning establishments or restaurants, nearby roadways, parking lots, loading docks, trash storage, and garage and their motor vehicle traffic patterns. Consideration must be given to variations in the potential sources over time including daily, weekly, and seasonal patterns.

.2 Temporal and spatial variations in wind direction and velocity, traffic patterns, or emissions from industrial processes which affect air quality at the site must be considered. The design professional must also consider and respond to the locations and forms of adjacent buildings which might result in local wind patterns that cause re-entrainment of the facility's own exhausts. The design professional must consider the potential impact of ponds, cooling towers, cooling coil drip pans and other potential sites of microbial contamination on IAQ. Previous land uses, such as agriculture or industry, might result in emissions from contaminated soil or groundwater as a potential indoor air pollutant source. some examples of potentially significant prior uses are wood preservation and treatment; solid or hazardous waste handling, storage, treatment or disposal; dry cleaning processes, leather, paint or chemical manufacturing; refrigerated storage; gasoline; and agriculture. Even nearby building demolition can result in significant site contamination through release of building materials such as asbestos into air or into soil, which may remain on-site or be backfilled onto it.

.3 SITE EVALUATION

.3.1 Solutions must include the potential impact of the site itself on indoor air quality. The prior history of the site must be disclosed as part of the design professionals research and review; see Supplemental Indoor Air Quality Information, Site Evaluation, Contaminants Source Distribution discussed later in this document. Solutions must include consideration of the following factors:

.3.1.1 Prior history of the site.
.3.1.2 Off-site and on-site sources of pollution.
.3.1.3 Soils and soil gases (including radon, organic chemicals, metals, and microbes).
.3.1.4 Ambient air quality.
.3.1.5 Landscaping (including highly sporulating types of plantings).

.3.2 The design professional shall review his responsibilities for an Environmental Assessment (ES) and an Environmental Impact Study (EIS) as described in Section 3 Guide for Facility Design and Layout of this document, paragraph 3.1.2.2 Surveys, Pre-Construction Testing & Environmental Assessment.

.4 EXTERIOR DESIGN IMPLICATIONS

.4.1 Solutions must include the following considerations:

.4.1.1 If this project is a new facility, locate the building on the site as far removed as possible from pollutant sources, or out of the normal wind patterns coming from pollutant sources. Vegetation or other screens should be utilized to form a barrier to particulate matter or to absorb certain chemicals. Vegetation should be used, where effective, in protecting a building from motor vehicle pollutant sources. Where vegetation is used, potential microbial contamination from it should be avoided.

.4.1.2 Building designs must include locating air intakes remote from pollution generation points or areas, creating architectural barriers to direct polluted airflow away from building air intakes, providing appropriate filtration for identified pollutants, and locating air-pollutant-sensitive elements away from exterior sources. Air intake locations for both mechanical and natural ventilation shall not be located near exhaust outlets or where outdoor air pollution plumes are expected.

.4.1.3 Selection and location of window and door systems must include consideration of their designed protection against infiltration and the outdoor air pollutants that might pass through the openings.

.4.1.4 The design professional must address the chemical and physical interactions between the building fabric and identified pollutants which might cause deterioration of the building fabric and systems or which might result in amplification of the contaminant concentrations in indoor air.

B.1.2.2 INDOOR POLLUTANT SOURCES

.1 Indoor Sources include the building fabric itself, equipment, furnishings, appliances, human metabolism and activities, consumer products, maintenance materials and processes, pest control materials, and others.

.2 INTERIOR DESIGN APPLICATIONS

.2.1 Major approaches to source control for indoor pollutants include building design, careful material selection, materials modification and treatment; isolation of pollution-generating activities; and management controls on polluting activities.

.2.2 Source reduction involves a variety of design strategies and practices including the following:

.2.2.1 Source removal
.2.2.2 Product selections
.2.2.3 Substitution
.2.2.4 Product use controls
.2.2.5 Enclosure
.2.2.6 Encapsulation
.2.2.7 Treatment
.2.2.8 Conditioning

.2.3 The building design must reflect consideration of the IAQ impacts of siting, orientation, configuration, materials, environmental control, and interior layout. The basic characteristics of the building - its size, shape, exterior shell as well as major environmental control strategies including illumination, ventilation, acoustics, and thermal environment - must reflect the emphasis placed on IAQ. This requires that the preliminary estimates of loads and the capacities of systems designed to handle them include specific loads related to ventilation requirements and air cleaning (filtration, precipitators, absorption, or scrubbing as required by ambient air and indoor air quality standards referenced in this section and applicable codes and standards).

.2.4 Preferentially, however, precipitators, absorbers and scrubbers should be avoided because of their high maintenance costs. Where proposed, a cost/benefit study must be submitted.

B.1.2.3 BUILDING MATERIALS EVALUATION

.1 The design professional shall provide descriptions of measures that will be taken to minimize the use of indoor air pollution sources in the building construction, finishes, maintenance, and operation. They consist of the following four phases.

.1.1 It shall be the responsibility of the design professional to review all products and materials and identify those considered likely to emit toxic or irritating chemicals in the completed facility. The design professional shall establish a library or repository locally available for inspection and use by the Government. This library shall contain product composition specifications for all products and materials used on construction. Copies of all specifications shall also be submitted to the Government.

.1.2 The Government reserves the right to screen all products and materials based on printed information from manufacturers and information in the open literature and to target selected products for testing.

.1.3 The Government reserves the right to require emissions testing of selected products, at no cost to the lessor, to determine chemical content, emissions rate, or change in composition due to environmental exposure. Based on test results, the Government reserves the right to disallow installation of a given product or material in the completed facility. All testing will be by the suppliers, with test guidance provided by Government. The design professional shall coordinate this process.

.1.4 Material selections, modifications or handling to minimize indoor air pollution.

B.1.2.4 RESULTS OF MATERIALS EVALUATION

.1 The results of the process must be the selection and appropriate installation of materials which have low content of toxic or irritating chemicals and which have stable chemicals (low emissions). The design professional may be required to computer model selected materials for the purposes of exposure assessment. Details of the materials evaluation process are in the Supplemental Indoor Air Quality Information presented later in this document.

.2 Special procedures available to prevent or remedy problems of indoor air quality that result from material emissions will be required prior to occupancy of the building. These procedures are discussed in the Supplemental Indoor Air Quality Information presented later in this document.

B.1.2.5 MATERIALS AFFECTING INDOOR AIR QUALITY

.1 Careful selection and application is required for all interior finish materials and compounds which may result in indoor air residues. Particular attention should be paid to the following materials:

.1.1 Adhesives
.1.2 Sealants
.1.3 Caulking
.1.4 Wood preservatives and finishes
.1.5 Pesticides
.1.6 Fungicides
.1.7 Carpet
.1.8 Carpet padding
.1.9 Paints
.1.10 Insulations: thermal, fire and acoustic
.1.11 Wood paneling
.1.12 Composite wood products such as particle board, cardboard, wafer board, chipboard, etc.
.1.13 Gaskets
.1.14 Glazing compounds
.1.15 Control joint fillers
.1.16 Floor coverings
.1.17 Wall coverings
.1.18 Ceiling tiles, panels

B.1.2.6 DESIGN

.1 The design of the HVAC system shall minimize conditions conducive to microbial growth, chemical contamination, and particulate matter releases and distribution of such within the building. Designs shall minimize conditions of accumulated moisture which, together with warmth and darkness, encourage the growth of microorganisms.

.2 Reliable control of humidity shall be provided. Water shall not be permitted to accumulate in drain pans. Drip or drain pans must be readily maintainable. Carbon-containing materials shall be avoided in areas where water accumulates.

.3 The HVAC system must be readily accessible to allow for maintenance, frequent inspection and cleaning of surfaces exposed to the air stream. Care must be taken to avoid use of materials which will release non-biological particles into the air stream.

B.1.3 HVAC SYSTEM DESIGN

B.1.3.1 IMPORTANT IAQ ISSUES

.1 The selection and installation of components and materials.

.2 Control of moisture accumulation within the system.

.3 Delivery of required outside air to the occupants' breathing zone.

.4 Design of a readily maintainable system.

.5 Implementation of energy management strategies which do not compromise indoor air quality.

.6 Space air distribution (both supply and return).

.7 Humidity control.

.8 Isolation zones for IAQ control.

B.1.3.2 VENTILATION STANDARD

.1 The most recent version of the ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality shall be followed. Additionally requirements of 2.3.1 and 2.3.2 shall be followed. Certain aspects of the ASHRAE standard are highlighted within this document.

.2 Emphasis on maintenance of ventilation system equipment is presented in terms of "readily maintainable" installations. This is a change from earlier language which read "readily accessible."

B.1.3.3 OUTSIDE AIR SUPPLY

.1 The HVAC system design must reflect the anticipated ventilation efficiency as the basis for assumptions which result in the sizing of equipment which impacts outside air supply quantities.

.2 The general office minimum ventilation rate is 20 cfm/person. This refers to the quantity of outside air actually delivered to the breathing zone. It will require a larger quantity at the building intakes to compensate for ventilation efficiency below 100%. 20 cfm/person is the required minimum quantity of outside air delivered to the occupants under conditions of minimum outdoor air supply. Where multiple spaces with dissimilar ratios of outside air to total air are served by a common air supply system, air quality shall be determined by equation 6-1 of the ASHRAE Standard 62. Performance will be determined by tracer gas injection at supply fan and measured at representative locations.

.3 It is important to note that the minimum outside air requirements in the ASHRAE standard are predicated on an indoor environment that is free of significant sources of pollution.

.4 The presence of unavoidable sources will require a higher percentage of outside air supply. Thus, the HVAC system must be capable of providing and sustaining higher outdoor air supply rates.

B.1.3.4 AIR CLEANING

.1 The facility will utilize the most technologically advanced and cost effective techniques to minimize the presence of gas, vapor and particulate phase pollutants to the maximum practical extent.

.2 The trade-offs between cleaning and recirculating return air and conditioning outside air vary greatly from time to time. The HVAC system and Building Automation System (BAS) must be capable of detecting critical factors which will allow the automatic selection of the most cost effective mix of air cleaning, outside air supply volume, and recirculated air. The critical factors are the thermal properties and contaminant contents of both the outside air and the return air relative to the design conditions.

.3 OUTSIDE AIR CONTAMINANTS

.3.1 Air cleaning devices (i.e. scrubbers) may be required which are capable of removing outdoor pollutants which periodically exceed established standard (National Ambient Air Quality Standards - NAAQS - and Table E-1, Ambient Air Quality Guidelines) from the ASHRAE Standard 62-1989.

This may involve the provision of air cleaning beyond the usual panel type particulate filters used in most commercial building currently. However, as stated earlier, precipitators, absorption or scrubbing should be avoided because of their high maintenance costs. Where proposed, a cost/benefit study must be submitted.

.4 RE - CIRCULATION AIR CONTAMINANTS

.4.1 Furthermore, additional air cleaning technologies must be used if necessary to achieve acceptable indoor air quality where re-circulation air contaminant levels result in supply air quality problems.

B.1.3.5 SPACE AIR DISTRIBUTION

.1 This method of indoor contaminant control presents a large potential for significant improvement in ventilation efficiency, and thereby, in indoor air quality. Poor ventilation efficiency results in deterioration of indoor air quality and increased operational costs. The Government requires that the design professional address the ventilation efficiency of the system.

.2 The Government requires that Air Distribution Performance Index (ADPI) exceed 80% and that the design professional must describe the approach and provide calculations.

.3 Ceiling plenums may be used for return air provided that sufficient return dampers and duct headers are provided to permit accurate air balancing and all code wiring provisions are followed for smoke and fire safety.

B.1.4 INDOOR AIR QUALITY REFERENCE GUIDELINES
The design professional shall review and respond to the latest edition of the EPA document: Building Air Quality, A Guide for Building Owners and Facility Managers as well as the latest edition of the AIA documents comprising the Environmental Resource Guide.

B.2 SUPPLEMENTAL INDOOR AIR QUALITY INFORMATION

B.2.1 GENERAL
The accompanying material has been provided to advise the design professional as to the nature of testing and evaluative procedures for which the facility may be subject.

B.2.1.1 SITE EVALUATION

.1 Valuable air quality and weather data are available from local air quality monitoring and regulatory agencies, National Oceanic and Atmospheric Administration monitoring stations, airports, harbors, and even certain resort and athletic establishments. Data on prior uses of sites may be available through historic building surveys or documentation, older fire insurance maps, municipal land use records, assessors' and recorders' files, and other state and local health, waste disposal, or hazardous materials control agencies.

.2 A set of manuals for air quality considerations in residential planning was prepared for the United States Department of Housing and Urban Development in 1978. While written for the residential environment, the methods and procedures described there will be useful for any type of building. These manuals provide illustrative base maps, calculations sheets, and other aids to the preparation of a comprehensive assessment.

.3 The following references are for the manuals referred to above; they will be helpful in the site evaluation. Thuillier, R.H. 1978. Air quality considerations in residential planning. Volume 1, Guide for rapid assessment of air quality at housing sites. Volume 2, Manual for air quality considerations for residential locations. Volume 3, Scientific support and documentation. Washington, D.C.: United States Department of Housing and Urban Development.

B.2.1.2 CONTAMINANTS SOURCE DISTRIBUTION

.1 Table D.2.1.2.1 - SOURCES CONTRIBUTING TO INDOOR AIR POLLUTION provides a summary of likely sources which contribute to indoor air pollution.

TABLE B.2.1.2.1 - SOURCES CONTRIBUTING TO INDOOR AIR POLLUTION

Type of Location	Description and Characteristics
Outdoor Air	Cyclical Daily traffic patterns Diurnal thermal patterns Seasonal thermal patterns Seasonal air quality variations Daily or seasonal releases from neighboring structures or land
	Episodic Extreme weather conditions Accidental releases
Base Building	Building materials and equipment Exposed to interior Exposed to air distribution system Concealed
Occupants and their activities	Metobolic activity Work recreational, food preparation, personal hygiene Operation of machines and equipment
Building Maintenance	Routine cleaning Dusting, vacuuming Waxing and polishing Repair of building equipment Treatment for pests, odors

B.2.1.3 BUILDING MATERIALS EVALUATION PROCESS

.1 PHASE 1 - IDENTIFYING TARGET PRODUCTS

.1.1 The first step is to become familiar with the overall project, design, and space planning program building design, and construction schedule. This understanding is essential for other tasks as well as for the building materials evaluation work. The simultaneous timing of certain construction tasks in relation to installation of major interior furnishings and workstation components increases the potential for retention of airborne contaminants from construction processes on large surface area materials such as carpets and textiles until long after initial occupancy. Table 2.3.2.1.3 - POTENTIAL SOURCES OF INDOOR AIR POLLUTANTS warranting particular attention is presented below.

TABLE B.2.1.3.1.1 - POTENTIAL SOURCES OF INDOOR AIR POLLUTANTS

Adhesives
Sealants
Caulking
Wood preservatives and finishes
Pesticides
Fungicides
Carpet
Carpet padding
Paints
Insulations: thermal, fire and acoustic
Wood paneling
Composite wood products such as particle board, chipboard,
wafer board, cardboard, etc.
Gaskets
Glazing compounds
Control joint fillers
Floor coverings
Wall coverings
Ceiling tiles, panels

.1.2 This is followed by a review of the design professional intended use of major interior finish materials including floor coverings, wall coverings, ceiling system, HVAC duct materials, and furnishings. Considerations include the criteria for selection of certain products (for example, maintenance, cost, acoustics, aesthetics, and functional performance) as well as the quantities and applications contemplated. This review phase concludes with identification of products and materials that might emit toxic or irritating chemicals in the completed building. At this point, all questionable products and materials are considered for further screening.

.1.3 The "Environmental Resource Guide" published by the American Institute of Architects may be of assistance in evaluating building materials.

.2 **PHASE 2 - SCREENING TARGET PRODUCTS**

.2.1 Screening of major components of the building fabric and furnishings is done by the following:

.2.1.1 Determining their quantity and distribution in the building.

.2.1.2 Chemical composition.

.2.1.3 Stability of chemical substances of concern.

.2.1.4 Toxic or irritation potential of their major chemical constituents.

.2.2 The result of this screening process is the identification of products and materials for further investigation.

.3 **PHASE 2 (A) - QUANTITATIVE ASSESSMENT**

.3.1 Quantitative use and distribution assessment involves identifying the major classes of materials, furnishings, and finishes to be used and determining the extent of use, use per unit of floor area, and potential exposure of occupants due to the nature of the product use.

.4 **PHASE 2 (B) - CHEMICAL CONTENT**

.4.1 At this phase, chemical content is assessed from published general information on building products and materials, information obtained from the building's interior designers, or from manufacturers' and suppliers' product literature and data sheets. These are obtained by requiring all potential vendors to provide Manufacturer's Safety Data Sheets (MSDSs) for all products assembled by them and the names of suppliers of each product not assembled by them. Additionally, they should be required to provide contact information for each of their suppliers and to request the contact individual to cooperate with the design team. These secondary suppliers and manufacturers are contacted and additional MSDSs and other information is obtained.

.4.2 MSDS are United States Occupational Safety and Health Administration (OSHA) mandated documents listing all hazardous substances contained in the product they cover; they are generally available for most products of interest. OSHA requires that MSDSs be available for most products of interest. OSHA requires that MSDSs be available to workers for all hazardous substances to which the worker will be exposed. Thus, whether in a factory or at the construction site, each substance used in building materials, products, and furnishings is theoretically covered by an MSDS.

.5 **PHASE 2 (C) - CHEMICAL STABILITY**

.5.1 Stability (chemical emissions) assessments are done by reviewing the vapor pressure and molecular weight data for chemicals of concern as identified on the MSDSs. Many sources can be used to obtain the data:

.5.1.1 American Conference of Governmental Industrial Hygienists 1988: Industrial Ventilation, A Manual of Recommended Practice.

.5.1.2 National Institute of Occupational Safety and Health 1982, 1984: Registry of Toxic Effects of Chemical Substances, 1981-1982, Volumes 1-3 (RTECS) plus the RTECS 1983-4 Supplement (2 volumes).

.5.1.3 National Institute of Occupational Safety and Health 1985: Pocket Guide to Chemical Hazards.

.5.1.4 Sax, N.I. 1970: Dangerous Properties of Industrial Materials, 5th Edition. New York: Van Nostrand Reinhold.

.5.1.5 Verschueren, K. 1983: Handbook of Environmental Data on Organic Chemicals, 2nd Edition. New York: Van Nostrand Reinhold.

.5.2 Additional information on potential emissions into building air is obtained by reviewing emissions test reports and articles in the published literature. See especially:

.5.2.1 Tucker, W.G. 1986. "Research Overview: Sources of Indoor Air Pollutants." in Proceedings of IAQ '86, Managing Indoor Air for Health and Energy Conservation. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

.5.2.2 Levin, H. 1987. "The Evaluation of Building Materials and Furnishings in New Buildings." in IAQ '87, Practical Control of Indoor Air Quality. Atlanta, Georgia: American Society for Heating Refrigeration and Air-Conditioning Engineers.

.5.3 Emission factors can vary significantly - up to a factor of 1000 - for different brands of similar products. Therefore, it is important to obtain as much information as possible about the identity and quantities of constituents in a given product. While such a paper evaluation cannot be definitive, it can be useful in selecting potentially acceptable products. It also can be useful in identifying specific compounds to be measured if laboratory testing is performed.

.6 **PHASE 2 (D) EXPOSURE AND TOXICITY EVALUATION**

.6.1 Toxicity or irritation potential of the constituent compounds is evaluated using standard reference sources (ACGIH 1980). Exposure evaluations by computer modeling may also be required. Documentation of the threshold limit values, 4th ed. Cincinnati: American Conference of Governmental Industrial Hygienists, Inc. Use the latest edition of sources listed:

.6.1.1 Clayton, G.D. and F.C. Clayton, eds. 1981. Patty's industrial hygiene and toxicology, 3d rev. ed. Volumes 1-3. New York: John Wiley and Sons.

.6.1.2 Gosselin, G.D., and F.C. Clayton, eds. 1981. Patty's industrial hygiene and toxicology, 3d rev. ed. Volumes 1-3. New York: John Wiley and Sons.

.6.1.3 NIOSH. 1983. Registry of toxic effects of chemical substances, 1981-2. Volumes 1-3. Cincinnati: National Institute of Occupational Safety and Health, U.S. Public Health Service.

.6.1.4 NIOSH. 1985. Registry of toxic effects of chemical substances, 1983-4. Supplement. Volumes 1-2. Cincinnati: National Institute of Occupational Safety and Health, U.S. Public Health Service.

.6.1.5 NIOSH. 1985. Pocket guide to chemical hazards. Cincinnati: National Institute of Occupational Safety and Health, U.S. Public Health Service.

.6.1.6 Olishifski, J.B., ed 1979. Fundamentals of industrial hygiene. National Safety Council.

.6.1.7 Sax, N.I. 1979. Dangerous properties of industrial materials, 5th ed. New York: Van Nostrand Reinhold.

.6.1.8 Sparks, L 1989. IAQ Model.

.6.2 For example, Sax (1979) lists a "summary of toxicity statement" or rating (THR) for each substance covered. Ratings of "none", "low", "moderate", "high", or "unknown" are given. The route or routes of entry are given for specified toxic effects. LD50 (lethal dose for 50% of experimental animals) are given for various exposure routes; tests and experimental species. Human irritation potential and target organs or sites are also listed and carcinogenic and mutagenic assessment is reported.

.6.3 NIOSH's Registry of Toxic Effects of Chemical Substances, 1981-1982. Volumes 1-3 (RTECS) plus the RTECS 1983-4 Supplement (2 volumes) provide an annotated listing of toxicity and irritation research for tens of thousands of chemical substances. RTECS also provides a comprehensive list of alternative trade and generic names by which products may be known or marketed, chemical formulas, and cross-references to the Chemical Abstracts Service (CAS) number for each chemical.

.6.4 A database on building materials emission rates is now being developed by EPA. There also exists a a large database developed by NASA for spacecraft design and operation. Work currently in progress will make both of these databases accessible and useful to the design professional at this point in the process. From this review, determinations are made regarding materials which will require laboratory testing according to the outcome of the combination of reviewed factors. A combination of high volatility and moderate toxicity would result in further consideration of the substance and the product. A very low volatility and moderate toxicity would be examined in terms of the quantity of the product and the quantity of the substance present in that product. No algorithm has been established for this evaluation; a qualitative assessment is the most reasonable approach given the limited amount of data currently available.

.7 RESULTS

.7.1 The results of this screening process allows identification of the products most likely to emit significant quantities of irritating or toxic substances. These are likely to be the carpet system (carpet, pad or backing, and adhesive), workstation (office furnishings) work surfaces and interior partitions, and the ceiling tiles. Shelving materials, adhesive, caulking compounds, and some wood finishes are also materials of concern. These materials should be evaluated by emissions testing.

.8 PHASE 3 - EMISSIONS TESTING

.8.1 Test methods include bulk testing and environmental chamber and headspace air sampling. Air sampling can also be done in the first completed building prior to, during, and after materials installation to develop air quality profiles of the installation. Chamber tests can be conducted in a very small chamber (less than 0.1 cu m) or in a medium size chamber capable of accommodating full size samples.

.8.2 Cut samples create problems of distorted ratios between surface area and edges, and cuts through materials can expose materials not normally exposed in the assembled product. Sealing the edges reduces some of these effects. Room size chamber can also be used, but they are expensive and require larger quantities of materials.

.8.3 Ratios of materials surface area and weight to chamber volume and wall area should be kept reasonably similar to the ratios found in actual building situations. Multiple material tests may also be run to determine "sink" effects, the tendency of materials to absorb airborne substances on their surfaces and re-release them to the air.

.8.4 Air movement, temperature, and relative humidity as well as outdoor (or pure) air exchange rates in the chamber should approximate those found in buildings. Airflow should be controlled within the chamber to assure good mixing and to minimize unusually high velocities at material surfaces. guidance is available from "A Standard Guide for Small-Scale Environmental Chamber Measurements of Organic Emissions from Indoor Materials / Products" now under development by ASTM Subcommittee D-22.05 on Indoor Air, 1916 Race St., Philadelphia, PA 19103.

.8.5 Material samples are generally conditioned by placing them in the chamber at controlled temperature and under forced air circulation for several hours or even days prior to testing. In order to best meet the purpose of the testing, handling of the material should resemble that employed in actual installations of the materials in buildings. Products are stored in factory containers until testing. Once opened, they are kept in a normally ventilated room containing typical, new office furnishings until additional testing is conducted. Complete and careful record keeping is essential to interpretation of testing results.

.9 **ANALYSIS AND RECOMMENDATIONS**

.9.1 Based on the results of the four-phase materials evaluation process, products can be selected, modified, treated or otherwise managed to improve indoor air quality.

.10 **DEFINITIONS**

.10.1 Breathing zone. The air space bounded by the lower and upper horizontal planes where human respiration occurs. For office space, this zone is between 42 and 64 inches above the floor. All breathing zone measurements shall be made at a height of 42 inches.

.10.2 Room ventilation efficiency. Percentage of the outdoor air per person entering the room that actually ventilates the breathing zone.

.10.3 Overall (building) ventilation efficiency. Percentage of the outdoor air per person entering the building that actually ventilates the breathing zone.

.10.4 Volatile organic chemicals. Such compounds having vapor pressures above 0.1 mm of mercury.

.10.5 Semi-volatile organic chemicals. Such compounds having vapor pressures less than 0.1 mm of mercury down to .0000001 mm of mercury.

B.3 CONSTRUCTION PROCESS

B.3.1 GENERAL

The construction process offers many opportunities to observe and correct problems before the building is completed and occupied. As part of the Quality Assurance/Quality Control Manual, a review of change orders, shop drawings and other submittals, and of installations in the field shall be used to avoid construction and occupancy delays, call-backs, and problems in the occupied building.

B.3.1.1 CHANGE ORDERS, SHOP DRAWINGS

.1 Changes made and details supplied by contractors or designers during construction can significantly impact indoor air quality. Changes made in response to previously anticipated problems or events during construction must meet the design intent and the established performance criteria outlined in the IAQ Quality Assurance / Quality Control Manual.

.2 The design professional must review, evaluate, and follow-up on change orders, field orders, and shop drawing approval requests for items determined significant to indoor environmental quality. These include HVAC system design and components, insulations, sealants, finish materials, and furnishings, among others. The list of items requiring special attention with respect to IAQ shall have been identified in the IAQ Quality Assurance/Quality Control Manual and the procedures and criteria for their selection specified.

B.3.2 COMMISSIONING

.1 Simultaneous thermal and air balance must include complete system balancing under heating, cooling, and economizer cycles. Limitations imposed by weather conditions shall be overcome by completion of the balance work at the earliest available opportunity.

.2 The design professional must assure that effective training programs will be included in control system and HVAC equipment construction contracts.

.3 Evidence that the facility's ventilation system is fully functional and that air quality is acceptable prior to initial occupancy of any specific area will be the responsibility of the design professional. This will be accomplished through performance testing during or immediately after the "commissioning" of the completed facility.

.4 While no specifics for performance verification are included in the proposed standard, it is the intent that the actual facility be measured prior to occupancy and periodically after occupancy to determine IAQ conformance to ASHRAE, the requirements of this document, and other specified code and Governmental requirements in force.

B.3.3 AIR-OUT PROCEDURES

Refer to the requirements of Chapter 4, Paragraph 3.b. and Chapter 5, Paragraph 12.c. of the current version of the Facility Safety Manual for off-gassing.

.1 An IAQ control procedure known as the "air-out" will be employed after completion of the building, commissioning of the equipment, and installation of major furnishings.

.2 The purpose of the air-out is to remove chemical emissions from materials in the building in order to reduce occupant exposure to these chemicals once occupancy commences. The air-out is achieved by the use of adequate ventilation for an extended period of time. This will require an additional time period of one to three weeks after commissioning and prior to occupancy.

.3 Some material such as carpets and other flooring systems may require elevated air temperatures to accelerate their chemical emissions. Refer to the IAQ Quality Assurance/Quality Control Manual and/or the building acceptance test manual for appropriate recommendations.

.4 Supplemental air movement devices such as portable fans shall be used to increase air flow within enclosed spaces to improve the efficacy of the air-out procedure.

.5 The air-out must be carefully planned and conducted to avoid adverse effects on building components and equipment. The design professional shall refer to the IAQ Quality Assurance/Quality Control Manual and/or building acceptance test manual.

.6 Such a process requires careful planning of commissioning and occupancy. The Government will provide the design professional with an occupancy schedule for purposes of planning the air-out process.

END OF APPENDIX

APPENDIX C

ROOM DATA SHEETS

APPENDIX C

ROOM DATA SHEETS

C.1 GENERAL

This section contains the Room Data Sheets for various typical functional layouts for EPA laboratories and laboratory support spaces. These data sheets should be used as guides and references by the design professional during the programming and design process of a specific project. Final laboratory layouts must be developed with the individual users and their research requirements as provided in Section 3 - GUIDE FOR FACILITY DESIGN AND LAYOUT. Specific criteria and requirements should be verified by the design team with the EPA, local, state and federal regulatory agencies.

C.2 TYPICAL ROOM REQUIREMENTS

C.2.1 ROOM DATA SHEETS

The Room Data Sheets for typical rooms are shown in the following laboratory and laboratory support room layouts. These Room Data Sheets indicate typical room/laboratory requirements as well as preferred floor plans with regard to installed equipment. Specific requirements, developed during the programming process with the individual user of the room, shall be in accordance with Section 3 under SPECIFIC ROOM REQUIREMENTS. The final layouts for these areas will be the responsibility of the design professional with approval by the EPA.

C.2.2 STANDARDS AND SYMBOLS

In addition to the typical requirements as shown in the room data sheets, standard requirements for each area or room as indicated in the various sections of the this document must also be included. A listing and definition of the standard requirements, symbols and abbreviation indicated on the Room Data Sheets are provided in the following paragraphs.

C.3 DEFINITION OF STANDARD REQUIREMENTS

All standard requirements shall be in accordance with codes and with all other requirements of this document. The narrative description of requirements in this Section and elsewhere in the Space Standards and Guidelines for EPA Facilities, shall take precedence over drawings. If an item is described in the narrative but not shown in a drawing that is not to be taken as a waiver of the requirement. The drawings are provided for illustrative purposes only. The following are definitions of the standard requirements used in the Room Data Sheets.

C.3.1 LABORATORY CLASSIFICATION STANDARD

The required construction for all laboratory units shall be classified as Fire Hazard Class B laboratories per NFPA - 45.

C.3.2 ARCHITECTURAL STANDARDS

C.3.2.1 FLOORING
Provide chemical resistant vinyl tile or seamless vinyl flooring. When a seamless vinyl floor material is required, the base shall also be seamless and integrally coved. Floor and base materials are described in Section 5.

C.3.2.2 BASE
Provide 4 inch high vinyl or rubber base with matching end stops and preformed or molded corner units.

C.3.2.3 WALLS
Masonry or gypsum wallboard partitions extending from the floor to the underneath of structural slab. Wall surfaces shall be painted with semi-gloss enamel paint. In instrumentation rooms, where sound absorption is required, walls shall be properly attenuated. Reverberating wall areas should be reduced to a minimum. See also Section 5 under PARTITIONS for flamespread and smoke development specifications.

C.3.2.4 CEILING
Finished ceilings shall be suspended acoustical tile system. Tiles shall be of a non-flaking material. Ceilings in extraction, preparation, glassware washing, microbiology and similar wet laboratories shall be of water resistant tile materials or painted gypsum wallboard. Ceiling height in all laboratory spaces shall be a minimum of 9 feet 8 inches.

C.3.2.5 DOORS
Open doors should not protrude more than 6 inches into exit corridors. Door sizes and hardware as follows:

.5.1 Hallway access doors: pair doors; 3 foot (active) with 1 foot panel (top and bottom bolts at inactive); wire glass (4" x 25" or 5" x 20" vision panel); no threshold; ADA compliant hardware; automatic closure.

.5.2 Interconnecting (between laboratories): 3 foot; push plate; vision panel; dual swing.

.5.3 Interconnecting (between Blocks); 4 foot (minimum) with panic bar hardware; automatic closures.

.5.4 Exterior fire doors: 4 foot with panic bar hardware; automatic closures.

.5.5 All doors shall be a minimum height of 7 feet 0 inches.

C.3.2.6 CASEWORK
Laboratory casework shall be of modular design and interchangeable. Standard casework shall be of metal construction; Room Data Sheets will indicate exceptions (wood or approved plastic laminate) to these requirements. Casework shall be as described in Section 5 under LABORATORY CASEWORK. Unless otherwise noted in the Room Data Sheets, peninsulas shall not have reagent shelves. Six inch drawers are standard in the base drawer units. All units shall include label holders on all drawers and doors.

.6.1 Vented Storage Cabinets: Vented acid/base storage cabinets shall be 3'-0" wide metal cabinets. The inner surfaces of the cabinet shall be factory coated to resist acid/base fumes and spills. One adjustable shelf shall be provided. Venting shall be as for vented chemical storage cabinets.

.6.2 Countertops: Man-made stone impregnated with chemical (e.g., acids, bases, solvents) resistant epoxies. A depth of 33" shall be standard depth for all casework. Countertops adjacent to sinks shall have grooved drainboards. Casework along walls shall have a four inch high backsplash.

.6.3 Knee Space: Unless otherwise noted in specific room data sheets, knee spaces shall be three feet (3'-0") in length and 29" in height.

C.3.2.7 EMERGENCY RESPONSE EQUIPMENT CLOSETS

Six hallway closets approximately 3' x 3' shall be located throughout the laboratory block with equal travel distance between closets. These closets will house laboratory supplies for spill cleanup and should include shelves on two walls.

C.3.3 MECHANICAL STANDARDS

C.3.3.1 HVAC

The laboratory HVAC system shall be designed as a one pass air system with exhaust through hoods where hoods are used. HVAC systems should be continuously operational 24 HR., seven days a week both summer and winter. Design temperatures shall be as follows:

.1.1 Every laboratory room shall be controlled individually in accordance with the following: summer: 72° FDB ± 2°F and 50% RH ± 5% and winter, 72° FDB ± 2°F and 30% RH ± 5%. For laboratories that are primarily instrumentation rooms, the standard shall be 72° FDB ± 2°F.

.1.2 See also MECHANICAL REQUIREMENTS Section 8 under FUME HOOD EXHAUST for additional requirements.

C.3.3.2 EMERGENCY EYE/FACE WASH

Emergency eye/face wash stations shall be provided at a minimum of one per single module (308 NUSF) in accessible locations, away from fume hoods, requiring no more than 10 seconds to reach and should be within a travel distance no greater than 30.5 meters (100 feet) from the hazard. See also the ARCHITECTURAL REQUIREMENTS and MECHANICAL REQUIREMENTS (Sections 5 and 8) for additional requirements.

C.3.3.3 EMERGENCY SHOWERS
Emergency showers shall be provided in all work areas where, during routine operations or foreseeable emergencies, areas of the body may come into contact with a substance which is corrosive or severely irritating to the skin or which is toxic by skin absorption. Emergency showers shall be in accessible locations, away from fume hoods, that require no more than 10 seconds to reach and should be within a travel distance no greater than 30.5 meters (100 feet) from the hazard. See the Room Data Sheets for recommended locations. Refer also to the ARCHITECTURAL REQUIREMENTS and MECHANICAL REQUIREMENTS (Sections 5 and 8) for additional requirements.

C.3.3.4 CENTRAL DI WATER SYSTEM
A central deionized water (DI) system shall be provided at a resistivity > 10 mega-ohms at tap. Refer to Mechanical Requirements (Section 8) under Deionized Water (DI) System for specific requirements.

C.3.3.5 NON-FLAMMABLE GAS DISTRIBUTION SYSTEM
Outlets shall be provided every 10 feet or as specified in the Room Data Sheet (exact location to be determined by the Government during an early design stage). See also the MECHANICAL REQUIREMENTS (Section 8) for additional requirements.

C.3.3.6 FIRE PROTECTION
The whole structure shall be sprinklered. Instrumentation laboratories shall have a dry pipe sprinkler system. Portable fire extinguisher shall be provided in all laboratories. Refer to the ARCHITECTURAL REQUIREMENTS and MECHANICAL REQUIREMENTS (Sections 5 and 8) for additional requirements.

C.3.3.7 FUME HOODS
All fume hoods called for in the specific design criteria of this document shall satisfy all requirements stated in Section 8 MECHANICAL REQUIREMENT under LABORATORY FUME HOODS.

.7.1 All hoods shall have two 120V duplex outlets and one 220V outlet on the face of the hood. The following services shall be standard in all hoods: industrial cold water (non-potable), laboratory vacuum, gas, and compressed air (15 psig). Fume hoods shall be equipped with a safety alarm system designed to signal unsafe operating conditions whenever fume hood velocity falls below 70% of specified design value. Alarm system shall consist of an audible and visual alarm to indicate malfunction or unsafe operating conditions.

.7.2 Noise Control: The noise level at the face of the hood shall not exceed 70 dB with the system operating; nor shall it exceed 55 dB at bench top level elsewhere in the laboratory room.

C.3.3.8 LABORATORY SERVICE FITTINGS
Laboratory service fittings for piped utilities (e.g., water faucets and spigots, gas jets or nozzles, etc.) shall have a solvent and acid-resistant epoxy powder coating or be made of PVC or equivalent corrosion resistant materials; chrome plated fixtures shall not be used.

C.3.4 ELECTRICAL STANDARD

C.3.4.1 ELECTRICAL OUTLETS
Laboratory standard electrical outlets shall be duplex convenience 20 amp/120V outlets in surface metal raceways as defined in the ELECTRICAL REQUIREMENTS (Section 9) of this document. These outlets should be provided in addition to specific electrical outlets called for or shown in the respective Room Data Sheet, and to outlets needed to feed the equipment used in each room. These outlets shall be located either on the reagent shelf, or if no reagent shelf is required, 8" above counter top level when base cabinets are used and 44" above floor level in other locations. These outlets shall be no more than 3'-0" apart in either situation.

.1.1 Additional requirements:

.1.2.1 Peninsulas Without Reagent Shelf: Provide a quadraplex pedestal outlet every 3'-0" in the center of the peninsula; pedestal units shall have brass, waterproof covers.

.1.2.2 Peninsulas With Reagent Shelf: Provide duplex outlets in surface metal raceway every 3'-0" flush along the face of the bottom shelf on each side of the peninsulas.

.1.2.3 Equipment Outlet Location: Electrical outlet location shall be near the equipment to powered; the exact location of equipment and outlets shall be determined by the Government during early design stage.

C.3.4.2 LIGHTING
Laboratory standard lighting should be fluorescent uniform lighting with two levels of lighting at bench top and double switching. The high level should be 100 FC and the low level should be 50 FC. See also the ELECTRICAL REQUIREMENTS (Section 9).

C.3.4.3 EMERGENCY LIGHTING
Provide a minimum of 5 footcandles throughout exit path, laboratory modules are included. See also the ELECTRICAL REQUIREMENTS (Section 9) for specific criteria.

C.3.4.4 SWITCHES
Provide one electrical switch at each door that provides hallway egress at 54 inches above the finished floor. See also the ELECTRICAL REQUIREMENTS (Section 9) for specific criteria.

C.3.4.5 EMERGENCY POWER SYSTEM
Emergency power system shall be provided by a diesel driven emergency generator or UPS system. See Room Data Sheets and the ELECTRICAL REQUIREMENTS (Section 9).

C.3.4.6 FIRE ALARM SYSTEM
Fire alarm system shall be provided in accordance with criteria set forth in the ELECTRICAL REQUIREMENTS (Section 9).

C.3.4.7 TELEPHONE OUTLETS

Telephone outlets shall be provided one per single laboratory module (308 NUSF) space. The exact location for outlets shall be determined by the Government at an early design stage. Provide one telephone outlet per 125 NUSF of office space. If work stations are identified and are smaller than 125 NUSF, one outlet per work station will be required.

C.3.4.8 LAN COMPUTER OUTLETS

LAN computer outlets shall be provided one per single module (308 NUSF) space. The exact location for outlets shall be determined by the Government at an early design stage. Provide one LAN outlet per 125 NUSF of office space. If work stations are identified and are smaller than 125 NUSF, one outlet per work station will be required.

C.3.4.9 LIMS COMPUTER OUTLETS

LIMS computer outlets shall be provided one per single module (308 NUSF) space. The exact location for outlets shall be determined by the Government at an early design stage. Provide one LIMS outlet per 125 NUSF of office space.

C.3.4.10 OUTLET COVER PLATES

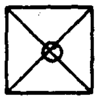
All telephone, computer and electrical outlets shall be PVC or equivalent corrosion resistant cover/face plates; metal covers shall not be used.

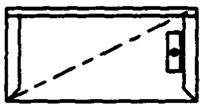
C.4 LABORATORY SYMBOLS LIST

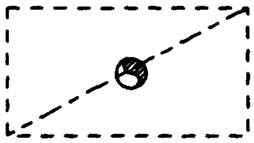
ARCHITECTURAL SYMBOLS

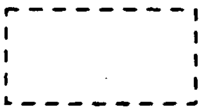
 **Cup Sink**

 **Epoxy Sink**

 **Stainless Steel Sink**

 **Fume Hood**

 **Biological Safety Cabinet**

 **Government Furnished Equipment**

 **Umbilical 5" x 18"**

 **Snorkle**
150cfm Exhaust (U.N.O.)

COUNTERTOP MATERIAL

Epoxy Top

Acid Resistant Plastic Laminate

Stainless Steel

C.4 LABORATORY SYMBOLS LIST (CONTINUED)

PLUMBING SYMBOLS

A	AIR, COMP. (100 PSIG U.O.N.)	HW	HOT WATER
LA	AIR, LAB (15 PSIG U.N.O.)		CUP SINK
CO2	CARBON DIOXIDE		LAB SINK
RO	REVERSE OSMOSIS WATER	FD	FLOOR DRAIN
SS	SAFETY SHOWER	FLD	FUNNEL DRAIN
CW	COLD WATER	FD	FLOOR SINK
CHWS	CHILLED WATER SUPPLY		SHUT-OFF VALVE
CHWR	CHILLED WATER RETURN	EW	EYE WASH

ELECTRICAL SYMBOLS

S_D	DIMMER SWITCH		JUNCTION BOX
	20A SGL REC 120V	W	WARNING LIGHT
	20A DUPLEX REC 120V		LIGHT FIXTURE
	30A SGL REC 208V SINGLE PHASE	S	SAFE LIGHT
	30A SGL REC 120∗208V SINGLE PHASE		DISC SWITCH
	20A SGL REC 208V 3 PHASE		TELEPHONE
		WP	WEATHERPROOF
	SPECIAL PWR ERC	EP	EXPLOSION PROOF
	PEDESTAL BOX WITH REC	EM	EMERGENCY CKT
	SURFACE RACEWAY		COMPUTER OUTLET

APPENDIX C

ROOM DATA SHEETS

SPACE TYPE - 1	**STANDARDS PREPARATION LABORATORY**
SPACE TYPE - 2	**ORGANIC EXTRACTION LABORATORY**
SPACE TYPE - 3	**WET CHEMISTRY LABORATORY**
SPACE TYPE - 4	**PARTIAL CONTAINMENT LABORATORY**
SPACE TYPE - 5	**GLASSWARE PREPARATION AREA**

ROOM DATA SHEETS

SPACE TYPE - 1

SPACE TYPE
Information given to generally describe type of laboratory space by function.
Preparation Laboratory

AREA
Information provided as part of a specific space requirement for a particular project. Example is used to illustrate a Typical 1-Module Laboratory.
330 Net Square Feet

SPACE NAME
Information provided as part of specific description of space usage for a particular project.
Standards Preparation Laboratory

ACTIVITY / PROGRAM NAME
Information provided to assign responsibility for a specific space to a particular Branch / Section for a project.
Analytical Support Branch

OCCUPANCY
Identifies number of personnel in a given space for a defined period of time.
1 - 2 Persons

BUILDING SECTION
Identifies functional grouping in which space is to be located.
Block C

ADJACENCIES
Information is to be developed during programming by the design professional in consultation with representative facility users and approval by the EPA.
None

OPERATION / TASK DESCRIPTION
Information is to be developed during programming by the design professional in consultation with representative facility users and approval by the EPA.
This laboratory is used for the preparation of analytical standards which are used in both organic and inorganic chemical analyses.

LIST OF REQUIREMENTS

Ceiling
- 10' Acoustical Ceiling

Doors
- Double Doors 3' Active Plus 1' Equipment Leaf
- Emergency Exit To Adjacent Space

Flooring
- Sheet Vinyl

Walls
- Metal Stud & Drywall reinforced for Wall Hangings

Window Treatment
- Windows Required
- Standard Window Shades

Special Construction
- None required

Outfitting
- None required

Fixed Laboratory Equipment
- Metal Casework - "C" Frame
- (21) LF of Base Cabinets - 36" High
- (6) LF of Wall Cabinets - Glass Door
- (12) LF Adjustable Wall Shelving - 2 Tier
- Epoxy Top
- (1) 6' Fume Hood with Services
- (2) Vented Solvent Storage Cabinet Below Hood
- (1) Vented OSHA Cabinet (30 Gallon)
- Lab Sink
- Cup Sink
- (2) Lab Desks with Bookshelves, Tackboards and File with Storage Cabinets

Mechanical Service
- Temperature and Humidity Control
- 100% Supply and Exhaust - 24 hour operation

Electrical Service
- 120V/20 Amp AC at Fume Hood
- 120V/20 Amp Receptacles 24" on Center in Raceway
- 208V/30 Amp-1 Phase, 4 Wire AC at Fume Hood
- Disconnect Switch at Door for 120/208V Lab Power
- Telephone
- Cable Tray
- Emergency Power
- Fluorescent Lighting - 100 Footcandles at 36" AFF
- Security
- Computer Outlets

Plumbing / Fire Protection
- Industrial Hot and Cold Water, Sink
- Industrial Cold Water, Cup Sink
- Deionized Water
- Lab Drain (Acid Waste)
- Compressed Air, 15 psi Serrated Connection
- Nitrogen Cylinder
- Lab Vacuum
- Water Sprinklers
- Dry Chemical and Carbon Dioxide Extinguisher in Safety Niches
- Safety Shower/Eyewash Station

CHEMICALS USED IN THIS ROOM

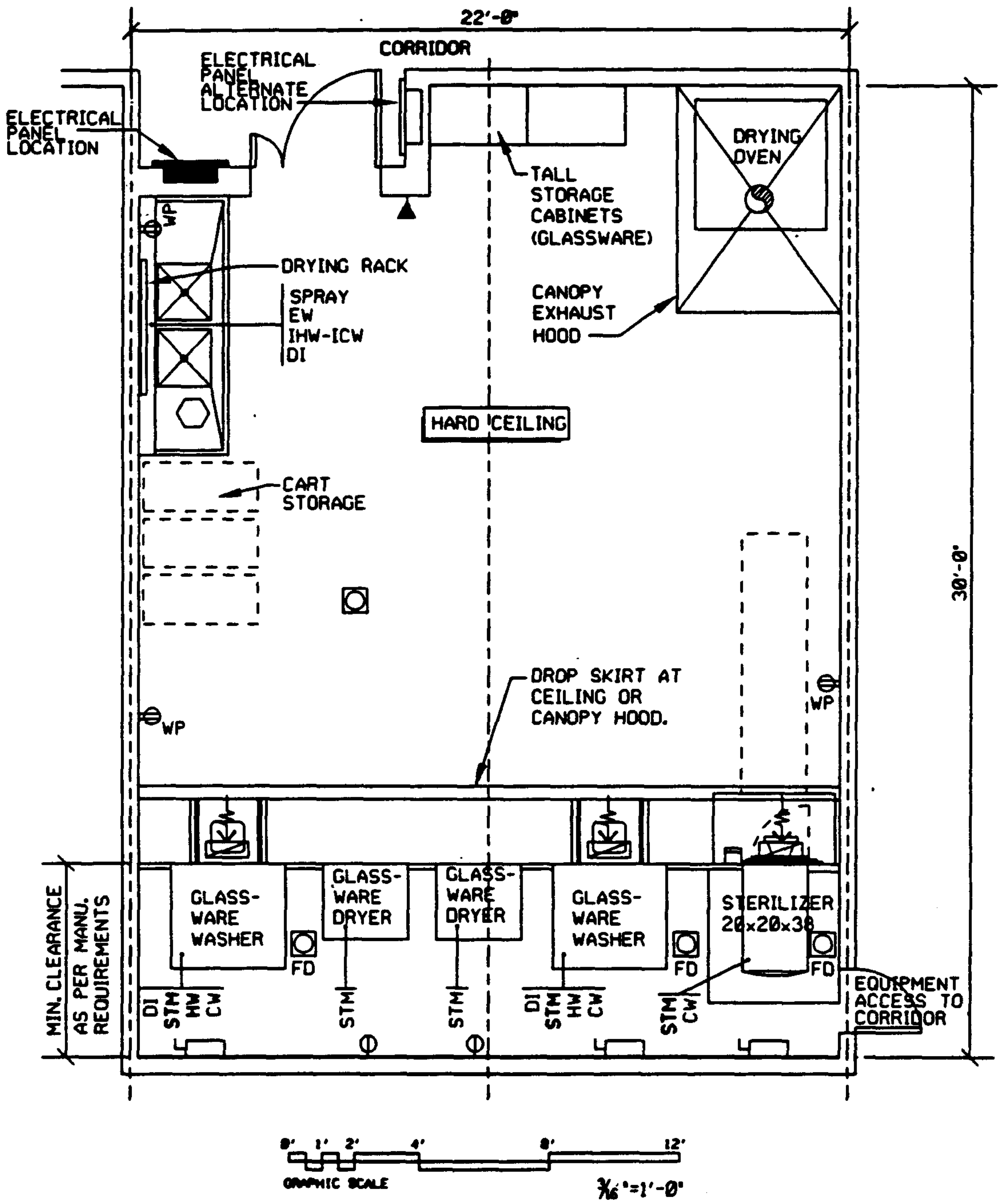
Types and quantities used are to be identified during programming by the design professional in consultation with representative facility users and approval by the EPA. The following is used as an example:

Small quantities of organic solvents, acids and bases (generally less than one gallon of each at any one time) in concentrations ranging from weak solutions to concentrated materials. Standard reagent chemicals in gram proportions.

MOVABLE EQUIPMENT & FURNISHINGS

List of Government Furnished / Government Installed (GFGI) equipment and furnishings is to be identified during programming by the design professional in consultation with representative facility users and approval by the EPA. The following is used as an example:
- (2) 2'-6" x 4'-0" Desk
- (2) Chairs
- (2) 2-Drawer File Cabinet
- (2) Analytical Balances
- (3) Bench Top Drying Ovens
- (2) Refrigerators
- PC Work station

SPACE TYPE - 1
STANDARDS PREPARATION LABORATORY



ROOM DATA SHEETS

SPACE TYPE - 2

SPACE TYPE
Preparation Laboratory

AREA
660 Net Square Feet

SPACE NAME
Organic Extraction Laboratory (Low-level)

ACTIVITY / PROGRAM NAME
Analytical Support Branch

OCCUPANCY
4 Persons

BUILDING SECTION
Block C

ADJACENCIES
This laboratory should be located next to the Organic Extraction Laboratory and away from the Gas Chromatography / Mass Spectrometry Volitales & Air Laboratories.

OPERATION / TASK DESCRIPTION
Preparation of environmental samples (drinking water and other very clean samples) for analysis of organic constituents, including: semi-volitales, pesticides, herbicides, and PCB compounds. Preparation includes extraction of the samples with specifided organic solvents, concentration of the solvent extract, clean-up of extract if required, and final vialing and labeling of the extract in preparation for analysis.

LIST OF REQUIREMENTS

Ceiling
- 10' Acoustical Ceiling

Doors
- Double Doors 3' Active Plus 1' Equipment Leaf
- Emergency Exit To Adjacent Space

Flooring
- Sheet Vinyl

Walls
- Metal Stud & Drywall reinforced for Wall Hangings

Window Treatment
- Windows Required
- Standard Window Shades

Special Construction
- None required

Outfitting
- None required

Fixed Laboratory Equipment
- Metal Casework - "C" Frame
- (46) LF of Base Cabinets - 36" High
- (16) LF of Wall Cabinets - Glass Door
- (4) LF Adjustable Wall Shelving - 2 Tier
- (24) LF Adjustable Reagent Shelving - 2 Tier
- (4) LF of Tall Storage Cabinets - Glass Door
- Epoxy Top
- (2) 6' Fume Hood with Services
- (4) Vented Solvent Storage Cabinet Below Hood
- (1) Vented OSHA Cabinet (30 Gallon)
- Lab Sink
- Cup Sink
- (4) Lab Desks with Bookshelves, Tackboards and File with Storage Cabinets

Mechanical Service
- Temperature and Humidity Control
- 100% Supply and Exhaust - 24 hour operation

Electrical Service
- 120V/20 Amp AC at Fume Hood
- 120V/20 Amp Receptacles 24" on Center in Raceway
- 208V/30 Amp-1 Phase, 4 Wire AC at Fume Hood
- Disconnect Switch at Door for 120/208V Lab Power
- Telephone
- Cable Tray
- Emergency Power
- Fluorescent Lighting - 100 Footcandles at 36" AFF
- Security
- Computer Outlets

Plumbing / Fire Protection

- Industrial Hot and Cold Water, Sink
- Industrial Cold Water, Cup Sink
- Deionized Water
- Lab Drain (Acid Waste)
- Compressed Air, 15 psi Serrated Connection
- Nitrogen Cylinder
- Lab Vacuum
- Water Sprinklers
- Dry Chemical and Carbon Dioxide Extinguisher in Safety Niches
- Eyewash At Main Sink
- Safety Shower/Eyewash Station

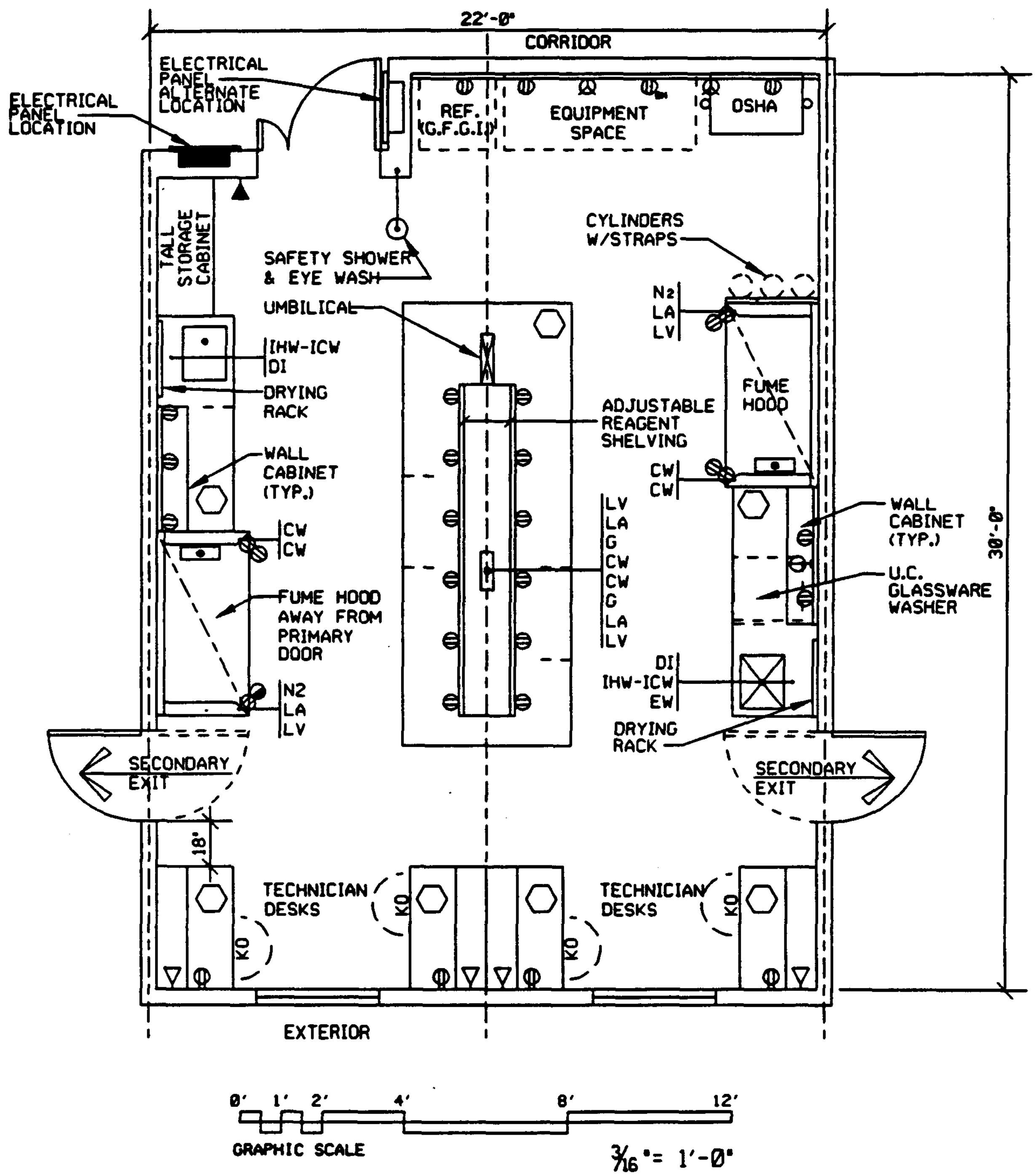
CHEMICALS USED IN THIS ROOM

Methylene chlorine - approximately 3 gallons /day
Acetone - approximately 0.5 gallons / day
Methanol - approximately 0.5 gallons / day
Hexane - approximately 0.5 gallons / day
Diethylether
Sulfuric acid - 500 ml maximum
Hydrochloric acid - 200 ml maximum
Organic compound standards
- 500 ug / ml or less
- 100 mg for most neat standards

MOVABLE EQUIPMENT & FURNISHINGS

- (4) 2'-6" x 4'-0" Desk
- (4) Chairs
- (4) 2-Drawer File Cabinet
- Sonicator probe
- GPC
- Continuous extractor water baths
- KD evaporator water baths
- Refrigerator/Freezer
- Soxhlet heat rack
- Balance
- Oven
- Undercounter Glassware Washer
- PC Work station

SPACE TYPE - 2
ORGANIC EXTRACTION LABORATORY



ROOM DATA SHEETS

SPACE TYPE - 3

SPACE TYPE
Laboratory

AREA
990 Net Square Feet

SPACE NAME
Wet Chemistry Laboratory

ACTIVITY / PROGRAM NAME
Analytical Support Branch

OCCUPANCY
4-6 Persons

BUILDING SECTION
Block C

ADJACENCIES
This laboratory should be located next to the Instrumental Chemistry Laboratory and near the Glassware Preparation Area and in vicinity of the Metals Laboratories.

OPERATION / TASK DESCRIPTION
Analysis requiring drying, refluxing or distillation are conducted in this laboratory. BOD dilutions and set-up for titrations and colorimetric determinations. Field preservatives for sampling crews are made up; color reagents for instrumentation are made and laboratory is the general center of activity in support of the other laboratories.

LIST OF REQUIREMENTS

Ceiling
- 10' Acoustical Ceiling

Doors
- Double Doors 3' Active Plus 1' Equipment Leaf
- Single Door 3'-6" Wide (Standard Lab Door)

Flooring
- Sheet Vinyl

Walls
- Metal Stud & Drywall reinforced for Wall Hangings

Window Treatment
- Windows Required
- Standard Window Shades

Special Construction
- None required

Outfitting
- None required

Fixed Laboratory Equipment
- Metal Casework - "C" Frame
- (73) LF of Base Cabinets - 36" High
- (14) LF of Wall Cabinets - Glass Door
- (48) LF Adjustable Reagent Shelving - 2 Tier
- (4) LF of Tall Storage Cabinets - Glass Door
- Epoxy Top
- (2) 6' Fume Hood with Services
- (1) 10' Distillation Fume Hood (No Sash) with Services
- (4) Vented Solvent Storage Cabinet Below Hood
- (1) Vented OSHA Cabinet (30 Gallon)
- Lab Sink
- Cup Sink
- (6) Lab Desks with Bookshelves, Tackboards and File with Storage Cabinets

Mechanical Service
- Temperature and Humidity Control
- 100% Supply and Exhaust - 24 hour operation

Electrical Service
- 120V/20 Amp AC at Fume Hood
- 120V/20 Amp Receptacles 24" on Center in Raceway
- 208V/30 Amp-1 Phase, 4 Wire AC at Fume Hood
- Disconnect Switch at Door for 120/208V Lab Power
- Telephone
- Cable Tray
- Emergency Power
- Fluorescent Lighting - 100 Footcandles at 36" AFF
- Security
- Computer Outlets

Plumbing / Fire Protection

- Industrial Hot and Cold Water, Sink
- Industrial Cold Water, Cup Sink
- Deionized Water
- Lab Drain (Acid Waste)
- Compressed Air, 15 psi Serrated Connection
- Nitrogen Cylinder
- Lab Vacuum
- Water Sprinklers
- Dry Chemical and Carbon Dioxide Extinguisher in Safety Niches
- Eyewash At Main Sink
- Safety Shower/Eyewash Station

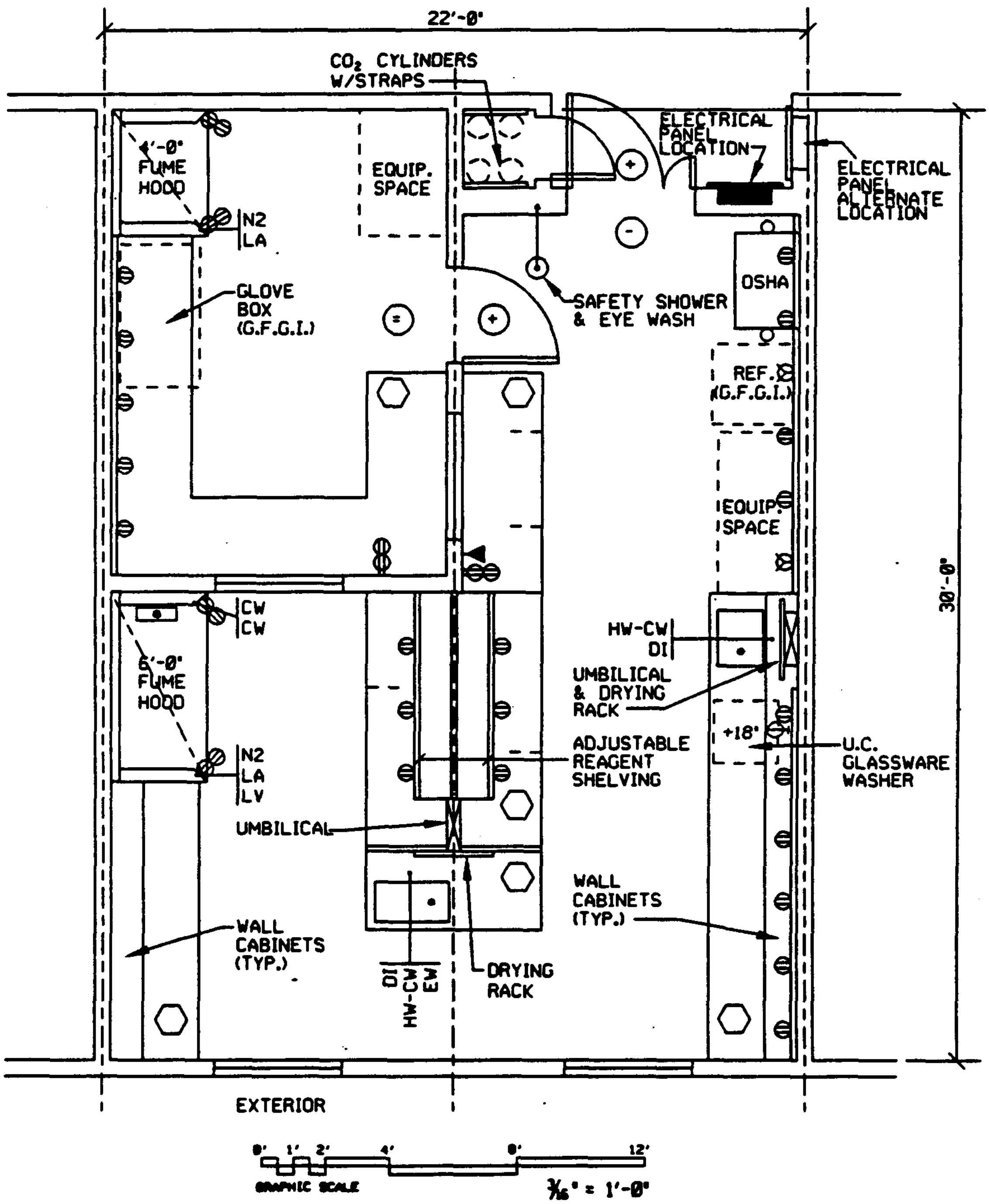
CHEMICALS USED IN THIS ROOM

This laboratory contains stock chemical storage cabinets and includes a broad range of chemicals and acids/alkali. Mineral salts, acids, phenol, pyridine, barbituric acid (color), indicator compounds, CFC's and other reagents. Chemicals are in concentrated form and may be in individual quantities of up to five pounds.

MOVABLE EQUIPMENT & FURNISHINGS

- (6) 2'-6" x 4'-0" Desk
- (6) Chairs
- (6) 2 - Drawer File Cabinet
- (2) Incubators
- UV/VIS Spectrometer
- (6) Distillation Heaters
- (2) pH Meters
- (2) DO Meters
- Millipore DI Water Polisher
- (2) Balances
- Drying Oven
- Drying Cabinet
- Muffle Furnace
- COD Heater (Reflux)
- Undercounter Glassware Washer

SPACE TYPE - 3
WET CHEMISTRY LABORATORY



ROOM DATA SHEETS

SPACE TYPE - 4

SPACE TYPE
Laboratory

AREA
660 Net Square Feet

SPACE NAME
Partial Containment Laboratory

ACTIVITY / PROGRAM NAME
Analytical Support Branch

OCCUPANCY
2-4 Persons

BUILDING SECTION
Block C

ADJACENCIES
This room should be located close to autoclave and shower facilities. The design of this room should consist of a "room-within-a-room" type arrangement.

OPERATION / TASK DESCRIPTION
This laboratory will be used to handle toxic and hazardous materials and will be designed to control all airborne and liquid effluent that may be generated in the room. Concentrated toxic and hazardous materials will be diluted to acceptable levels in the Containment Room glove box and fume hood and further analyzed thereafter in the Main Laboratory.

LIST OF REQUIREMENTS

Ceiling
- 10' Drywall Ceiling, Epoxy Painted

Doors
- Double Doors 3' Active Plus 1' Equipment Leaf
- Single Door 3'-6" Wide (Standard Lab Door)

Flooring
- Sheet Vinyl

Walls

- Metal Stud & Drywall reinforced for Wall Hangings
- Epoxy Paint

Window Treatment

- Windows Not Required

Special Construction

- HEPA/Charcoal Filtered Exhaust on separate Laboratory HVAC Exhaust System
- Entry to Containment Room through Main Laboratory

Outfitting

- None required

Fixed Laboratory Equipment

- Metal Casework - "C" Frame
- (68) LF of Base Cabinets - 36" High
- (7) LF of Base Cabinets - 30" High
- (21) LF of Wall Cabinets - Glass Door
- Epoxy Top
- (1) 6' Fume Hood with Services
- (1) 4' Fume Hood with Services
- (1) 5' Class III Safety Cabinet (Glovebox)
- Lab Sink
- Cup Sink
- (3) Solvent Storage Cabinet Below Hood

Mechanical Service

- Temperature and Humidity Control
- Fume Hood Exhaust
- 100% Supply and Exhaust (HEPA/Charcoal Filters)

Electrical Service

- 120V/20 Amp AC at Fume Hood
- 120V/20 Amp Receptacles 24" on Center in Raceway
- 208V/30 Amp - 1 Phase, 4 Wire AC at Fume Hood
- Telephone (Main Laboratory)
- Intercom (Between Main Lab & Containment Room)
- Emergency Power
- Fluorescent Lighting - 100 Footcandles at 36" AFF
- Security

Plumbing / Fire Protection

- Industrial Hot and Cold Water, Sink
- Industrial Cold Water, Cup Sink
- Deionized Water
- Lab Drain (Acid Waste)
- Compressed Air, 15 psi Serrated Connection
- Nitrogen Cylinder
- Lab Vacuum
- Water Sprinklers
- Dry Chemical and Carbon Dioxide Extinguisher in Safety Niches
- Eyewash at Main Sink
- Safety Shower/Eyewash Station

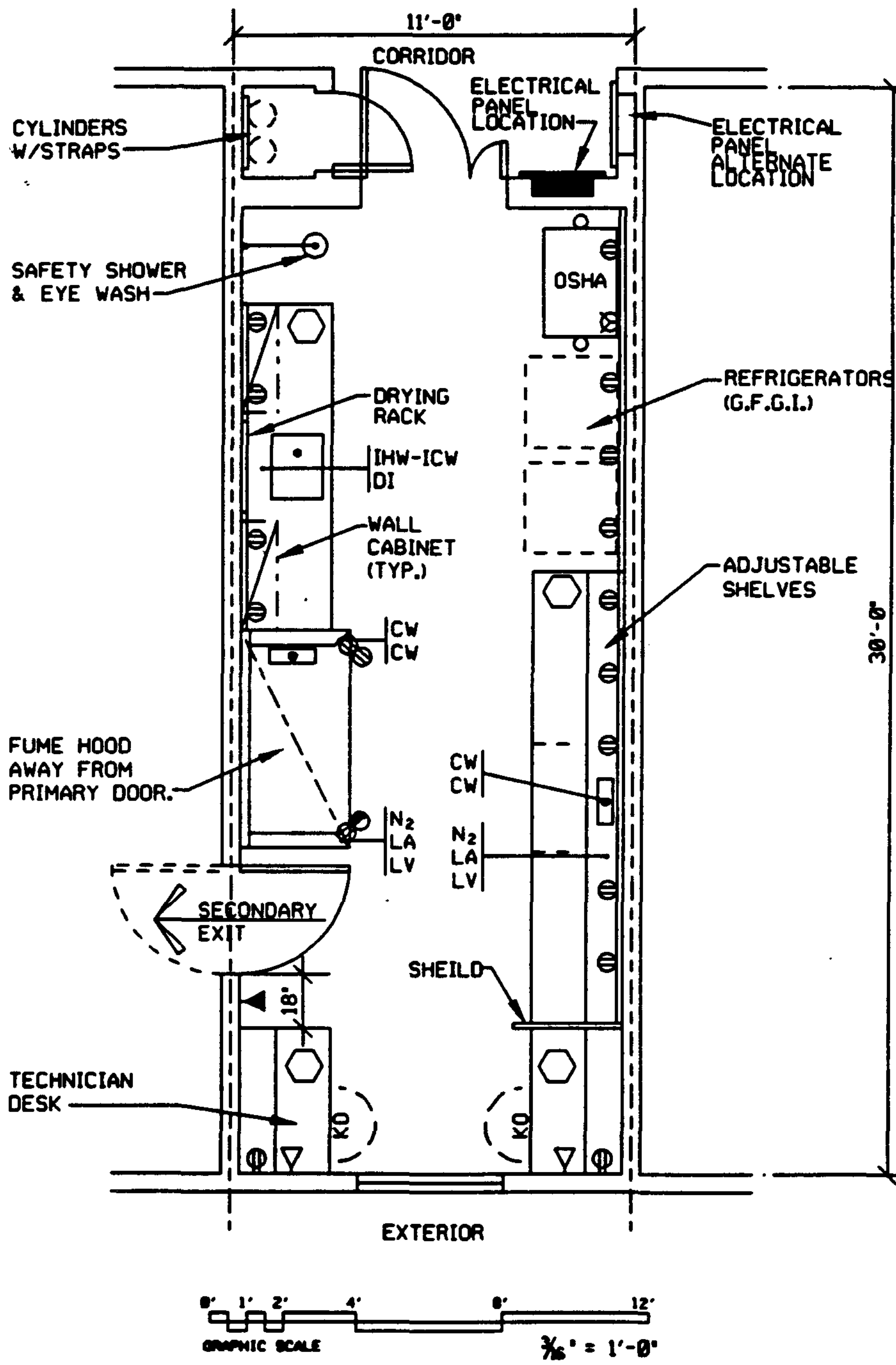
CHEMICALS USED IN THIS ROOM

A variety of organic solvents, acids, bases and analytical standards. Samples suspected of containing high concentrations of toxic and/or hazardous materials will be weighed out, extracted and prepared in this room.

MOVABLE EQUIPMENT & FURNISHINGS

- Drying Oven
- Analytical Balance
- EP Toxicity Tumbler
- (2) Hot Plates
- Soxhlet Extractor
- Undercounter Glassware Washer

SPACE TYPE - 4
PARTIAL CONTAINMENT LABORATORY



ROOM DATA SHEETS

SPACE TYPE - 5

SPACE TYPE
Preparation Laboratory

AREA
660 Net Square Feet

SPACE NAME
Glassware Preparation Area

ACTIVITY / PROGRAM NAME
Analytical Support Branch

OCCUPANCY
3-5 Persons

BUILDING SECTION
Block C

ADJACENCIES
This room should be close to the organic and metals preparation laboratories.

OPERATION / TASK DESCRIPTION
This area will serve as the central glassware washing and preparation area for all laboratory operations.

LIST OF REQUIREMENTS

Ceiling
- 10' Drywall Ceiling, Epoxy Painted

Doors
- Double Doors 3' Active Plus 1' Equipment Leaf

Flooring
- Ceramic Tile, Floor Drain

Walls
- Metal Stud & Drywall reinforced for Wall Hangings
- Ceramic Tile

Window Treatment
- Windows Not Required

Special Construction
- None Required

Outfitting
- None Required

Fixed Laboratory Equipment
- Stainless Steel Scullery with Double Bowl Sink
- (8) LF of Tall Storage Cabinets-Glass Door

Mechanical Service
- Temperature and Humidity Control
- 100% Supply and Exhaust - 24 hour operation

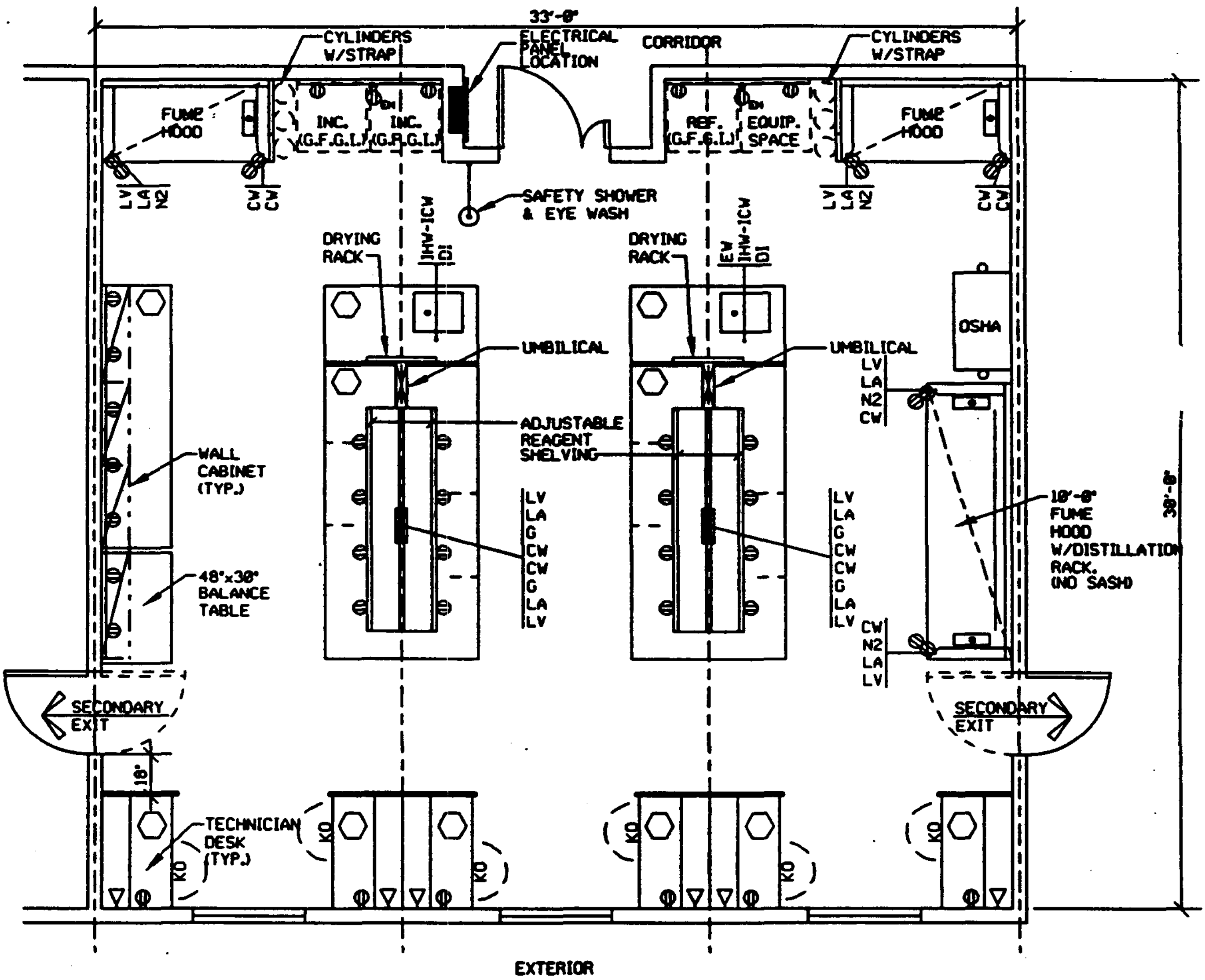
Electrical Service
- 120V/20 Amp AC Weather-proof Receptacles
- 220V AC
- Telephone
- Vapor-proof Fluorescent Lighting - 100 Footcandles at 36" AFF

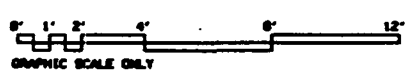
Plumbing / Fire Protection
- Industrial Hot and Cold Water, Sink
- Industrial Hot and Cold Water, Sink
- Low Pressure Steam
- Deionized Water
- Floor Drain
- Floor Sink (at Glassware Washer & Sterilizer)
- Lab Drain (Acid Waste)
- Water Sprinklers
- Dry Chemical and Carbon Dioxide Extinguisher in Safety Niches
- Eyewash At Main Sink

CHEMICALS USED IN THIS ROOM
The primary chemicals used in this area are: mineral acids (i.e., nitric acid, hydrochloric acid, sulfuric acid), dish washing detergents and acetone. These chemicals will be used in concentrated and diluted form. The form of chemical will be limited to not more than one gallon of each chemical.

MOVABLE EQUIPMENT & FURNISHINGS
- (2) Glassware Washer
- (2) Glassware Dryers
- (1) Sterilizer - 20" x 20" x 38" Chamber
- (1) High Temperature Drying Oven

SPACE TYPE - 5
GLASSWARE PREPARATION AREA





APPENDIX D

DESIGN GUIDELINES

APPENDIX D
DESIGN GUIDELINES

D.1 AMENITIES

Amenities in laboratory facilities are spaces and/or features that provide an enjoyable environment for staff and visitors. An amenity exceeds the minimum functional requirements established by the program and may include the following:

.1 Interaction spaces, lounges, and break areas should be strategically located to foster maximum interaction while being convenient to both offices and laboratories.

.2 Conference and meeting room spaces appropriate to the laboratory/office functions should be provided in close proximity to the laboratory. The meeting room spaces should be of various sizes and shapes to accommodate a wide range of conference needs. At least one of these conference rooms should be designed to accommodate teleconferencing.

.3 Lunch room facilities should be sized specifically to each facility. Quality design of food service areas, concession areas, and seating areas will contribute to an enhanced quality of life for the researchers. Refrigerator space needs to be integrated into coffee and vending areas to eliminate the temptation to store lunches in refrigerators within the laboratories. Consideration should be given to appropriate microwave and oven appliances. A "white board" for impromptu conversations should be considered.

.4 Toilets and lockers in close proximity to the laboratories and offices should be coordinated to provide maximum benefit to the staff. These facilities could be contiguous in most cases. Where appropriate the toilet/locker combination should accommodate a shower. The shower could satisfy staff after exercise and be used to stabilize a chemical accident victim prior to medical assistance.

.4.1 Attempt to locate lockers and toilets close to laboratories and offices in such a manner that clothing and valuables are easily accessible to the staff, precluding co-location of casework in the laboratory for personal items. Avoid placement of lockers in corridors.

.5 Space for an employee wellness center with appropriate facilities should be considered.

.6 Provide special attention to art work and/or photos and how they are to be integrated into the design. The solution should include an integrated design for the display of research materials throughout the laboratory. Displays should be easily, quickly, and inexpensively changeable.

.7 For reasons of safety, day or elder care facilities should not be included inside a laboratory facility.

D.2 AESTHETICS

Aesthetics refers to the nature of both the interior and exterior of the facility. Aesthetic considerations should include, but not be limited to the following:

.1 Contextural relationship of the adjacent buildings and environment. Color, texture and massing of building components should be investigated. Historical and contextural details should be considered.

.2 The landscape design shall integrate site and building into one concept.

.3 The sequence of access, entry and use of the building from the view point of both staff and visitor must be considered.

.4 The interior finishes must be integrated into a single concept for the entire facility. This shall include all visible materials.

.5 Consider accent and background colors with special attention to their psychological effect on people.

.6 Consideration shall be given to lighting from the view of both visual comfort and aesthetics. Visual Comfort Probability (VCP) for lighting fixtures should be a factor for selection. Consider accent, indirect , artwork and general lighting.

.7 Consider the introduction of natural light in the design. Consider methods to introduce natural light into the interior circulation spaces.

.8 Special aesthetic consideration should be given to all building entrance lobby spaces.

D.3 INTERACTION

Interaction of researchers is important in a research facility. There is a relationship between researcher interaction and the flow of technical information (Managing the Flow of Technology, Thomas Allen, 1977, 1984 , MIT Press). Incorporate appropriate interaction space where feasible.

D.3.1 DESIGN CONSIDERATIONS

Design considerations to promote researcher interaction shall include, but not be limited to, the following:

.1 Communication is a function of both organization and proximity. People communicate more if they work on a similar project or are in close proximity to each other. For weekly contact, it has been shown that communication drops off dramatically after 30 meters. It is desirable to cluster researchers in 30 meter diameter groups with shared facilities in between these research clusters.

.2 Building form has an influence on communication. Whenever possible, the researchers that need to communicate should be located in close proximity on the same floor. It has been shown that floor space less than 10,000 square meters (108,000 square feet) should be located on one floor if possible.

.3 The laboratory director shall be located strategically among his research staff. The director's office would best be located toward the center of the facility. From an interaction perspective, a corner office with the best view is not the best location for the director's office.

.4 Offices in a cluster may be a better form to promote communication and interaction among researchers. To minimize separation, a square configuration is desirable. Buildings that are arranged in odd shapes to provide everyone with an outside office view, often compromise researcher communication. Solutions that provide for both natural light and office clusters should be strongly considered.

.5 When offices are put near labs, the researchers located in these offices have a greater sense of territoriality than if offices are further away.

.6 Direct access should be provided to managers. Secretaries located directly outside the manager's door often inhibit a subordinate from initiating informal contact with that manager.

.7 Library space appropriate to the laboratory/office functions should be located strategically to promote researcher interaction and efficiency.

.8 Shared building facilities can be used as a tool to promote greater researcher communication. Place the shared facilities to provide maximum inter-group communication. Shared building facilities should be located by proximity and in locations which enhance the users ability to positively influence researcher interaction. Shared building facilities include, but are not limited to, the following:

.8.1 Washrooms
.8.2 Copy machine areas
.8.3 Coffee areas
.8.4 Computer rooms
.8.5 Secretarial and Message areas
.8.6 Computer printer terminals
.8.7 Instruction areas
.8.8 Lounges
.8.9 Special test equipment
.8.10 Libraries
.8.11 Conference rooms
.8.12 Supply rooms
.8.13 Food vending
.8.14 Common refrigerator
.8.15 Locker facilities

.8.16 Exercise facilities
.8.17 Day care facilities
.8.18 Elevators
.8.19 Stairs
.8.20 Reception
.8.21 Drinking fountains

D.4 COLOR
Color selection for building exterior and interior shall be responsive to the local environment, provide a favorable psychological effect on people and minimize maintenance.

D.4.1 SITE CONTEXTURALISM
Color of both building and landscape elements should complement the context environment.

D.4.1.1 LANDSCAPE MATERIAL
Concepts for the design shall include the color and texture of the landscape material, how it relates to existing vegetation, how accent colors are to be used, and how color changes throughout the year. Establish a concept or strategy for landscape material selection.

D.4.1.2 SITE AND BUILDINGS
Concepts for the design shall include the color, texture and details, and how they relate to the existing site and buildings. Establish the existing materials. New building materials shall relate to the existing materials. New details shall relate to the existing details in a coherent manner.

D.4.1.3 MAINTENANCE REQUIREMENTS
Color affects the maintenance requirements of buildings. Care should be exercised to take color and maintenance into consideration during the color selection process.

D.5 LABORATORY / OFFICE LOCATION
There are four basic locations of researcher offices related to the laboratories:

.1 Offices separate from laboratories.
.2 Grouped offices across the corridor from laboratories.
.3 Offices not grouped, but across the corridor from the laboratories.
.4 Offices not grouped but on the same side of the corridor as the laboratories.

D.5.1 ASSETS AND LIABILITIES
There are assets and liabilities for each design choice. The following questions shall be answered on a building by building basis. After the questions are answered, the designer needs to "test" various lab/office options with the users. The designer must keep in mind that clustered offices offer the greater potential for researcher interaction over offices lining the corridors.

.1 Do the offices require an exterior view, interior view or no view?
.2 What is the relationship of secretarial support relative to the offices?
.3 What is the proportion of offices to laboratories?
.4 What are the user needs and how does this affect office configuration and location?
.5 How are the laboratories to be configured?

.6 How should the offices relate to the laboratories?
.7 What are the sizes of the offices?
.8 Are there any special psychological influences regarding office location?
.9 Who will use the offices?
.10 Where will technicians be located?
.11 Is constant visual supervision over the laboratories required?

D.5.2 DESIGN CONSIDERATIONS
Design considerations to keep in mind while configuration is under design:

D.5.2.1 OFFICES SEPARATE FROM LABORATORIES

.1 Advantages:

.1.1 Noise or vibration to offices is minimized.

.1.2 Some offices may need to be separated from prime researchers to foster other administrative needs.

.1.3 In renovated building solutions, the close proximity of labs and offices may not be an option due to other factors.

.1.4 There is less researcher territoriality of labs if researchers are farther from their laboratories.

.1.5 Separate HVAC System allowing for recirculated air thereby reducing operational costs.

.2 Disadvantages:

.2.1 Longer circulation between offices and laboratories.

.2.3 Reduced researchers interaction unless offices are clustered.

D.5.2.2 OFFICES NOT GROUPED, BUT ACROSS THE CORRIDOR FROM THE LABORATORIES

.1 Advantages:

.1.1 Close office laboratory relationship reduces walking distance for researchers.

.1.2 Very efficient use of a double loaded corridor.

.1.3 Relatively easy to integrate this massing into an easy and efficient structural solution.

.1.4 Relatively contiguous building mass that will be more energy efficient than other solutions.

.2 Disadvantages:

.2.1 The advantages of clustering offices in terms of interaction is not possible.

.2.2 Exterior light normally does not penetrate wall to the corridor nor to the laboratories unless clerestory lighting is used.

.2.3 Promotes an uninteresting corridor environment.

.2.4 Promotes territoriality of laboratory space.

D.5.2.3 GROUPED OFFICES ACROSS THE CORRIDOR FROM LABORATORIES

.1 Advantages:

.1.1 Offices in relatively close proximity to laboratories.

.1.2 Outside light to offices, laboratories and corridors.

.1.3 This concept presents increased opportunity for researcher interaction.

.1.4 Offices are slightly removed from laboratories, thereby reducing noise and vibration to and from offices.

.1.5 Allows offices to be on separate HVAC system from the laboratories thereby reducing operational costs.

.2 Disadvantages:

.2.1 Does not provide for flexibility in reconfiguration of office space.

.2.2 The clustered office configuration significantly increases the exterior envelope of the building resulting in higher energy and construction costs.

D.5.2.4 OFFICES NOT GROUPED BUT ON THE SAME SIDE OF THE CORRIDOR AS THE LABORATORIES

.1 Advantages:

.1.1 Provides for close proximity to the laboratories which reduces walking time between offices and laboratories.

.1.2 Provides greater safety due to the almost constant supervision of the research laboratories.

.1.3 Promotes natural lighting to corridors since exterior is not lined with offices.

.2 Disadvantages:

.2.1 Office dimensions are more controlled by the laboratory module than other concepts.

.2.2 Because the office is between the corridor and the lab, this tends to reduce the amount of light available to the laboratory.

.2.3 Premium cost for office space in locations better allocated for laboratories or lab support.

.2.4 HVAC costs cannot be reduced as office space is on laboratory ventilation system.

D.6 LOCKERS AND SHOWERS

Lockers must be provided for both sexes. Each locker room can be designed as a separate element or integrated into a locker/toilet/shower group. There are some advantages to providing these functions in a coordinated group.

.1 Utilities are clustered for service to both toilet and shower areas.
.2 Duplicated functions in these areas can be eliminated.
.3 Close proximity provides for greater efficiency in use of facilities.

D.7 ENVIRONMENTALLY CONSCIOUS DESIGN

The Agency's objective is to foster environmentally conscious design in its facilities. To that end the design professional shall consider but not be limited to the following:

.1 Site planning that is environmentally based.

.2 Facility designs that reflect environmental as well as energy conscious concepts.

.3 Material selection based on low energy consumption both in the production as well as transportation to the site.

.4 Material selection based on using indigenous materials and to refrain from using ecologically sensitive materials.

.5 Material selection based on reducing hazardous chemicals within the buildings due to off gassing of the material.

.6 Material selection based on the products life cycle energy use.

.7 Ecologically sensitive use of water within the facilities.

.8 Sensitive use of HVAC components to reduce pollution, conserve energy and maintain the appropriate quality for the interior environment.

.9 Concepts that focus on recycling of materials.

D.8 OFFICE (ADMINISTRATION)

The administrative offices shall be designed considering the following factors :

D.8.1 CIRCULATION PATTERNS OF VISITOR GROUPS

If there are visitors expected at the facility, the design shall reflect not only tour groups, but all other visitors and their potential circulation patterns from the administration area to their destination point. Staging areas for tours should be anticipated.

D.8.2 CIRCULATION PATTERNS OF RESEARCH STAFF

Often, the placement of administration and administration support between research groups will foster intergroup interaction. Consider researchers interaction as a prime determinant for location of administration and administration support.

D.8.3 EFFICIENT ACCESS TO ADMINISTRATIVE SUPPORT AREAS

The use and control over administration support functions necessitates their close proximity to administrative offices, especially the resource center and meeting rooms.

D.8.4 SUPPORT SPACE FOR ADMINISTRATION OFFICES

The support space shall include, but not be limited to, the following:

- .1 Security Control / Reception
- .2 Conference Room
- .3 Teleconference Room
- .4 Storage
- .5 Copier
- .6 Coffee Area/Vending
- .7 Computer Access/Printer Output
- .8 Visitor Information Center

D.8.4.1 SECURITY CONTROL / RECEPTION

Security control shall be at the main entrance to the facility. The security control area shall have good visual control over the building entrance and lobby area. Administrative areas shall be in close proximity to the security control to provide reception function activities to support the security control staff.

D.8.4.2 CONFERENCE ROOM

Conference room areas must be sized in proportion to the number of staff and conference activities anticipated. In most building programs, conference room areas have been under programmed. The proper and adequate design of conference space for administrative areas and research areas reduces travel time and promotes interaction. "Satellite conference rooms" can also double as "satellite resource centers" for periodicals related to special laboratory groups.

.1 Conference areas that are centrally located for general administrative meetings are often designed to be subdivided with the use of folding sound resistant doors. A vending area and related seating area may be coordinated adjacent to the main conference area to provide a broader use of the conference area. When conference areas and food related areas are adjacent to one another, walls and doors need to provide adequate sound control.

D.8.4.3 TELECONFERENCE ROOM
The teleconference room shall be designed to the specific teleconferencing needs of the facility. Additional Issues to Resolve include:

.1 Number of participants anticipated
.2 Special lighting requirements
.3 Special acoustic requirements
.4 Acoustic isolation from adjacent spaces
.5 Storage requirements
.6 Control room requirements
.6.1 Define if a common control room for two conference rooms is required
.6.2 Define control room requirements
.6.3 Identify equipment requirements
.6.4 Is a control room even required

D.8.4.4 STORAGE
Storage areas adjacent to administrative offices are required to hold paper stock and miscellaneous equipment storage. Storage areas are often under programmed in facilities. Special attention shall be exercised regarding storage needs related to administrative conference space to hold extra supplies, (i.e., tables, chairs, overhead projectors, slide projectors, and easels).

D.8.4.5 COPIER
Copier area shall be provided in close proximity to administrative areas. It shall be located to promote researchers/staff interaction. Area shall be exhausted to the outside to provide adequate air quality. Adequate space adjacent to the copier is needed for proper storage, recycle paper bins, and collating or layout areas for sorting copies.

D.8.4.6 COFFEE / VENDING
A coffee/vending area shall be strategically located within short travel distance from the area serviced. The coffee/vending area should be located to promote communication and researcher interaction. Adequate area shall be provided for storage of various kinds of recycled products. Often coffee/vending areas are co-located with concession purchased items. Special attention is required to design concession areas to be designed for both functional use and good aesthetic design.

D.8.4.7 COMPUTER ACCESS / PRINTER OUTPUT
Computer areas including computer staff offices, paper storage and computer tape storage are often designed into a "computer suite". Often times, the "suite" will include printer output areas.

.1 The computer area shall be located as centrally as possible to reduce travel as well as wiring to computer terminals. The computer printer output areas are good interaction areas for researchers and should be located to promote interaction.

.2 Special care is required to design both floor loading and fire ratings for film and paper storage areas. Special fire protection consideration is required for the computer areas. A preaction fire protection system shall be a part of the fire protection analysis for these areas.

.3 Computer areas will probably have access flooring which may require accessible ramps (ADA compliance required) to these areas. Special acoustical consideration is required in computer and printer output areas. If a glass wall is used to view into the computer area, adequate attention shall be given to fire protection of this glass wall.

D.8.4.8 VISITOR INFORMATION CENTER
If the laboratory will be open to domestic and/or foreign visitors, a Visitor Center should be considered. A Visitor Center shall include, at a minimum, the following amenities:

1. Relaxation Area
2. Projection / Sound equipment
3. Large Screen T.V. with V.C.R.
4. Coffee Area

D.8.5 SIGNAGE
Provide coordinated and integrated signage in compliance with ADA requirements. The signage solution should encompass the following:

.1 Exterior facility signage

.2 Directory signage (lobby)

.3 Directional signage

.4 Room signage (integrate with safety information)

.5 Employment information

.6 Employee photo information

.7 Current event notices

.8 New publications display

.9 Position opening notices

D.9 LABORATORIES
The laboratory layout results from an in-depth analysis of research type, workflow patterns, and relationships to support spaces and other labs.

D.9.1 MODULE
A laboratory module is usually 11 feet in width and between 24 to 33 feet in length. Laboratories with heavy instrumentation requirements may require the wider module dimension due to equipment wire and service access.

D.9.2 DISTRIBUTION OF SERVICES

An important consideration for the laboratory design is the distribution of services on a modular basis within the laboratory. Special design attention shall be paid to location of structural members related to penetrations for services both along the walls and benches located in the center of the laboratory.

D.9.3 FUME HOOD PLACEMENT

Fume hood placement is important and shall be located away from egress and circulation patterns. A 5'-0" minimum aisle width shall be maintained in front of fume hoods. It is good design practice not to have "dead-end" circulation patterns that may trap an individual in case of a laboratory accident. Two means of egress from a laboratory with any fume hood is required. Refer to Chapter 5, paragraph 13.c.(3) of the latest edition of the Facility Safety Manual for additional requirements.

D.9.4 EYEWASH AND SAFETY SHOWER

Eyewash and safety shower placement is important. A good location for both safety items is at the hinge side of the egress laboratory door out of the path of travel. A fire extinguisher location in the laboratory is preferable. Refer to Chapter 7, paragraph 12 of the latest edition of the Facility Safety Manual for additional requirements.

D.9.4.1 SAFETY SHOWER

Safety showers shall be located in a position away from the face of a hood; if a hood accident occurs, staff will be able to use the safety shower facility.

D.9.5 ELECTRICAL PANEL/FIRE EXTINGUISHER

The electrical panel to "shut down" the laboratory may be located outside of the laboratory; if an accident occurs, researchers may exit the lab and "shut it down" from the outside. It is good practice to locate a fire extinguisher in the corridor outside the laboratory in addition to those located within the laboratory.

D.9.6 SIGNAGE

The laboratory signage should contain the room number, room name, occupants by name, hazardous chemicals within the laboratory, emergency telephone number and special procedures in case of emergency. Provide coordinated and integrated signage in compliance with ADA requirements. The signage solution should encompass the following:

- .1 Directional signage
- .2 Room signage (integrate with safety information)
- .3 Special chemical information for each space containing hazardous chemicals
- .4 Employment information
- .5 Employee photo information
- .6 Current event notices
- .7 New publications display
- .8 Position opening notices

D.9.7 DOORS
The laboratory doors shall swing in the direction of egress from the laboratory. The laboratory door consists of a 3'-0" active leaf and a 1'-0" inactive leaf to facilitate movement of equipment into the laboratory.

D.9.8 HVAC DIFFUSERS
HVAC diffusers shall be located so they do not "short circuit" the air flow to a hood.

D.9.9 WALLS
Laboratory walls shall be considered for extra structural reinforcing due to the potential loads they may support due to shelving or cabinets. This consideration shall include future modifications to the room layout and additional shelving or cabinet requirements.

D.9.10 LABORATORY SUPPORT
Laboratory support space shall suit the needs of the specific laboratory. In some cases, a service corridor is used for laboratory support. In some cases, special support spaces are needed between laboratories.

D.9.11 LABORATORY TECHNICIAN
It is desirable to provide work space for technicians outside of the laboratories in order to reduce their exposure to the laboratory chemicals. There is also a need to provide some work space in the laboratory for laboratory related work. Ideally, both requirements can be met to provide the greatest productivity to technicians within the most healthful environment possible.

D.10 LIBRARY
The library shall be located with good access to storage, services elevator and conference facilities. Additional issues are as follows:

.1 Identify type of library storage.
.2 Identify computer terminals required.
.3 Identify study carrels required.
.4 Identify work space required.
.5 Floor loading/structural requirements.

D.11 OUTSIDE RESEARCH FACILITIES
Any outside related research space shall be constructed and designed of a quality in keeping with the research complex environment.

D.11.1 EXTERIOR SPACES
The exterior spaces on the property shall be adequately secured to eliminate the potential for unauthorized individuals gaining access to the property. Potentially hazardous or accident prone exterior areas shall be secured by adequate perimeter security.

D.12 CUSTODIAL SPACE
Custodial space shall be strategically located on each floor for efficient maintenance with adequate storage space for cleaning equipment and supplies. Besides the custodial space located on each floor, a central custodial office, locker rooms and storage space shall be considered during the early phases of design. This area shall be located in close proximity to other building services areas.

D.12.1 SHOP FACILITIES
Shop facilities shall be located with exterior access appropriate to their function. The shop facilities shall be remotely located from vibration, noise, or dust sensitive areas.

D.12.2 OVERHEAD HOISTS
Overhead hoist requirements shall be defined early in the programming and design phases.

D.12.3 WELDING
Welding areas shall be designed to meet all code requirements.

D.13 LOADING DOCK / STAGING
Appropriate loading dock/staging facilities are required relative to the size, function and material requirements of each laboratory.

D.13.1 LOADING DOCK SIZE AND REQUIREMENTS
The truck turning radius to loading facilities should be appropriate to the truck size anticipated. The loading dock might include a leveling device for accommodating different size trucks. A covered loading/unloading area is desirable.

D.13.2 HVAC INTAKE
Special care shall be exercised not to locate mechanical air intakes toward the loading dock area. Idling trucks located in loading dock areas may cause contamination of intake air.

D.13.3 VIDEO MONITORING
The loading dock area shall be considered for video monitoring for security purposes. Issues to resolve are as follows:

.1 Nitrogen storage requirements and location; note security fence requirements
.2 Breakout area size
.3 Bulk mail process defined
.4 Access for emergency vehicle and ramps
.5 Truck parameters (dock height, leveler requirements)
.6 Security requirements
.7 Concrete paving for loading dock area
.8 Define dumpster and compaction requirements

D.14 CHEMICAL STORAGE

The chemical storage area location shall be researched related to the quantity and type of chemicals stored. Chemical storage and gas cylinder storage may be located in close proximity. Special code consideration shall be taken to provide adequate fire protection and separation. Special consideration shall be given to contaminated chemicals and contaminated fire protection water. The response time of the fire department is a factor that shall be considered. Special attention shall be paid to explosion relief panels and their location and safety. Refer to NFPA 30 and 45, Chapter 7 for additional requirements.

D.14.1 ADDITIONAL ISSUES TO RESOLVE:

.1 Type of chemicals to be stored
.2 Quantity of chemicals to be stored
.3 Dispensing procedures
.4 Explosion relief panel requirements
.5 Fire rating separation requirements
.6 Building code requirements
.7 Zoning requirements
.8 Government agency requirements
.9 State agency requirements
.10 Agency having jurisdiction
.11 Safety officers for facility
.12 Local fire marshal

D.15 RECYCLING / WASTE HANDLING

Recycling design considerations are important and must be considered at the early programming and design phases. Recycling receptacles must be sized and adequate space provided on each floor and in the central loading area. Special attention is also required in vending locations for various types of recyclables. Waste handling in laboratories with animal research requires special consideration at the early program and design stages. At early program and design, identify the type and size of facilities anticipated for waste storage, waste compaction and waste removal.

D.16 GENERAL STORAGE

General storage is usually required on every floor. General storage facilities are the most typically forgotten or undersized spaces in EPA research facilities. In government research facilities, where it is difficult to resolve equipment disposition, adequate storage space is critical.

D.16.1 ADDITIONAL ISSUES TO RESOLVE:

.1 Good access to service elevator
.2 Size rooms with freezers relative to freezer dimensions and layout
.3 Check corridors for movement of equipment
.4 Resolve signal runs to central control area as required by program

D.17 FOOD SERVICE

Food service must be located with good access to the loading dock and service elevator. The food service shall be as centrally located as possible with an exterior view if possible.

D.17.1 ADDITIONAL ISSUES TO RESOLVE:

.1 Identify quantity of seating required
.2 Identify type of food service to be provided
.3 Identify secondary uses of food service spaces

D.18 EMERGENCY GENERATOR LOCATION

D.18.1 LOCATION PARAMETERS:

.1 Locate with fresh air intakes
.2 Locate with exhaust, away from fresh air intakes
.3 Locate away from vibration, acoustic, or electrically sensitive equipment

D.18.2 ADDITIONAL ISSUES TO RESOLVE:

.1 Identify size and shape of room, including usable space around generator
.2 Identify fuel supply and location (note code and environmental requirements)
.3 If located outside, determine the screening parameters of such equipment
.4 Exhaust requirements

D.19 FLOOR LOADINGS

The design professional must secure any special requirements for floor loading from the Project Officer with the understanding that building codes, local codes, and agencies having jurisdiction regulate these requirements. Analysis in the early planning stages of a project is required to establish the loadings for specific pieces of equipment since these equipment loads may exceed the design floor loads. The timing and sequencing that the equipment is placed into the building must be considered; this will affect the design or construction phasing. The travel path of the equipment into the building must also be considered. The most stringent floor loading requirements shall govern.

D.20 PARKING

Parking and its related circulation shall be separated from the service circulation to minimize conflicts.

D.20.1 GENERAL RULES / LOCAL CODE

Parking at EPA facilities varies with the function of the facility. Some facilities range from approximately 19 to 24 cars per 10,000 gross square feet of building. These ranges tend to have parking problems. As a general rule, parking requirements shall follow local codes. If the parking falls under 25 cars per 10,000 gross square feet of the facility, a more detailed analysis shall be made to verify adequate parking is provided. If local codes require more parking spaces, the more stringent requirements shall apply.

D.21 FIRE DEPARTMENT ACCESS

Fire access to buildings is very important. In designing buildings, and fire access to them, assure that the fire access road is far enough away from the building (road to be at least 20' in width with the edge of the road at least 10'-0" from building as per NFPA 1) such that the distance will not hamper fire fighting. Dead-end roadways for fire fighting vehicles shall not be allowed.

D.21.1 HIGH RISE BUILDINGS

For high rise buildings, special attention to fire fighting apparatus areas is required. A fire control room inside the building is required.

D.21.2 AUTHORITY HAVING JURISDICTION

In conjunction with local and EPA requirements, the local fire marshal shall be consulted to address and resolve any of his special concerns.

D.21.3 ELEVATORS AND FIRE VICTIMS

Special attention shall be provided to the elevator/service elevator design and its function in a fire fighting mode. Special consideration shall be given to the removal of fire victims from the building.

END OF SECTION

APPENDIX E

ABBREVIATIONS AND ACRONYMS

APPENDIX E

ABBREVIATIONS AND ACRONYMS

ABS	**Acrylonitrile-Butadiene-Styrenne**
AC	**Alternating Current**
ACMD	**Atmospheric Characterization and Modeling Division**
ADP	**Automated Data Processing**
ADPI	**Air Distribution Performance Index**
AEERL	**Air and Energy Engineering Research Laboratory**
AHU	**Air Handling Unit**
AQMD	**Air Quality Management Division**
AREA	**American Railway Engineering Association**
AREAL	**Atmospheric Research and Exposure Assessment Laboratory**
AT&T	**American Telephone and Telegraph Company**
AWG	**American Wire Gage**
BAS	**Building Automation System**
bhp	**brake horse power**
BTU	**British Thermal Unit**
C-Frame	**Cantilevered Frame**
CADD	**Computer Aided Drafting Design**
CCTV	**Closed Circuit Television**
CERLLA	**Comprehensive Environmental Response**
CFCs	**Chloroflurocarbon Compounds**
CFM	**Cubic Feet Per Minute**
CMD	**Contracts Management Division**
CMU	**Concrete masonry unit**
CPVC	**Chlorinated Polyvinyl Chloride**
CVTS	**Cabled Video Teleconference Space**

dB	**decibels**
db	**dry bulb**
DC	**Direct Current**
DDC	**Direct Digital Controls**
DI	**Deionized Water**
DOP	**Dioctyl Phthcelate**
DTD	**Developmental Toxicology Division**
e.g.	**for example**
EA	**Environmental Assessment**
ECAO	**Environmental Criteria and Assessment Office**
EERD	**Ecosystem Exposure Research Division**
EIS	**Environmental Impact Statement**
EM	**Engineering Memorandum**
EMS	**Energy Management System**
EMT	**Electrical Metallic Tubing**
EPAB	**Engineering, Planning and Architecture Branch**
ESD	**Emission Standards Division**
etc.	**et cetera, and other unspecified items of the same class**
ETD	**Environmental Toxicology Division**
FC	**Footcandles**
FFL	**Carpet pill test**
FGCC	**Federal Geodetic Control Committee**
FM	**Factory Mutual**
FMSD	**Facilities Management and Services Division**
FMSD-C	**Facilities Management and Services Division - Common Facilities**
FMSD-O	**Facilities Management and Services Division - Office Facilities**
FPM	**feet per minute**
GCMS	**Gas Chromatograph/Mass Spectrometer**
GDHS	**Geometric Design of Highways and Streets**

GECD	**Global Emission and Control Division**	**HTW**	**High Temp Water**
GPS	**Globaling Positioning System**	**HVAC**	**Heating, Ventilating and Air Conditioning**
GTD	**Genetic Toxicology Division**	**i.e.**	**that is**
HCFC	**Hydrochloroflurocarbons**	**IAQ**	**Indoor Air Quality**
HD	**Heavy Duty**	**IBM**	**International Business Machine**
HEFRD	**Human Exposure and Field Research Division**	**ID**	**Inside Diameter**
HEPA	**High Efficiency Particulate Air**	**"K" Rated**	**Transformers specially constructed for use with non-linear loads**
HERL	**Health Effects Research Laboratory**	**kv**	**Kilovolt**
HFC	**Hydroflurocarbons**	**kva**	**kilovolt - ampere**
HID	**High Intensity Discharge**	**KWD**	**Kilowatt Demand**
HMSF	**Hazardous Materials Waste Storage Facility**	**KWH**	**Kilowatt Hours**
hp	**horsepower**	**Lab**	**Laboratory**
HP	**High Pressure**	**LAN**	**Local Area Network**
HPLC	**High Plasma Liquid Chromatograph**	**LCC**	**Life Cycle Cost**
HRMD	**Human Resources Management Division**	**LCCA**	**Life Cycle Cost Analysis**

low E glass	low emissivity glass
MDF	Main Distribution Frame
MEF	Main Entrance Frame
MIL-F	Military Federal Specification
MRDD	Methods Research and Development Division
MSDS	Manufacturer's Safety Data Sheets
N Value	Number of blows per lineal foot
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NAVD	North American Vertical Datum
NC	Noise Criteria
NCF	Network Control Facility
NCPD	National Contracts Payment Division
NDPD	National Data Processing Division
NEBB	National Environmental Balancing Bureau
NEMA KS1.1	Safety Guidelines for the Application Installation and Maintenance of Solid State Control
NEPA	National Environmental Policy Act
NGVD	Navigible Ground Vertical Datum
No.	Number
NRC	Noise Reduction Coefficient
NTD	Neurotoxicology Division
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
OARM	Office of Administration and Resources Management
OD	Office of the Director
OD	Outside Diameter
ODF	Ozone Depletion Factor
ORD	Office of Research and Development
OSA	Outside Air Ventilation Systems

OSORD	**Office of the Senior Official for Research and Development**
PB	**Polybutylene**
PBX	**Private Branch Exchange**
PCD	**Pollution Control Division**
PCI-MNL	**Precast Concrete Institute Manual**
PDU	**Power Distribution Unit**
ph	**phase**
pH	**potential of Hydrogen, measure of the acidity or alkalinity of a solution**
plf	**pounds per lineal foot**
POR	**Program of Requirements**
psf	**pounds per square foot**
psig	**Pounds Per Square Inch Gage**
PURPA	**Public Utility Regulatory Policies Act**
PVC	**Poly Vinyl Chloride**
QATSD	**Quality Assurance and Technical Support Division**
R (values)	**Thermal Resistance**
RCRA	**Resource Conservation and Recovery Act**
RG59	**Cable Model Number**
RJ11	**Cable Model Number**
RJ45	**Cable Model Number**
RSD	**Research Support Division**
RTECS	**Registry of Toxic Effects of Chemical Substances**
SDR-PR	**Standard Dimension Ratio - Pressure Rated**
SDWA	**Safe Drinking Water Act**
SFO	**Solicitation for Offers**
SHEMD	**Safety, Health and Environmental Management Division**
STC	**Sound Transmission Class**
STL	**Sound Transmission Loss**
TC	**Telecommunication Closet**
Telco / Data	**Telecommunications / Data**

TM	Technical Memorandum
TSD	Technical Support Division
TV	Television
Type K	Type of Pipe
Type L	Type of Pipe
U-factor	a coeficient of heat loss
U.S.	United States
UPS	Uninterruplible Power Supply
USA	United States of America
UTP	Unshielded Twisted Pair
VAV	Variable Air Volume
VCP	Visual Comfort Probability
VCR	Video Cassette Recorder
wb	wet bulb
°C	Degrees Celecius
°F db	Degrees Farenheit dry bulb
°F	Degrees Farenheit