300 AREA REPLACEMENT FACILITIES

PROJECT DESIGN CRITERIA

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1.0 PROGRAM

1.1 INTRODUCTION

PNNL will be consolidating multi-functional research capabilities that are currently located in the 300 area of the Hanford Site. New replacement facilities, as currently envisioned, total approximately 500,000 gross square feet. These facilities will house, office, research and laboratory functions. To accomplish the transition out of the 300 Area without interrupting ongoing departmental and national mission-based research programs will require that PNNL research capabilities be relocated. The summary level objectives of this Project are as follows:

1. Create cost effective new replacement facilities that meet or exceed the intent of PNNL's vision for DOE, the local and regional community and for the nation.
2. Complete a seamless transition of research staff and equipment from the 300 Area into the new facilities in a manner that enables accelerated cleanup.
3. Minimize the impact to programmatic research in support of DOE and other governmental and commercial clients during the creation of replacement facilities and associated transition or divestiture of the 300 Area.
4. Manage projects with safety as the first priority, and to meet all environmental safety, health and security requirements.

The facilities shall be designed to maximize efficiency while providing the required spaces along with the necessary circulation and services to support the use and operation of the building. The laboratories will represent a significant portion of PNNL capabilities. As such, it is important that each facility's infrastructure be designed with the following goals in mind.

1. Occupancy: The normal occupancy of the building shall be from 6:00 am to 6:00 pm on normal business days. Laboratories and offices will be used beyond normal work hours and on weekends depending on the work assignments of the occupants.
2. Routine Maintenance: Maintenance activities must be done without affecting computer and laboratory experimental operations. The building and systems shall be designed so the critical systems (power, laboratory supply and exhaust, heating, cooling, fire protection, security, networks) downtime is minimized.
3. Integration: The building subsystems must be constructed in such a way as to facilitate operating computer systems, laboratory supply and exhaust, and experimental equipment. The entire infrastructure must be capable of being monitored and controlled from multiple locations.

4. Flexibility: During the life of the building, the mission of the occupants could change and the building is to be designed to be flexible with minor changes to office partitions and laboratory arrangements expected. It is impossible to foresee all possibilities. Therefore, flexibility shall be designed into the use of all the spaces.

1.2 LOCATION

The majority of the facilities are envisioned to be located in an area north of Horn Rapids Road, which is a recent expansion of the PNNL campus. The PDT will also explore facilities on the existing PNNL campus as well. This area north of Horn Rapids Road is referred to as the Horn Rapids Triangle This property was recently transitioned from DOE Environmental Management to DOE Office of Science to support this project. This area is bounded by Stevens Drive on the west, Horn Rapids Road on the south, and George Washington Way on the north and east. This area is the proposed area of development for this project.

1.3 MASTER PLANNING

The purpose of the PNNL Richland master plan update is to state the development and improvement strategy that will progressively transform the existing campus into an exceptional working environment that is reflective of PNNL's signature capabilities and corporate values. The master plan update will build upon the master planning work, completed in 2002, to include the Horn Rapids Triangle. The goal of this portion of the project is to deliver an overall master plan which will provide a consistent, integrated and sustainable vision for the existing Battelle campus including the proposed area of development. The expected growth of PNNL is an opportunity to provide a cohesive, unified campus that maintains a coexistence of natural features and manmade landscape, enhances efficient and safe site circulation and implements thoughtful building placement within the natural environment. This master plan update is intended to build on, focus and further articulate the campus development options and issues identified in the master plan developed in 2002. Specifically, this update will further develop the following issues:

1. Provide site location criteria for the placement of future facilities.
2. Determine campus layout options that will specifically address the 300 Area transition.
3. Determine campus layout to address PNNL's growth agenda.
4. Integrate with Richland Research Park planning activities.

The following goals are intended to provide a cohesive guideline to the growth expectations at PNNL. The intention is to manage growth with a comprehensive plan to encourage campus unity, order and sustainability.

1. Create a campus that enables world-class science and engineering and its translation to solutions.
2. Provide academic campus qualities.
3. Mediate coexistence of pedestrian and vehicular traffic.
4. Encourage synergies between work environments to optimize research processes, relationships and interactions.
5. Create a campus that is the physical embodiment of PNNL's research and development capabilities and aspirations.
6. Enhance the general efficiency of the campus regarding operations and maintenance.
7. Manage distance between buildings to encourage staff interaction and multi-disciplinary work teams.
8. Provide sustainable landscape that is consistent with the local environment
9. Provide a safe, secure, healthy work environment that encourages employee satisfaction, productivity and retention.
10. Minimize risk and maximize value to PNNL, DOE and the community.

A conceptual master site plan was developed for the new replacement facilities to be located in the Horn Rapids Triangle. This conceptual plan provided the framework for a conceptual design for the proposed utilities in this area. It is envisioned that this master plan will not only look at the conceptual site planning but also study this utility project design and provide alternatives for delivering a truly integrated sustainable infrastructure that will allow maximization of sustainable alternatives for the conceptual design of these new facilities.

The conceptual site planning incorporated many of the goals and objectives stated thus far; as well the design tried to incorporate maximum flexibility for the use of the land in order to implement various funding mechanisms, land ownership and various facility deliver schedules. The master plan update should provide the criteria necessary to implement the near term goals of the master plan and allow for flexibility for future growth.

1.4 ENERGY AND SUSTAINABILITY

PNNL is committed to incorporating sustainability into its facilities. Sustainability includes the balance of environmental (including energy), economic and quality of life considerations. Each facility shall incorporate sustainable design principles.

A. Sustainability

1. Office Space - The interior of the building shall provide flexible reconfiguring by basing location of partitions, location and

distribution of power/communication/data upon a standard building module.

2. Each building form, selection of materials, development of the site and engineering design and procurement activities shall follow sustainable design principles. The goals shall be as presented in the following Executive Orders:
   a. Executive Order 13123 – Greening the Government Through Efficient Energy Management, @ http://www.archives.gov/federal_register/executive_orders/1999.html.
   b. Executive Order 13148 – Greening the Government Through Leadership in Environmental Management, @ http://www.archives.gov/federal_register/executive_orders/2000.html.
3. LEED™
   a. The building shall be accredited in accordance with the U.S. Green Building Council's (USGBC) Green Building Rating System Criteria, Leadership in Energy and Environmental Design (LEED™), for a LEED™ Certified Green Building. During conceptual, the level at which the facilities will be designed will be determined.
   b. The Laboratories for the 21st Century (Labs 21) program builds on the LEED approach but specifically addresses issues that are unique to laboratories. See http://www.labs21century.gov. This program has developed a draft LEED for Laboratories standard which provides guidance for designing a green laboratory by adding additional LEED credits.
4. Environmentally preferable construction materials, as designated by the U.S. Environmental Protection Agency (EPA), shall be purchased for the construction and operation of each facility where cost effective, quality is not compromised, and materials are available.

B. Energy Efficient Designs
1. As a minimum, each building's energy performance shall be designed to exceed the requirements of the 2001 Washington State Energy Code by 40%.
2. Central Plant Concept - A central physical plant concept shall be used to house the cooling system, heating system, electrical services, etc. for all the buildings.
3. Product Energy Efficiencies
   a. Products requiring energy and water usage shall provide as a minimum, the recommended level of energy efficiencies

specified in the 2001 Washington State Energy Code (will be revised and effective July 1, 2005) or at the Federal Energy Management Program's (FEMP) web site: http://www.eren.doe.gov/femp/procurement/begin.html whichever is more stringent.

4. A whole building design approach that considers the interactions of siting, architecture, envelope, glazing, lighting, and properly sized HVAC equipment, shall be used.

5. The HVAC system shall be correctly sized, and part load performance shall be considered when selecting the equipment. Modular future expansion of equipment capacity while providing oversized air/water distribution systems shall be provided.

6. HVAC systems shall reuse energy first, utilize renewable energy next, and only if additional energy is needed should equipment using non-renewable fossil fuels be used and only in the most efficient overall approach. Utilizing adsorption chillers powered from waste heat is preferable to using electrically driven chillers.

7. A life cycle cost analysis (LCCA) shall be performed for each facility's systems and equipment utilizing a software program such as BLCC or equivalent and using a whole building simulation model (DOE-2 or equivalent) to calculate the energy budgets and cost inputs for the various LCCA scenarios.

   a. Strategies such as heat and cool recovery using heat pipes, heat wheels, heat reclaim type chillers shall be considered; utilizing air and water economizers shall be considered; using renewable sources such as geothermal ground or water source heat pumps, passive and/or active solar, (for both heating/cooling and hot water), photovoltaic cells, natural lighting or day-lighting with advanced lighting controls shall be considered; variable air volume systems, "oversized" and sealed ductwork to minimize fan static pressure, temperature setbacks, and combined heating/cooling/power systems such as micro turbines/fuel cells, adsorption chillers, etc., for energy and cost savings where LCC effective shall be considered.

   b. The DOE-2 or equivalent simulations shall be part of the design. The simulation shall also be updated to reflect the actual equipment and operating scenarios at the conclusion of construction. This simulation shall then be used as part of the ongoing energy commissioning during the life of the facility.

C. Energy Star Label

1. Energy efficiency in the design and operation of each facility shall be measured using the EPA's Energy Star labeling procedure for the office and non-process portion of the facility.
2. The office portions of the each facility shall be designed and operated to achieve a benchmark score of 75 or higher in order to receive the Energy Star Label.
3. Sub-metering shall be installed to adequately document the energy use of the office portions of each facility separately from the laboratories and high performance computing area (if required). Appliances and building equipment shall be purchased with an Energy Star label, when available.

1.5 CODES AND STANDARDS

Design, construction, and operation of each facility shall be in accordance with the 2003 International Building Code, the City of Richland WA. Municipal Code, the 2001 Washington State Energy Code, and other codes and standards adopted by the City of Richland.

A. Richland Municipal Code (only applicable to private funded facilities, see AHJ) .
B. International Building Code w/ WAC title 51.
C. Uniform Plumbing Code
D. International Mechanical Code
E. WAC Title 296 Electrical Cod
F. State of Washington Non-Residential Energy Code
G. National Fire Codes.
H. Factory Mutual Approval Guide.
I. Underwriters Laboratory Listing Directories or other nationally recognized independent testing agency.
J. DOE Handbook – Nuclear Air Cleaning Handbook.
K. Requirements shall be based on the codes and standards in effect at the time the facility is designed, which establish the Codes of Record.

1.6 AUTHORITY HAVING JURISDICTION

A. Authority Having Jurisdiction (AHJ)
   1. Privately funded facilities: City of Richland.
   2. Federally funded facilities: PNNL

1.7 RESTRICTIONS

A. Material or components containing asbestos, polychlorinated biphenyl (PCB), CFCs, HCFCs, lead, carcinogens and Halon shall not be utilized in

any portion of the design or construction. Space shall be free from hazardous materials, including environmental tobacco smoke (ETS), according to applicable Federal, state, and local environmental regulations.

2.0 SITE

2.1 SITE CRITERIA

A. The site development and orientation of the buildings shall be designed to maximize the functional relationship between the new and the existing research activities while minimizing their energy use. The design shall provide pedestrian circulation between buildings and parking. In addition, site development shall include provisions that anticipate the future of the undeveloped land adjacent to the site.

B. The organization of the site, including interface with parking areas and walkways, shall include provisions to anticipate how it might influence future development.

C. Service vehicle access shall be provided throughout the campus in an inconspicuous manner that minimizes vehicular access impact.

D. The site design shall facilitate interaction within the campus and encourage pedestrian activity.

2.2 TRAFFIC

A. Pedestrian Traffic

1. The primary access to each facility shall be from a main pedestrian circulation system.
2. The pedestrian circulation system shall connect each new facility, as well as, providing a connection to the existing campus.
3. Sidewalks shall be provided to connect the main parking lots and each facility. Sidewalks shall also connect main parking and the pedestrian system.

B. Vehicle Traffic

1. Vehicle access systems shall be addressed to minimize the visual impact.
2. Vehicle access to each building shall be limited to service-and delivery vehicles with controlled access to each buildings' loading dock.
3. The design shall locate the service roads so that they have a minimal impact on pedestrian traffic. Utilizing properly designed sidewalks for emergency vehicle access.
4. Emergency vehicle access shall be provided in accordance with fire code requirements. Special access lanes shall be provided between buildings where roads are not installed.

5. A visitor-loading zone shall be provided within easy access of the main entrance.
6. Bicycle parking shall be included near each building's main entrance and other entrances and appropriate.

2.3 UTILITIES

A. Irrigation
1. Irrigation water shall be provided from the City of Richland or the existing PNNL pump station.
2. A recording (quantity and rate) meter shall be installed on the irrigation line to each facility site.
3. Alternatives to standard irrigation such as moisture sensing, weather based, root level or direct/drip irrigation technologies shall be used to manage irrigation water use.

B. Gas (Utility owner: Cascade Natural Gas)
1. An industrial gas meter shall be provided at each facility service entrance which shall be monitored by the Building Management System (BMS).

C. Sanitary Water (Utility owner: City of Richland)
1. An industrial water meter shall be provided at each facility service entrance which shall be monitored by the BMS.
2. A reduced pressure type backflow preventer shall be installed at branch lines supplying process or other water systems.
3. The system shall be designed to prevent cross connections between potable water and all other systems, either liquid or gas.
4. Fire protection water supply – see Section 7.0 Fire Protection for requirements.

D. Sanitary Sewer (Utility owner: City of Richland)
1. The sanitary sewer shall be extended to sanitary sewer system from the nearest manhole.
2. The sewer line is to be laid at as low a slope as possible to allow future development to gravity drain to the manhole.

E. Process Waste

See Section 6.0.

F. Storm Sewer
1. The site shall be graded for the appropriate building floor level, parking areas, and to control runoff.
2. New parking areas shall be graded to prevent standing water, and storm water shall be contained on each facility site.

G. Electrical (See section 8.0)

2.4 LANDSCAPING

A. Use indigenous plants that are native of Washington, typically found east of the Cascade Mountains, drought resistant, and low maintenance. Refer to 1999 PNNL Master Campus Master Plan.

B. Landscape design and plant selection shall minimize the need for pesticide, insecticide, and herbicide applications.

2.5 GEOTECHNICAL

A. A geo-technical study as needed to characterize the site shall be completed.

B. Basements, if provided, shall be designed, detailed and water proofed to prohibit the infiltration of ground water.

3.0 STRUCTURAL

3.1 GENERAL

A. Building Classifications are detailed in Section 7.0 Fire Protection.

B. Structural Loads:

1. Structural loads shall meet the IBC, except as noted below. Site-specific criteria shall be as follows:

a. Seismic	Zone 2B
b. Basic wind speed	80 mph
c. Importance factor	1.0
d. Ground snow load	20 psf
e. Minimum roof live load	25 psf
f. Allowable soil bearing pressure	1500 psf (unless a higher value is substantiated by a project specific geotechnical study)
g. Minimum foundation depth	24” below final finished grade

3. All design criteria and loads for each facility shall be identified on the project drawings and posted in spaces of each facility.

3.2 STRUCTURAL SYSTEMS

A. A description of the structural systems, including the lateral force resisting system, shall be summarized on the design summary.

B. Installation of a structural system above the suspended ceiling of the laboratories to support future loads due to specific research equipment or utilities shall be considered.

C. Special consideration shall be given to the structural foundation and floor system in order to incorporate vibration sensitive research equipment.

4.0 ARCHITECTURAL

4.1 INTRODUCTION

The architectural and site design strategies are based on the following principles and objectives:

A. The creation of an open research campus that reflects ideals and identity of the PNNL.

B. The integration of sustainability as a major design principle for the facilities and the landscape.

C. The creation of a flexible yet coherent site and building structures that allows for growth and change.

D. The enhancement of the PNNL campus.

4.2 BUILDINGS

A. The buildings shall be integrated with the PNNL, both in style and configuration. The styles shall be compatible as much as is practical.

B. Overall, each facility shall continue the high quality, permanence and professional facilities of the current campus.

C. The main entrance to each facility shall be an important architectural element that is singularly identifiable as the entrance to the building lobby/reception area. The lobby/reception area shall serve as main point of controlled entry into the offices and laboratory areas.

D. The main entrance to the building site shall be a “gateway” style. Both exterior and interior directional signage shall be placed to enhance pedestrian and commuter ease of access.

E. Buildings shall be sited to maximize the use of natural day lighting, maximize the energy efficiency, and provide the maximum solar potential for each building.

4.3 SPACE COMPONENTS

A. The design of space must be conducive to efficient layout while promoting a collaborative research and teaching environment and providing full ADA accessibility.

B. Common Areas

1. General - Common areas shall be designed to promote a collaborative environment among the research personnel.
2. Interaction Areas – provide spaces for interaction between staff and visitors within offices areas, laboratory areas, and on each floor.
3. Interior office corridors shall be provided with natural light where possible such as by providing windows, skylights and light wells. Consider interaction areas incorporated into the circulation system of the building.
4. Recycling Rooms – Provide a centrally located collection on each floor for recyclable materials.
5. Accessibility –Building shall be accessible per the provisions of the Americans with Disabilities Act of 1992. All labs and offices shall be accessible, or easily converted.

C. Offices

1. The appropriate office space standards will be approved by PNNL during the programming phase based on experience, current trends and industry standards in research/office facilities.

D. Laboratories

1. The appropriate laboratory module(s) will be approved by PNNL during the programming phase based on laboratory type and program facility standards.
2. The laboratory areas shall be designed to facilitate maintenance and installation of equipment, both for operation of the building and support of the laboratories with minimal disruption to research.
3. Highly flexible laboratories that minimize the effort required for the laboratory to adapt to continual changes in the research industry will be designed.

5.0 HVAC

Heating, Ventilating, and Air Conditioning (HVAC) requirements shall be provided in each facility as described in the following subsections.

5.1 GENERAL

A. The HVAC system design shall be based on the requirements in this document.

B. Critical applications such as laboratory exhaust, central plant equipment, and equipment serving process areas shall be designed with sufficient backup so that the failure of any one component does not preclude operation of the facility.

C. Equipment arrangements shall allow for all maintenance access requirements, component removal space, lay down areas, and any other clearances necessary for safe operation, maintenance, and repair.

D. The design and equipment selection shall consider energy conservation, occupancy comfort, and operational cost. Also, building HVAC systems that take maximum advantage of reclaiming and redistributing building waste heat from all areas or systems and minimizes the use of utility electrical power or fossil fuels shall be evaluated.

5.2 BUILDING MANAGEMENT SYSTEM (BMS)

A. A Johnson Controls “METASYS” based direct digital control (DDC) type BMS for the building mechanical and lighting systems shall be provided.

1. The system shall have a graphic interface and monitoring capabilities for temperature, airflow, and fan/pump status, chiller/boiler/cooling tower % loading, plus remote monitoring and control capability to change temperature set points.
2. The design shall include a fully developed sequence of operations for all equipment controlled by the BMS. The sequence of operation shall include desired operation under all conditions that may occur.
3. As much equipment as practical shall be controlled by the BMS in order to minimize equipment electrical/thermal usage. Use occupancy detection to control both lighting and HVAC throughout the building. Reduce outside airflow by a minimum of 40% to unoccupied areas as well as resetting zone temperature set points.

5.3 CHILLED WATER SYSTEMS

A. The chilled water system shall be designed to provide a combination of cost-effective installation and operation. The choice of either water-cooled or air cooled equipment shall be determined during conceptual design based on factors such as energy efficiency, maintenance costs, aesthetics and noise considerations.

B. Propylene glycol with inhibitors (such as DowFrost HD) shall be used for all chilled water and condenser systems that are exposed to outside ambient conditions. Only HFC type refrigerants shall be used.

C. Where feasible, major equipment such as chillers shall be located in the buildings central plant. Equipment on the roof is discouraged.

D. Chilled water distribution shall be a variable primary of secondary flow type of system utilizing variable frequency drives (VFDs).

E. Cooling Towers: Cooling towers shall be located to minimize aesthetic disturbance, noise, recirculation, and spray.

F. Chilled water system capacity shall meet specified loads with 50% redundant capacity.

G. Laboratory Chilled Water: Laboratory chilled water shall be provided to all laboratories. It shall be used to cool equipment. This system shall be a closed loop type that is separate from the building chilled water system, however the building chilled water system can be used as a heat sink.

5.4 HOT WATER SYSTEM

A. Reheat shall be provide by hot water fed from recovered waste heat, solar, geothermal heat pumps, microturbines, or condensing pulse gas boilers with capacity to meet current building loads with at least one redundant heat pump, microturbine, or boiler. Emphasis shall be placed on using recovered heat, then utilizing renewable energy sources such as solar or geothermal, with fossil fuels only used as a last resort, as efficiently as possible, and only if overwhelmingly LCC effective using realistic future fuel price projections for this region.

5.5 HEATING WATER PUMPS

A. Either a primary or primary/secondary piping system shall be provided to meet heating water loads with redundancy and shall be variable flow type of systems utilizing VFDs. The system shall have one redundant pump for the heating hot water.

5.6 SUPPLY/RETURN/EXHAUST AIR SYSTEMS

A. Provide energy efficient air-handling systems for the building.

1. The sum of the peak watts for supply, return, and exhaust fans divided by the supply cfm shall be designed to be less than 0.5 watts/cfm and optimally lower than 0.3 watts/cfm.
2. Variable air-volume type air handling units equipped with premium efficiency motors and VFDs shall be used.
3. The office areas and computer rooms shall be on systems separate from the laboratory areas.
4. The laboratory area supply air VAV system shall interface with the laboratory area VAV exhaust system.
5. Outside air economizer dampers and controls shall be provided on all systems employing return air. Waterside economizers may be used in lieu of airside economizers as justified in the Energy Budget.

B. The laboratory areas and chemical storage areas require that all supply air be exhausted outdoors, recirculation of air from these areas is not allowed.

C. Individual environmental controls for the HVAC system shall be provided, at a minimum, for the following rooms: lobby, conference rooms, laboratories, manager/secretary suites, lunchroom, computer rooms, main communications equipment, and sub-equipment rooms. Consider the use of individual office environmental controls. If this isn't LCC effective then offices grouped into control zones shall have the same type of HVAC loads and shall not exceed groups of four. Consider the use of wireless temperature/occupancy sensors for temperature averaging grouped offices and identifying offices exceeding temperature setpoints.

D. The air supply, return and exhaust systems shall be designed to minimize noise and vibration and to provide and remove a uniform distribution of conditioned air to each room.

E. Multiple supply diffusers shall be installed in rooms larger than 150 square feet.

F. The systems shall be designed to allow a system air balance.

G. The general laboratory areas of the building shall be provided with a central, variable air volume type exhaust system with a single discharge point. All fume hoods shall be VAV type. The lab VAV system shall communicate to the BMS and be capable of providing pressurization control of lab spaces. The system shall have 100% redundant fans.

H. Laboratory areas of the building where any dispersable nuclear material is used/handled shall be served by a separate exhaust system. This system shall be equipped with high efficiency particulate air (HEPA) filters, 100% redundant fans and a stack monitoring system. The monitoring system shall meet the requirements set forth by the Washington state Department of Health. The degree of HEPA filtration required will be determined during the conceptual design stage.

6.0 PLUMBING/LABORATORY PIPING SYSTEMS

6.1 GENERAL

A. Equipment arrangements shall allow for all maintenance access requirements, component removal space, lay down areas, and any other clearances necessary for safe operation, maintenance, and repair of all equipment to be provided.

B. Access to mechanical equipment for servicing and maintainability is very important. Careful room design and equipment layout is required to ensure that all equipment is accessible for maintenance and replacement without shutdown or disruption of building functions.

C. Piping for hot, chilled, process, and sanitary water systems will be designed with the minimum number of bends and turns to minimize pumping energy, especially for pipe sizes of 2" and larger. Consider the

use of oversized piping to reduce pumping energy and provide for future capacity.

6.2 BUILDING GENERAL REQUIREMENTS

A. Sanitary water heaters and circulation pumps shall be controlled by the Building Management System (BMS).

B. Process water heaters and circulation pumps shall be controlled by the BMS.

C. Process wastewater from the laboratory areas (including lab sinks, cup sinks, eyewashes/safety showers and floor drains) shall be served by a dedicated process sewer system. This system shall have capabilities for flow monitoring (including flow, PH, and conductivity) upstream of a tie-in point with the sanitary sewer discharge from the facility.

D. Safety Showers and Emergency Eye Wash Systems

1. Emergency eyewashes, emergency showers, or combination emergency eyewash showers shall be provided in areas where corrosive or other skin or eye irritant chemicals are stored, handled, used or dispensed.

E. Instrument Air System

1. An instrument air system shall be provided that serves the mechanical systems and laboratory areas of the building. The compressor shall be an oil-less type.

F. Insulation

1. Piping systems and auxiliary components and equipment shall be insulated to minimize energy loss, prevent condensation, and to provide safe surface temperatures. The 2001 Washington State Energy Code shall be the guide for determining minimum insulation thickness for water piping in buildings. More insulation thickness shall be used if LCC effective.

7.0 FIRE PROTECTION

7.1 GENERAL REQUIREMENTS

A. The new facilities shall be designed and constructed to meet DOE's improved risk level of fire protection. This includes meeting the building code and National Fire Protection Association Codes and Standards requirements or exceeding them when necessary to meet safety objectives.

B. The construction of the new facilities shall be with noncombustible or fire resistive materials. Fire barriers shall be installed to separate lower hazard areas, such as offices, from higher hazard areas, such as chemical laboratories. Three-hour rated fire barrier separation walls shall be

installed to limit the maximum possible fire loss to less then $50,000,000. Automatic fire suppression and fire alarm systems shall be installed throughout the new facilities.

C. A fire hazards analysis (FHA) shall be performed for each new laboratory facility. The purpose of an FHA is to comprehensively and qualitatively assess the risk from fire within individual fire areas in the facility so as to ascertain whether the DOE fire safety objectives are met. This must include an assessment of the risk from fire and related hazards (direct flame impingement, hot gases, smoke migration, firefighting water damage, etc.) in relation to proposed fire safety features to ensure that the facility can be safely controlled and stabilized during and after a fire. To the extent that this analysis completely addresses the following issues, an FHA will satisfy the requirements for a traditional "Fire Protection Safe Shutdown Analysis." In accordance with the "graded approach" concept, the level of detail necessary for an acceptable FHA is directly related to the complexity of the facility and the potential risk to the public and facility staff. A preliminary FHA shall be performed early in the design phase to ensure that an acceptable level of protection is being incorporated in the evolving design. It shall be updated when significant changes occur within an individual fire area and shall form the basis for the post-construction facility FHA.

7.2 PROJECT SPECIFIC REQUIREMENTS

A. The fire protection water supply system shall be designed and installed in accordance with NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2002 Edition. The fire protection water mains shall be of the looped grid type providing two-way flow with sectional valving arranged to provide alternate water flow paths to any point in the system. The fire protection water supply main shall be looped around each building and fire hydrants shall be installed on the main so that no part of the building is over 300 feet from a hydrant. There shall be a fire hydrant within 50 feet of each fire department connection on the fire sprinkler system. Fire mains (except those supplying a single hydrant or extensions of existing smaller mains) shall be at least 12 inches. Mains shall be sized to supply the largest fire demand plus the largest domestic and process demand with consideration for residual sprinkler system pressure requirements. Sectional valves shall be installed such that not more then 1 fire hydrant and 2 sprinkler risers will be out of service for any outage of the water supply main.

B. Automatic fire sprinkler systems shall be installed in each facility in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, 2002 Edition. The systems shall be designed as a wet pipe sprinkler system for Ordinary Hazard Group 1 occupancy classification as a minimum. Sprinkler supply lead-in mains shall be at least 6 inches.

Double check valve backflow preventers and alarm check valves shall be installed on each sprinkler system riser.

C. Life safety features shall be designed and installed in accordance with NFPA 101, Life Safety Code, 2003 Edition. The interior finish on walls and ceilings within the facility shall not exceed a flame spread rating of 25 and a smoke developed rating of 200. The interior finish of assembly areas, computer rooms and laboratory spaces shall not exceed a flame spread rating of 25 and a smoke developed rating of 50. Floor covering materials in assembly areas, computer rooms and laboratory spaces shall have a critical radiant flux of 0.45 watts per square centimeter or greater. Floor covering materials in areas shall have a critical radiant flux of 0.22 watts per square centimeter or greater.

D. The design and construction of the laboratory spaces shall be in accordance with NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, 2004 Edition. Most laboratory spaces will be Class B.

E. Fire alarm systems shall be installed in each building in accordance with NFPA 72, National Fire Alarm Code, 2002 Edition. The fire alarm system shall include a fire alarm control panel in each facility and shall provide alarm notification to the building occupants in the event of fire in each facility, transmit fire alarm signals to the fire department, and provide automatic shutdown of recirculating HVAC systems. Fire alarm and supervisory initiating devices shall be installed per the code requirements. A heat detector with remote test capability shall be installed in each hot cell.

F. The design and construction of computer rooms, network server rooms and telecommunications rooms shall be in accordance with NFPA 75, Standard for the Protection of Information Technology Equipment, 2003 Edition. Smoke detectors connected to the building fire alarm system shall be installed in these rooms and a shutdown of the ventilation and computer systems shall be initiated in the event of multiple smoke detector alarms.

G. The installation, storage, and use of compressed and cryogenic gases shall be designed and installed in accordance with NFPA 55, Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks, 2003 Edition.

H. Fire extinguishers shall be installed in accordance with NFPA 10, Standard for Portable Fire Extinguishers, 2002 Edition. Multipurpose 10 lbs. dry chemical extinguishers shall be installed in most locations. Carbon dioxide and metal-ex type extinguishers may be required is some locations.

I. Other NFPA codes that are applicable to the design and construction of the new facilities are listed below. NFPA codes not listed may be applicable to portions of the new facilities and shall be incorporated into the design and construction of the facilities.

1. NFPA 1, Uniform Fire Code, 2003 Edition.
2. NFPA 30, Flammable and Combustible Liquids Code, 2003 Edition.
3. NFPA 54, ANSI Z223.1–2002 National Fuel Gas Code, 2002 Edition.
4. NFPA 80, Standard for Fire Doors and Fire Windows, 1999 Edition.
5. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems, 2002 Edition.
6. NFPA 110, Standard for Emergency and Standby Power Systems, 2002 Edition.
7. NFPA 232, Standard for the Protection of Records, 2000 Edition.
8. NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials, 2003 Edition.

7.3 QUALIFICATIONS OF THE DESIGN AGENCY

A. Design Packages. All fire suppression, fire detection, and fire alarm drawings, specifications, and calculations shall be prepared under the supervision of, and be approved by, a licensed and/or degreed fire protection specialist.

B. Fire Sprinkler Performance Specifications. The design and installation shall be by a recognized fire protection Contractor licensed under the State of Washington.

C. Fire Detection and Alarm Performance Specifications. The fire detection and alarm performance specification shall be prepared to secure the services of a recognized fire detection system contractor licensed under the State of Washington for the design and installation of the system(s). Specific fire alarm design requirements are also set forth in this section.

8.0 ELECTRICAL

8.1 GENERAL ELECTRICAL REQUIREMENTS

A. The design shall include state-of-the-art energy saving equipment and methods to the maximum extent practicable to achieve a LEED™ certification. Energy saving considerations shall include premium efficiency motors, power factor correction capacitors, occupancy sensors and daylight sensing dimmers for lighting, and setback controls for HVAC equipment.

B. Electrical service to each facility shall be 480/277 V, 3-phase, 4-wire. 480 V, 3-phase power shall be used for all motors one-half horsepower and above, and for other large equipment. 208/120 V, 3-phase, 4-wire power shall be supplied for convenience outlets and other single and three-phase loads. 480/277 V, 3-phase, 4-wire panel boards shall be provided for 277 V lighting.

C. HVAC equipment shall be supplied from dedicated feeders and distribution panels to provide electrical noise isolation from receptacle and lighting circuits.

D. Standby power with UPS backup shall be provided for the computer room (if required), telecommunications equipment, alarm and security equipment, and selected laboratory fume hood exhaust systems.

E. On-site energy generation for routine operations, with the ability to return energy to the grid shall be considered and is strongly encouraged.

F. UPS running on battery and/or computer room cooling alarm to be reported to the BMS. The UPS shall be configured to allow computer systems to be automatically shutdown by the UPS, when it is on battery. Consider the use of flywheel energy storage in lieu of batteries to reduce environmental impacts.

G. Power factor correction capacitors shall be installed as close to the equipment as practical and where necessary so that the building's power factor is near unity but never less than 0.97. Extra cabinet space shall be provided for additional future power factor correction capacitors.

8.2 SITE UTILITIES

H. Site Power Supply:

1. Electrical power is provided by the City of Richland to the North Richland area from two medium-voltage underground lines to serve existing and proposed facilities.
2. The City of Richland will provide the following equipment and services as part of the facility power supply:
   a. High-voltage switch(es) including installation.
   b. Primary transformer(s) including installation and final tie-in.
   c. Manholes or vaults for primary switches.
   d. Primary electrical cables including installation and final terminations.
   e. Watt-hour meter(s) and totalizing meter(s) including meter bases with connections to the BMS.
3. Each facility shall include the following as part of site power services:
   a. Primary conduit banks from City of Richland power.
   b. Construction of concrete pads for primary transformers, including grounding provisions.

c. Secondary conduit banks with cables between primary transformers and main switchgear, and termination of all low voltage (<600 VAC) cables.

d. Empty signal conduit from watt-hour/totalizing meters.

4. Consider the use of a facility owned micro grid serving the new facilities in lieu of a City of Richland owned electrical utility loop. This would enable the electrical services of the buildings to be combined in order to qualify for a more cost effective electrical rate classification. Estimated annual electrical cost savings are on the order of 20% - 30%.

8.3 POWER DISTRIBUTION

A. Main Switchgear

1. The main switchgear shall be double-ended for two incoming services. It shall include dual main circuit breakers with metering compartments, a tie circuit breaker and branch circuit breakers as necessary.
2. The switchgear shall be sized per NEC and shall have capacity and branch breaker space for 25% future expansion.
3. Main and branch circuit breakers shall be electrically operated and shall have ground fault tripping. Tripping characteristics shall be coordinated between main and branch breakers.

B. Transformers

1. Distribution transformers shall be dry type, energy saving, 80 deg C, with copper windings.
2. Transformers serving computer and other nonlinear loads shall have UL K-4 rating, minimum.

C. Distribution Panels and Panel boards

1. All panels shall have copper bussing and bolt-on molded-case circuit breakers.
2. Building loads such as lighting and receptacles circuits shall be fed from panel boards and feeders isolated from HVAC loads.
3. Install all metering and sub-metering needed to meet the requirements of Section 5.2.F.

D. Generator and UPS System:

1. A standby power generator, approximately 300 kVA, shall furnish backup power for alarm and security systems and specifically identified critical computer room equipment. Consider the use of six 60 kVA micro turbines integrated into the buildings normal operation, with adsorption chillers utilizing the wasted heat and tied into the switchgear in lieu of a standby power generator.

2. The generator, with automatic transfer switch, shall be located on an exterior concrete pad, diesel or natural gas powered, and shall include a weather proof enclosure, integral 24 hour UL listed sub-base double wall fuel tank with leak detection, battery, battery charger, and starting system, engine block heater, exhaust silencer, output circuit breaker, microprocessor based control panel and remote annunciator panel. The engine-generator shall be mounted on vibration isolation pads. Generator operation shall be monitored by the BMS.
3. A UPS system shall be provided and sized to furnish approximately 15 minutes of power during startup of the generator. Applications of the UPS shall comply with IEEE 446 and NFPA 110. This shall be monitored by the BMS.
4. A separate UPS system shall be supplied for LAN equipment, see Section 9.2. It shall be supplied from standby power.

E. Grounding

1. Provide an overall grounding electrode system to provide a ground reference throughout the facility. Structural components shall be a part of the electrode system. Impedance to earth shall not exceed one ohm.
2. Provide means to ground power system components and large motor-operated equipment to the grounding electrode system.
3. Provide grounding plates in all telephone, data and mechanical rooms.
4. Refer to Section 8.5 for Main Computer Room grounding requirements.

8.4 MAIN COMPUTER ROOM POWER (IF REQUIRED)

A. Provide shielded and filtered isolation transformers to serve room power panels.

B. Provide an additional panel similar to above, powered from the UPS source.

C. An under voltage, phase loss/imbalance protection system shall be installed to monitor equipment power and trip the equipment power main shunt trip breakers for PMM on normal power when voltage imbalance exceeds 5%, or sags below 105-V.

D. All room HVAC units shall be shut down by a smoke detector fire alarm as activated by the fire alarm control panel.

E. All room power except lighting circuits shall automatically shut down on computer room fire alarms as activated by the fire alarm control panel or manual operation of an emergency power shutdown station.

F. Provide power shutdown at each computer room exit. Shutdown stations shall be double action type that requires two operations and shall stay in the operated position until manually reset.

G. Room Grounding

1. Provide an isolated/insulated ground mat below the raised floor with a maximum impedance of 1 ohm. Provide a bonding jumper between the ground mat and the building grounding electrode system.
2. Raised floors shall be grounded to form a signal reference grid.

8.5 LABORATORY POWER

A. Panel Boards

1. Provide one dedicated 120/208-V, 3-phase, 4-wire panel board for each laboratory. It shall have a minimum 150-amp main breaker and minimum 30 branch breaker spaces.
2. Laboratory panel boards shall only serve either one laboratory room or one laboratory and one laboratory support room. Flush-mount laboratory panel boards shall be in recessed partitions outside of lab doors.
3. Flush-mount laboratory panel boards in recessed partitions outside of laboratory doors.
4. Provide one spare ¾-inch conduit stubbed into space above laboratory ceiling for each breaker space in panel board.

B. Outlets

1. ASA grounded 120-V NEMA 5-20R duplex receptacles shall be spaced at 2-ft on center along bench and island casework in laboratory and laboratory support rooms.
2. Receptacles shall be in metal-enclosed multi-outlet raceways such as Wiremold Type 3000.
3. Receptacles within 6-feet of laboratory sinks shall be ground-fault circuit interrupting (GFCI) type.

C. See Room Criteria Data for fume hood receptacle requirements.

8.6 OUTLETS

A. Provide a minimum of one 120-V ASA grounded NEMA 5-15R duplex receptacle at 8 feet on center along the wall or partition in offices and work areas. Provide at least one receptacle on each wall or partition.

B. One 120-V ASA grounded NEMA 5-20R duplex receptacle shall be provided for each 30 feet of corridor on alternating sides of the corridor. Separate corridor receptacle circuits from all other receptacle circuits.

C. Each office or other location where computer and telecommunication equipment or jacks are specified shall be provided with two duplex receptacles located in immediate proximity of the communications jacks, as identified in the Communications section. The duplex electrical receptacles shall both be on the same 120-VAC, 20-amp circuit. There shall be a maximum of two workstations per 20A circuit. Receptacle mounting height shall be coordinated with modular furniture panels.

D. Refer to Room Criteria Data for specific requirements.

8.7 LIGHTING

A. Provide recessed fluorescent lighting in the hallways, lunch rooms, other "public" common spaces with consideration of using pendant mounted direct/indirect lighting fixtures for offices, computer rooms, and conference rooms in lieu of recessed fixtures.

B. Multiple lighting levels shall be provided in offices, computer rooms, and conference rooms, with preference to switching of lamps (ballasts) in each fixture rather than fixtures. Consider using three-lamp fixtures to provide 1/3, 2/3, full lighting levels with 2 lamps on an occupancy sensor and the single lamp manually switched.

C. Large rooms shall have lights zoned into quadrants with dual-level switching for each quadrant, unless otherwise specified in Room Criteria Data.

D. Lighting shall be energy efficient. T-5 or T-8 and compact fluorescent lamps and electronic ballasts or better shall be used. The illumination levels shall comply with the IESNA standards and use as much daylight as possible. The preferred interior lighting system is fluorescent with 277-volt, fuse protected, electronic ballast, unless otherwise noted.

E. Consideration shall be given to proposals utilizing task lighting in laboratory spaces to reduce general room illumination.

F. Daylight dimming (continuous, not stepped) and occupancy sensors shall be utilized where practicable for energy conservation. Use occupancy sensors to control both HVAC and lighting in offices and common spaces. Consider using them for laboratories as well. Submit the interior lighting control strategy as part of the proposal.

G. Provide battery backup emergency egress lighting in corridors, conference rooms, main telephone room, HVAC control room, electrical switchgear room, laboratories and other areas as required by the Life Safety Code. Battery backup ballasts shall be self-diagnostic type.

H. Exterior lighting shall be compatible with exterior lighting at nearby Battelle facilities. No direct-beam light shall leave the site, and lighting circuits shall be photocell controlled with manual override switching of parking lot lighting circuits. Use the BMS to control lighting for common spaces and parking lots. The parking lot lighting shall be zoned in order that ¾ of the

outer, middle, and near parking lot lights can be independently turned on or off by zones with the BMS. Submit the exterior lighting control strategy as part of the proposal.

I. Light fixtures or other equipment mounted 8' or higher above floor shall be maintainable from a portable ladder.

9.0 COMMUNICATIONS

9.1 SITE INFRASTRUCTURE

A. As the campus develops, there will be a need to have a communications infrastructure hub built to support the new facilities This is expected to be constructed early to support the first facility occupation. This may be part of the first facility or a separate structure. The communications hub facility shall be designed to support all of the facilities covered in the master plan.

B. The communications hub facility shall contain a recessed slab with accessible floor complete with data center quality building infrastructure, such as HVAC, electrical/UPS and fire detection/suppression systems.

C. The communications hub facility shall be above grade to minimize flooding risks.

D. The conduits connecting this facility shall leave at least two separate points at opposite ends of the building and tie into the site infrastructure at different locations. Provide no less than (6) 4" conduits at for each building entry point.

9.2 SITE UTILITIES

A. Site Signal Services

1. Telephone, data and security conduits to the facility shall be in underground conduit banks.
2. Signal conduits shall be Schedule 40 PVC, buried a minimum of 36 in. below grade.
3. A minimum of three 4" spare conduits from each site manhole interface point shall be provided for future use unless noted otherwise.
4. Signal service conduit feeds from two separate locations shall be provided for all major facilities.

9.3 COMMUNICATIONS ROOMS

A. For each building the following infrastructure is to be incorporated into the design.

1. Main communications equipment room

The Main Equipment Room houses the main telephone equipment, termination equipment for incoming copper and optical fiber cabling is the location where external communications ducts banks enter the building. The room is also the demarcation point for incoming service providers.

2. Sub equipment rooms (SER's)
   a. The rooms are used for the terminations of all backbone (or riser) cabling, cabling running to the communications outlets, and houses equipment cabinets for local area network equipment. The equipment rooms are to be located so that the maximum cable length running to the outlets is 250'.
   b. If the rooms feed multiple floors, the cabling to each floor shall be routed separately. The risers (vertical pathways) are to pass through these rooms, so the cables serving other floors will pass through the slabs inside the room.

9.4 COMMUNICATIONS CABLING

A. Communications cabling shall comply with the current PNNL standard. This is likely to consist of high band width copper, multimode and single mode optical fiber cabling, running to each communication outlet.

B. Cable routing shall be installed in the corridors in cable trays with conduit running from the tray to the communications outlet boxes. Cable trays shall be sized to allow for 50% future expansion.

C. Outlets shall be standard outlet shall consisting of four enhanced category 5 cables and one optical fiber distribution cable.

D. There shall be an electrical receptacle for every communications outlet. The communications outlets are typically to be mounted at the same height as the electrical receptacles in that area.

Laboratory Space:

1. One communications outlet is to be provided for every 10 linear feet of bench space. In addition, every workbench must have at least one outlet.

Computer Labs:

2. Computer labs are to have one communications outlet for every 5 linear feet of wall space.
3. In larger areas where access to wall outlets is limited, an AMP 5 gang floor-boxes shall to be installed.

10.0 SECURITY

10.1 GENERAL SECURITY REQUIREMENTS

A. PNNL will provide detailed facility security requirements to the successful PDT.

10.2 AUTOMATED ACCESS CONTROL AND ALARM SYSTEM

A. The building access control and alarm system shall be a proximity card type system as manufactured by Casi Rusco Inc. of Boca Raton, FLA.

B. A host computer utilizing the Casi Rusco “Merlin” system to work shall be installed to work in concert with the PNNL “Merlin” system.

C. The access control equipment shall consist of:

1. Micro 5 processor(s) as needed to control the proximity card readers and monitor status of door alarm switches.
2. Proximity card readers, Casi Rusco model 970, shall be installed at all planned perimeter entrances (with unique key override and intercom capabilities), lab and computer laboratory entrances, and laboratory support rooms.

10.3 CCTV

A. A CCTV camera shall be installed at each main facility entry to allow control room technicians to verify picture ID as required. The cameras (installed at all perimeter prox card reader entrances) shall be Panasonic PA-WVCF254 and accompanying power supply or equal.

B. An outdoor type color CCTV camera shall be installed to view the entry location and allow visual assessment of activity at the doorway. Video link shall be the same configuration as the ID camera.

C. The CCTV camera video signal shall be linked to the control with optical fiber.

10.4 LOCK AND KEY ACCESS CONTROL

A. A unique key strategy shall be implemented for each facility.

B. All exterior door hardware shall be of heavy-duty strength and must be substantial enough to show signs of forced entry. Locking devices and hardware shall preclude undetected manipulation and unauthorized access.

C. Emergency exit doors shall not include key access from the exterior of each facility. Instead, emergency exit doors shall be “blanked” to reduce the number of access points to the facility. Locking hardware shall remain in a “locked at all times” mode, while permitting free egress.

1. In addition to be keyed to the Building Master key, all interior doors shall be keyed to a unique, individual key. Interior door keys shall

be maintained, protected, and controlled on a graded approach based on assets located therein.

2. Public Access Areas adjacent to security areas must be clearly defined via physical barriers as a means to preclude unauthorized access. At such location(s), prox card hardware shall be used for access control to the security areas with unique key override. Locking devices and hardware shall preclude undetected manipulation and unauthorized access.

10.5 MISCELLANEOUS ALARMS

Any manned reception area must be equipped with a duress switch with alarm annunciation reporting to the Control Room. Fire alarm system control panel trouble and fire alarms shall be transmitted to the PNNL Control Room by the security system with alarm annunciation.

11.0 BUILDING COMMISSIONING

The building will undergo a “Total Building Commissioning” process per PNNL procedures to ensure that the building and associated systems meet the design needs and requirements of the owner.