SUSTAINABLE DESIGN CONSIDERATIONS

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Introduction

During the last 40-50 years society has looked at various aspects of the results of the industrial revolution and as a result words like environmental, "green", and ecological have become more prominent in the English vocabulary. These issues and the resulting changes have been combined in the last decade into a more encompassing term called "Sustainability". Whether the term is Sustainable Design or Sustainable Forestry, the context and focus is the same-working to minimize the impact of the activity on the future through the use of renewable processes, materials, and energy.

This list of considerations is provided to the designer to use in designing, selecting equipment, and construction of facilities that minimize the long term impact on the eco-system. The selections made using this list will impact the results of an in-depth rigorous Life Cycle Cost Analysis (LCCA). If the LCCA is conscientiously completed, the more sustainable selections made in the design process will result in long-term cost savings and minimize the impact on the environment.

This list is to be used in a graded approach to design and replacement of equipment, systems, and facilities. Only the applicable sections need to be used in the design effort. Once the list has been used in the design, a note to file with applicable portions of the list will be entered into the project records. The note should address what applicable questions were not used in the design and why.

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General Design Requirements

Preliminary Activities

In order to insure that the design has the addressed all aspects of sustainability, a team of designers and stakeholders needs to be assembled. These individuals should have a basic understanding of sustainable design which will be augmented by training in the expected outcomes conducted by the project manager.

The project manager will provide an outline of the activities required to be successful in sustainable design. The activities will include the project specific training, establishment of the design goals, the depth and sources of the research, the review process, the procedures for optimizing the design including the use of the LCCA, the expectations during the construction process including the bidding, actual construction, and commissioning, and the operation and maintenance criteria.

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1. A. General

1) Has an integrated design team been involved throughout the facility design?

2) Have recent regulations been reviewed to identify potential design opportunities?

3) In process designs, have the life cycle and environmental impacts been compared for batch versus continuous processing?

4) Does the facility layout include space for recycling storage containers?

5) Can the facility be designed with non-toxic raw materials that are resistant to termite infestation?

6) Is the facility designed to handle bulk materials (as opposed to materials in single use packages) to minimize secondary waste generation associated with packaging and containers?

7) Is the facility design responsive to the local climate? (Is the building designed to take advantage of external heating and cooling sources provided by the sun and wind, etc.?)

8) Has the size of the facility and the installed equipment been "right-sized" to its current and anticipated needs?

9) Would an open plan design meet the needs of the facility? (Keep in mind that certain open plan characteristics could result in the expenditure of more energy through ineffective use of windows, larger than needed heating loads, etc..)

10) Have all the unique requirements of the residents been identified and clearly incorporated into the design?

11) Does the design incorporate aspects for ease of future modifications or final demolition?

1. B. Construction

1) Can lesser amounts of material (including hazardous or nonhazardous) be used in place of materials and material quantities currently planned for construction or operation?

2) Can effluent and/or emission points be consolidated to reduce the amount of monitoring necessary? (Be sure that the consolidation does not result in an increased energy use.)

3) Have potential scrap wastes from processing been evaluated for potential treatment or further processing that would make them reusable in another process?

4) Will precut and/or pre-manufactured construction materials be procured to minimize onsite waste generation during construction?

5) Have precautions been taken to minimize the release of gases, vapors, and exhaust emissions during site development and construction activities? Have dust palliatives and soil waterproofing materials been used to mitigate air quality impacts?

6) Is it possible to use recycled content gypsum that contains recycled newsprint or recycled gypsum board?

7) Is preference given to specification and purchase of recycled materials, products containing recycled materials, or products made in an environmentally preferable manner (e.g., building insulation products, paper, cement containing fly ash, retread tires for vehicles)?

8) Can temporary safety barricades use plastic mesh fencing that is made of recycled plastic?

9) Has the excess surplus property database been reviewed to identify the surplus government property available instead of buying new equipment?

10) Is preference given to suppliers that take back containers/packaging materials?

11) Can pipe materials be selected to avoid soil/groundwater contamination due to cracked, off-set joints or the corrosion of buried pipes?

12) Can underground piping be tested for pipe and joint integrity before backfilling?

13) During construction, are vessels such as oil drums and gas storage tanks stored in contained/bermed areas?

14) Has a central material-receiving area been identified during construction and for operation to avoid duplicate materials and reduce waste associated with traffic and forklifts?

15) Will the site require dust control during construction and if so will the application of dust control measures impact the ecology of the site?

16) Can the number of different raw materials used in construction (e.g., plastics, metals, etc.), as well as the number of different chemicals, solvents, or cleaning products be limited to one or only a few different types in each category?

17) Are specifications written to meet minimum necessary materials requirements?

18) During facility construction or modification, have storage areas been established for recyclable materials?

19) Can the construction site have visible recycling containers for scrap materials?

20) Can an existing facility be renovated rather than constructing a new facility?

21) Have routes through the construction site been identified to minimize soil compaction?

22) Can concrete from demolition be crushed and used for road beds or aggregate?

23) Can used asphalt be purchased for road construction?

24) Has exposure of soil areas been limited through scheduling of construction activities?

1. C. External Design

1) Can benches, picnic tables, landscaping timbers, etc., be made from recycled plastics or wood fiber, or recovered wood?

2) Can pipes or tanks be placed above ground instead of underground to avoid undetected leaks and potential groundwater contamination? (Remember to include the monitoring in the facility monitoring system.)

3) Has the roofing color been reviewed for energy effects?

4) Are paved surfaces minimized? Is impervious paving material minimized?

1. D. Internal Design

1) Does the layout of the facility provide specific control and isolation of incompatible materials?

2) Can a computer-assisted plant inventory and material tracking system (e.g., bar coding) be used to reduce excess procurement of materials and reduce wastes from expired materials?

3) Is the facility floor plan such that heavily used corridors are located away from areas where hazardous materials are used or stored to reduce the risk of accidental spillage?

4) Can unauthorized access to hazardous materials be controlled to reduce the risk of operator errors that could cause accidental releases?

5) Can monitoring or process control equipment be incorporated into the facility or process design so optimum equipment function is achieved? (Use facility monitoring systems and Programmable Logic Controllers (PLCs) whenever possible to control the facility equipment.)

6) Can computer networks be used to automate some processes?

7) Are safety barricades used to protect people from entering hazardous areas?

8) Would eliminating dropped ceilings offer day lighting opportunities?

9) Are low-flow toilets incorporated in the design?

10) Are low-flow urinals incorporated in the design?

11) Are low-flow lavatory faucets incorporated in the design?

12) Are infrared sensors/delayed action shut-off/automatic mechanical shut-off valves used for lavatory sinks?

13) Are low-flow kitchen faucets incorporated in the design?

14) Are low-flow shower heads incorporated in the design?

15) Are air barriers provided to control moisture flows the exterior walls?

16) Has a hot water system been considered for heating?

1. E. Siting

1) Can the construction site have visible recycling containers for scrap materials?

2) Does the soil sampling reveal any problems with water retention or structure foundations?

3) Is the site conducive to local plant life?

4) Is the site close to transportation nodes?

5) Will the site require a large parking lot and resultant storm water collection and processing?

6) Will the outside vegetation require special irrigation?

7) Is the facility designed to minimize the impact on the pre-construction environment?

8) Is an erosion plan required?

9) Was an Environmental Impact Statement or Environmental Assessment completed for the site and were all the identified actions completed?

10) Are berms provided for decreased noise from identified point sources?

11) Have all high noise generators been identified and sited in such a manner that the sound is dissipated?

12) Does the site provide a natural drainage system?

13) Was the site a "Brownfield"?

1. F. Environmental

1) Can computer networks be used for electronic communication and record keeping to minimize the use of paper?

2) Can chemical and/or waste management systems be tested during the construction phase by using simulation or by using chemicals and wastes generated during construction?

3) Has a graywater scheme been defined and designed?

4) Is the facility designed for sequential control and containment? Do the areas containing hazardous materials or areas where spills are most likely to occur have multiple containment and adequate control barriers?

5) Is spill and overflow protection provided for tanks and drums?

6) Has a central area within the facility been identified for handling and management of waste?

7) Is the facility or process designed to handle reusable materials and containers in conjunction with bulk storage?

8) Have ozone depleting substances been reduced or eliminated?

9) Has the design considered possible oil spills and leaks?

10) Are parking lots curbed so that outlets can be plugged in case of a spill?

11) Are hazardous material storage areas covered to protect against discharges to the storm water system?

12) Are areas for storage of hazardous materials during construction identified and appropriately bermed to contain any spill?

13) Have compost areas been established for appropriate materials?

14) Have reduced irrigation plants and lawns been used?

15) To prevent secondary waste generation, does the design include adequate provisions for the safe collection, packaging, inventory, storage, and loading for transport of waste that is contaminated with radioactive material?

16) Has daylight use been maximized? Can solar design strategies be incorporated?

1.G. Security

1) Where floor storage is required, does the layout of floor and access areas consider the requirements for secure location of storage containers, traffic control, and proper segregation?

2) Does the construction result in increased security?

3) Are new access requirements generated?

4) Are new intrusion requirements generated?

5) Are new entrance/exit inspections required?

6) Are new physical barriers required?

7) Are new vehicle inspection requirements instituted as a result of security changes?

8) Are exits required to be alarmed and controlled?

9) Is a central alarm station required as a result of security requirements?

10) Is a secondary alarm station required as a result of security requirements?

11) Is a Local Law Enforcement/Private Alarm Station required as a result of security requirements?

12) Is a video recorder system required as a result of security requirements?

13) Is special lighting required as a result of security requirements?

14) Is an auxiliary power source required as a result of security requirements?

15) Does the wiring require special protection as a result of security requirements?

16) Are special locks required as a result of security requirements?

17) Do any new security containers exist?

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18) Do any new communications requirements exist as a result of security requirements?

19) Are any new signs or postings required as a result of security requirements?

1.H. Demolition

1) Does the design provide for ease of demolition/modification and subsequent recycling of materials?

1. I. Energy

1) Do designs incorporate energy recycling to the maximum extent practicable (e.g., use lighting for heat source (an inefficient heat source), steam condensate for heating/preheating, used oil for energy recovery, cogeneration, heat recovery, free-cooling, cooling tower heat rejection, etc.)?

2) Has an energy balance been conducted to determine the inputs and outputs for all energy?

3) Can "green power" be purchased for the operation of the facility?

4) Has landscaping been considered for use as an element in energy conservation design solutions for buildings (e.g., reduction of solar radiation during cooling season, heat loss from wind, and heat loss during the heating season)?

5) Has the building shape and footprint been optimized to take advantage of solar heat and light?

1.J. Operations

1) Have potential scrap wastes from processing been evaluated for potential treatment or further processing that would make them reusable in another process?

2) Is preference given to suppliers that take back containers/packaging materials?

3) Is it possible to use waste paper and corrugated cardboard to generate packing material?

4) Has a material balance been conducted to determine all materials entering during normal operation and where those materials go upon completion of the process?

5) Has a central material-receiving area been identified during construction and for operation to avoid duplicate materials and reduce waste associated with traffic and forklifts?

6) Can the number of different raw materials used in construction (e.g., plastics, metals, etc.), as well as the number of different chemicals, solvents, or cleaning products be limited to one or only a few different types in each category?

7) Is storage space identified for reusable/ returnable containers in the material receiving area?

8) Can process control systems be used to automate materials distribution, handling, processing, and general use if the facility requires these functions?

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Site and Civil Engineering

2. A. General

1) Can the building layout be designed to minimize building materials use without compromising structural and functional integrity?

2) Can storage piles be covered, bermed/diked, or otherwise enclosed to prevent contamination of storm water runoff?

3) Are areas where potential for spills might occur (e.g., truck unloading stations) diked to prevent contamination of storm sewers?

4) Will paved areas be designed, evaluated, and tested to ensure minimization of drainage into natural water courses?

5) Has the possibility of cross-contamination been reduced by confirming that there are no interconnections among storm water systems, the sanitary waste system, and radioactive or other hazardous material handling systems or areas?

6) Have plants been selected to minimize the need for irrigation while maximizing the cooling benefits (e.g., xeriscape, shading windows and condensing units)?

7) Can landscaping be used to reduce the amount of storm water runoff (e.g. trees, shrubs, grasses)?

8) Can terracing steep slopes reduce storm water runoff?

9) Can percolation areas be used to reduce the amount of storm water runoff?

10) Can the facility use earthen berms or be built underground to reduce energy usage?

11) Will storm water drains be clearly and permanently labeled to prevent release of contaminants to the storm water sewer?

12) Has advanced irrigation engineering been completed for the site to minimize water consumption, evaporation loss, and runoff?

13) Can vegetation and brush that has been cleared from the facility site or grounds be composted and used as a fertilizer?

14) Can chemical-free landscaping be employed?

15) Will storm drains be fitted with filters to strain contaminants from runoff water?

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16) Have recycle and recovery systems been implemented where feasible within industrial waste streams to conserve energy and resources?

17) Can asphalt containing recycled tires/rubber be used?

18) Can adequate soil erosion control, soil stabilization, and drainage be accomplished with the use of geotextiles made of or containing recycled materials?

19) Can topsoil made from compost/sludge be used for landscaping?

20) Can used bricks, blocks, or glass, which would otherwise go to the landfill, be used for road beds or fill material?

21) Can blasting mats made from recycled tires be used during use of explosives?

22) Can parking bollards and parking stops be made from recycled rubber, plastic, or recycled fiberglass?

23) Can reclaimed wastewater be used for irrigation or other secondary uses?

24) If water-thirsty landscaping that requires high chemical input and high maintenance cannot be avoided, can hydraulic seeding mulch containing recycled paper or wood fibers be specified?

25) Will provisions for composting of landscape wastes be included in the site layout and design?

26) Have alternative waste treatment techniques been considered for potential waste reduction and energy savings?

27) Have constructed wetlands on the site been considered for industrial wastewater purification and/or treatment?

28) Has careful consideration been given to the proper routing of stormwater discharge (e.g., routing to a process wastewater treatment system, public sewer, or dead end sump)?

29) Does the siting and facility design take advantage of passive solar design techniques?

30) Have the water pipes been downsized as appropriate for use with water conserving plumbing fixtures?

31) Does this site allow for on-site solar or wind power generation?

32) Does the facility, parking, and road design fit existing contours and limit cut and fill?

33) Are berms or walls incorporated to decrease noise impacts where point sources can be identified?

34) Has external lighting been designed to minimize light pollution in the sky?

2. B. Site

2. B. i. Infrastructure

1) Can walking paths between facilities be designed to encourage people to walk rather than drive between facilities?

2) Are bike paths and secure storage provided?

2. B. ii. Landscaping

1) Can native landscaping be used and labeled to provide information to the public?

2) Can disturbances of existing vegetation be minimized?

3) Can vegetation and trees that are impacted be transplanted?

4) Are impacts to hydrological features and water flows minimized?

5) Can organic fertilizers be utilized?

6) Is impervious cover minimized?

7) Are sporulating plants minimized to reduce allergy effects?

8) Are plants and lawns requiring minimal irrigation?

2. B. iii. Environmental

1) Has a graywater scheme been defined and designed?

2) Can recycled-content or reusable containers be specified for use throughout the facility?

3) Has a soils report been completed identifying all wet lands, the flood plane, drainage areas, stream corridors, aquifer recharge zones, endangered species habitat, and special vegetative areas?

2. C. Concrete

1) Can autoclaved cellular cement (ACC) be used for wall systems and other construction applications requiring concrete?

2) Can concrete containing fly ash be used?

3) Can cement be obtained from plants that used renewable energy sources or have kilns that used hazardous waste, used oils, or spent tires as fuel sources for energy recovery?

4) Can cleanup wastes from concrete tools and equipment be captured and used for mixing other batches of concrete, rather than being washed into the ground?

5) Can concrete containing recycled materials (other than fly ash) be used?

6) Can recycled concrete be used as aggregate for new concrete placement?

7) Can a soy-based curing agent be used to assist in the curing of concrete?

8) Can the texture of concrete walking surfaces that might be wet be brushed?

9) Can the texture of concrete surfaces that must be cleaned by sweeping or mopping be smooth without crevices?

10) Can signs be placed on concrete made from recycled materials so that the sign is visible to passersby?

11) Can a policy be established that encourages selecting the type of cement and admixture combination that meets the useful life of the structure, rather than always using 'top-of-the-line' products?

2. D. Masonry

1) Can nonhazardous cleaners be used to cleanup after masonry work?

2) Can masonry bricks, blocks, or grout containing fly ash or other byproducts be used?

3) Can masonry products be obtained from kilns that used hazardous waste, used oils, or spent tires as fuel sources for energy recovery?

4) Can brick carriers be used to carry multiple bricks at once?

2. E. Metals

1) Will nonhazardous processing or cleaning fluids be used whenever possible?

2) Can cathodic protection be used to reduce corrosion and potential leaks?

3) Are products made from or containing recycled metal being used?

4) Can metal working fluids (e.g., solvents, plating solutions, lubricating oils) be recycled?

5) Can provisions for treatment of liquid wastes from metal working, plating, or cleaning, such as solvents, acids or anodizing solutions be designed into the process?

6) Can sharp edges on corners of metal surfaces be rounded or shielded?

2. F. Wood and Plastic

1) Can wood made from recycled plastic, recovered wood fiber, or salvaged wood be used rather than from non-renewable lumber sources?

2) Can recycled plastics be used instead of virgin plastics?

3) Can benches, picnic tables, landscaping timbers, etc., be made from recycled plastics?

4) Can waste wood be collected for reuse in other processes?

5) Can wood products made of engineered wood be used?

6) Can recycled plastic be used in place of lumber sources that would splinter?

7) Can signs be placed on furniture made of recycled plastic be visible to passersby?

8) Can a policy be established prohibiting the use of old growth forest or rain forest wood products?

2. G. Environmental

1) Can a non-toxic insulation such as cellulose, expanded polystyrene, or borax-treated insulation be used instead of insulation treated with harsher chemicals?

2) Are storage pads and tanks designed with covers/roofs to prevent stormwater from becoming contaminated?

3) Can drainage piping made of recycled plastics or other recycled materials be used?

4) Can insulation made from recycled materials be used?

5) Can roofing made from recycled materials be used?

6) Can wood siding or flooring composed of recovered wood fiber or waste wood byproducts be used?

7) Can the ceiling be made from recycled materials?

8) Can pre-manufactured wall panels containing engineered wood and/or recycled materials be used?

9) Can a sealing technique be used to further insulate the facility?

10) Has a Mylar liner for acoustical attenuation around areas that can not meet acoustical requirements using unlined ducting been considered?

11) Have bike racks been provided?

12) Has the potential for rainwater retention or graywater recycling been considered?

13) Have meters been incorporated for monitoring power use?

14) Have Life Cycle Cost Analysis (LCCA) been completed for equipment and the most cost effective selected based on the LCCA?

15) Will construction wastes be minimized?

16) Is a "take back" program in place for returning scrap material upon completion of installation?

17) Is a concerted effort made to recycle instead of dispose into a landfill, construction waste?

Internal

3. A. Doors and Windows

1) Can a policy requiring energy efficient windows/doors be established?

2) Are energy-efficient doors, windows, and door/window frames specified throughout the facility?

3) Can doors or windows from previous facility modifications be reused/recycled?

4) Can doors, windows, and/or door and window framing that contain recycled materials be used?

5) Can passive solar energy gained through energy-efficient windows be used to help heat a facility in cold seasons?

6) Can skylights and daylighting be included in the design to minimize energy consumption from electrical lighting?

7) Can operable windows and/or ceiling fans be installed to increase natural air flow?

8) Has window glazing been optimized throughout the facility?

9) Has exterior shading and sun control been incorporated?

10) Has interior sun shading been reviewed for applicability?

11) Can doors made with environmentally preferable products be labeled?

12) Can doors made from non-toxic materials be used?

13) Are all doors weather-stripped?

3. B. Finishes

1) Have changeable, movable, and/or demountable materials been considered where functional requirements are likely to change?

2) Are washable or strippable finishes used on walls, floors, and ceilings in areas where radioactive or other hazardous materials are processed or handled to prevent spread of contamination and secondary waste?

3) If the facility will include painting operations, can equipment and processes be considered for minimizing paint wastes?

4) Can fly ash be used as filler in coatings?

5) Has finish material and its support, backup, and substrate been selected, designed, fabricated, assembled, and installed to exclude or prevent the escape of fibers (e.g., fiberglass) and the escape of emissions from volatile organic compounds?

6) Can coatings containing nonhazardous pigments be used to minimize wastes in painting or future paint removal, and to minimize indoor air pollutants?

7) Have nonhazardous, nonvolatile paints or coatings been considered for surfaces requiring coating?

8) If processes will require paint stripping, will alternatives to hazardous solvents be incorporated in the process design?

9) Can lacquer thinners and Methylethyl Ketone (MEK) be replaced with less toxic chemicals for use in paint gun cleaning?

10) Can painting solvents be recovered and recycled?

11) Can unused or unwanted latex paint be recycled?

12) Can paint cans be recycled?

13) Has a low-E interior wall finish been considered?

14) Can structural materials be used as finish materials?

15) Has a highly reflective coating been considered for application on the roof?

16) Have glazings been specified for different orientations?

17) Is painting equipment with the highest transfer efficiency being used?

18) Can low biocide paints be used to improve indoor air quality?

19) If design includes modification to lead-painted surfaces, has an over coating process been considered for repainting?

20) Has a method been considered for segregating regulated and non-regulated waste to minimize regulated waste disposal?

21) Have “wet” materials been identified and evaluated for Volatile Organic Compounds?

22) Have “fleecy” materials been identified and evaluated for possible allergic reactions?

23) Have Material Safety Data Sheets (MSDSs) been reviewed for all materials intended for construction to insure that materials with toxic, flammable, corrosive, or carcinogenic characteristics are minimized or eliminated?

3. C. Specialties

1) Have the future residents of the facility been able to participate in the facility design?

2) Have temperature and humidity criteria been set?

3) Has the use of air hand dryers versus paper towels been compared in context to the specific facility needs to determine which will generate less pollution?

4) Can composting toilets or electric incinerator toilets be used at remote facilities?

5) Are low-flow aerators and showerheads installed in faucets and showers?

6) Have the most current technologies in sanitary water conservation been reviewed for incorporation in facility design?

7) Can nonhazardous solid waste streams be evaluated for treatment alternatives that render the material useful to another department or facility?

8) Can flooring containing recycled content be used?

9) Could the floor slabs be exposed rather than carpeted?

10) Has water efficient equipment, such as waterless urinals, been incorporated where feasible?

11) Can access flooring be incorporated into the design?

12) Have the future residents of the facility been able to participate in the facility design?

13) Can shower dividers, toilet partitions, locker room benches, vanities, etc., be made from recycled plastics or other recycled materials?

14) Will excess materials or waste streams be evaluated for use in another onsite or offsite application? Will nationally available material exchange services be useful in redeploying excess materials or reusable waste streams?

15) Has insulation been optimized?

16) Have possible areas of “thermal bridging” been examined to avoid cold spots and the resultant condensation?

17) Have air and vapor barriers been examined to insure air and moisture flow is controlled through exterior walls?

3. D. Mechanical

1) Can the facility piping be designed to reduce the sources of potential leaks (e.g., valves, pumps with seals, use of welded piping versus threaded/flanged piping)?

2) Can point source hot water heaters be installed instead of hot water tanks or hot water systems to conserve energy?

3) Are spring-loaded/automatic shut-off valves used on faucets and at rinse stations and cleaning areas?

4) Can lead-free solder replace lead-based solder?

5) Can the ducts be placed away from exterior walls?

6) Has consideration been given to the collection and monitoring of radioactive and nonradioactive contaminants in natural runoff (e.g., roof drainage) and blow downs from heating and cooling systems before discharge to the environment?

7) Has equipment, waste routing, and spare storage volume been installed and made available to transfer the contents of one tank to another if a tank shows indication of excessive leakage or other conditions that warrant taking the tank out of service?

8) Is the HVAC system for facilities that process hazardous materials designed to ensure that the building pressure is negative with respect to the atmosphere, and hazardous materials cannot leak outward to the atmosphere?

9) Will safety shower drains and personnel decontamination shower water drains be routed directly to the proper sewer line or contained in an isolated sump?

10) Can mercury switches be replaced with switches that do not contain hazardous materials?

11) Does the water treatment program employ the least hazardous additives compatible with performance requirements, if the facility design includes cooling towers?

12) Have mechanical cleaning systems or high-pressure cleaning systems for pipes and tanks been considered instead of standard water or solvent rinses?

13) Do vacuum pumps have filters on their exhaust to prevent oil mists from becoming airborne?

14) Where automatic sprinkler systems or standpipes are fed from a potable water system, have approved check valves been installed in sprinkler lead-ins to preclude the introduction of pollutants from systems or recirculation of stagnant water that would contaminate the domestic water system?

15) Have timers, flow reducers, and/or flow meters been considered for process or rinse water lines so that only the amount of water required is used?

16) Are reusable filters considered wherever feasible to prevent secondary solid waste generation from filter disposal?

17) Have air-cooled condenser intakes been located away from areas that receive peak solar heat gain so the condenser can operate more efficiently and consume less energy?

18) Have collection systems been provided for water runoff, such as from firefighting activities or from areas within special facilities containing radioactive material?

19) Have roughing filters or prefilters upstream of a HEPA filter been considered to maximize the useful life of the HEPA filter and reduce radioactive waste volume?

20) Do oil storage tanks have fail-safe engineering design so the failure of a component will not allow accidental release of oil from the tank?

21) Have mechanical fasteners been considered instead of adhesives to facilitate recycling and avoid hazardous waste streams often associated with adhesives?

22) Will high-efficiency particulate (HEPA) filters be tested with nonhazardous materials so the filter will not be designated as hazardous waste when disposed?

23) Are drains clearly labeled to prevent accidental release of a contaminant to the wrong sewer system?

24) Have systems for the storage and handling of coal and ash been designed to prevent the release of significant quantities of dust to the atmosphere?

25) Are underground vaults and tanks sealed to prevent stormwater or runoff infiltration?

26) Have non-ozone depleting solvents (or alternative) cleaning processes been considered instead of chlorinated solvents?

27) Is a closed-loop cooling water system or air-cooled system being considered wherever feasible (instead of single-pass or once-through cooling) to minimize wastewater generation?

28) Have supercritical fluids been considered instead of hazardous solvents?

29) Have oil-less pumps been considered for laboratory and sample vacuum pump installations?

30) Has air pollution control planning included an analysis of the characteristics of the pollutants and the feasibility of conversion products for use or sale?

31) Can antifreeze/coolant be recycled?

32) Have air treatment methods been considered for recycling or reusing volatile organic compounds (VOCs)?

33) Has the possibility been considered for the sale of residual ash or its useful byproducts as a means of disposal?

34) Have heat-recovery systems been considered for incorporation into the building HVAC system design?

35) Have collecting and recycling/reuse of volatile organic compound emissions been considered?

36) Can sludge dehydrators be used to reduce the volume of sludge that must be disposed of?

37) Can solar heat be used to pre-heat air for ventilation systems?

38) Can a solar heating water system be used?

39) Have computational maintenance management systems been included?

40) Have ground source heat pumps or other energy efficient HVAC systems been considered?

41) Are backflow preventers and air gaps used to prevent cross-connection (contamination) of potable water supplies?

42) Have air filtration units been installed as near to the source of contaminants as practical to minimize contamination of ventilation system ductwork?

43) Is the HVAC system designed to cascade from areas of least potential for contamination to areas of greatest potential for contamination to minimize contamination spread and the area of the facility requiring future decontamination?

44) Does the stack height and location preclude subsequent uptake into facility air intakes?

45) Does the indoor air quality, at a minimum, meet regulatory requirements?

46) Has the use of regulated chlorofluorocarbons (CFCs) in HVAC installations been minimized to the maximum extent feasible?

47) Have appropriate "low flow" plumbing fixtures been incorporated?

48) Have cooling tower blow downs been minimized?

49) Are hot water systems fully insulated?

50) Has equipment been selected that has compatible maintenance requirements?

51) Do Preventive Maintenance (PM) requirements include the following:

a. Recalibrating lighting sensors, controllers, and other devices;
b. Verifying proper operation of air economizer dampers and automatic temperature control dampers;
c. Performing recommended PMs on valves, actuators and other control devices
d. Verifying the status of control set points for reasonableness;
e. Establishing automatic start/stop and reset schedules for equipment that coincide with facility operation and occupancy;
f. Verifying correct automatic responses by system components;
g. HVAC filter replacement;

52) Are the chillers appropriately sized and designed to be high-performance?

53) Are heat exchangers designed with low approach temperatures and reduced pressure drops?

3. E. Electrical

1) Have energy-efficient and/or water-efficient appliances been considered (e.g., refrigerators, water heaters, dishwashers, ice machines, laundry machines, computers, etc.)?

2) Has energy-efficient overhead lighting been considered?

3) Is electric circuitry protected from accidental damage such as cutting/crushing by fork-lifts or falling drums or crates?

4) Are computers equipped with sleep or power-down modes to conserve energy and prevent data loss or equipment damage?

5) Can the use of battery powered clocks be eliminated to prevent battery disposal?

6) Can solar powered battery chargers for remote equipment be used?

7) Are monitoring devices installed on facilities/equipment to monitor energy consumption?

8) Has the hazardous material content or recyclability of spent lights been considered in selection? Can nonhazardous bulbs be purchased?

9) Has energy efficiency been evaluated for ancillary fixtures such as exit signs, exterior and parking lot lights, and vending machines? Have plug loads and lighting levels been established?

10) Can daylight switches be used to reduce lighting usage?

11) Has cogeneration been considered if steam is being produced for onsite process?

12) Has renewable energy been evaluated for use?

13) Have high-efficiency electric lighting with high-efficiency lamps and ballasts been used to augment daylight?

14) Has a lighting control system been incorporated?

15) Have energy efficient motors been considered for electrical equipment?

16) Are transformers and generators designed as close to actual anticipated loads as possible?

17) Are water heaters set as low as feasible?

3. F. Equipment

1) Is it possible to select and/or design equipment and structures for disassembly, allowing for easy desegregation of dissimilar materials for recycling at the end of the useful life?

2) Can equipment be designed for life extension (e.g., is the component easily repaired, and/or can it be easily rebuilt or modified with updated componentry)?

3) Are solvent tanks provided with lids to minimize evaporative losses?

4) Are sumps optimally sized and designed for minimization of residual waste following sump pumping?

5) Are solvent tanks located away from heat sources or air movement to minimize evaporative losses?

6) Can sealed pumps, such as magnetic drive pumps, be used instead of pumps with couplings to reduce the potential for leakage and reduce waste due to maintenance?

7) Can digital/dial thermometers, thermostats, and bi-metallic strip thermocouples be used instead of temperature control or monitoring devices containing mercury?

8) Do flexible pipes, hoses, and unloading stations have dry break couplings?

9) Can valves or systems be easily locked/isolated to prevent unauthorized cross-connections?

10) Can smooth heat exchanger tube surfaces (e.g., Teflon) be used to minimize the sites available for scale formation, reduce the cleaning frequency, and therefore, the volume of waste cleaning solutions?

11) Are floating roof tanks or covers used for volatile organic compound control?

12) Have all equipment components not functionally required to operate directly in the presence of radioactive materials been located outside the enclosure?

13) Have closure devices or permanent seals been provided on entrances and exits of piping, ducts, or conduits penetrating confinement barriers to reduce migration of contamination? Do such closures or seals have integrity equal to or greater than the barrier itself?

14) Are all functions and contents of lines, tanks, vessels, and valves clearly labeled to prevent cross-contamination of waste?

15) Can rupture diaphragms be installed in systems to prevent accidental cross-contamination?

16) Have fugitive emission and leak control and/or minimization been considered?

17) Can devices be installed on tanks or piping to prevent overfill, spills during liquid transfer, or accidental draining of systems?

18) Can diaphragm or pinch valves be used to prevent leakage around the valve stem?

19) Are conservation vents used on fixed roof tanks for control of volatile organic compound evaporation emissions?

20) Can closed-loop cooling systems be used rather than once-through cooling if the system being cooled contains hazardous materials?

21) Can air dryers be used instead of preheaters to preclude downstream condensation?

22) Can ozone, which decomposes more readily, be used to destruct microorganisms in cooling water rather than biocides?

23) Are ventilation systems installed on enclosure systems maintained at a negative pressure with respect to the operating area to prevent leakage of contamination outside the enclosure?

24) Can propylene glycol be substituted for ethylene glycol for use as vehicle antifreeze?

25) Is equipment selected and/or designed so spent fluids (lubricants, refrigerants, etc.) can be recovered for recycling or reclamation?

26) Can materials or equipment from another facility be reused on this project?

27) Can oil filters be recycled or reused?

28) Can in-line oil-water separators reduce the volume of oil-bearing wastes from sumps, compressor blow downs, etc.?

29) If oil filters cannot be reused or recycled, can the use of an oil filter crusher be employed to minimize disposal volume?

30) Have HEPA filters been provided at the interface of the enclosure outlet and the ventilation system to minimize the contamination of ductwork, and at the enclosure inlet to prevent movement of contamination within the enclosure inlet to the operating area in the event of a flow reversal?

31) Do sumps, tanks, or containers that could contain hazardous materials have high-level alarms?

32) Are robots and computerized operations employed to reduce waste and minimize worker exposure in spray painting, tank cleaning, radiological surveys, and other process operations?

33) Has equipment been purchased from local companies?

34) Has a policy to purchase energy efficient equipment (Energy Star certified) been established?

35) Have Life Cycle Cost Analysis been completed for each piece of equipment?

36) Has insulation been optimized?

37) Have premium-efficiency motors been used for motors required over one horsepower and those expected to operate long hours?

38) Have variable frequency drives for pumps and fans and variable air volume boxes for air distribution been incorporated in the design if life cycle cost effective?

39) Has the hot water system been fully insulated?

40) Has the selection of the HVAC systems been based on an in-depth Life Cycle Cost Analysis?

41) Has the amount of reheating or mixing of conditioned air streams been evaluated for comfort control?

42) Are variable frequency drives for pumps and fans and variable air volume boxes for air distribution incorporated?

3. G. Furnishings

1) Does the design of and location for stock shelving and chemical storage ensure adequate spill prevention, containment, and countermeasures?

2) Can carpet tiles be used so individual tiles that are worn or ruined can be replaced or locations exchanged, rather than recarpeting entire offices or hallways?

3) Can furnishings containing recycled materials be used?

4) Can benches, picnic tables, landscaping timbers, etc., be made from recycled plastics?

5) Can laminate floors contain recycled content?

6) Can the flooring be made of renewable materials, such as cork or bamboo?

7) Have furnishings been selected and installed to minimize or prevent the escape of emissions from volatile organic compounds that present health hazards?

8) Can floor matting or antifatigue matting made of recycled rubber/plastic be used?

9) Have the furnishings been purchased from local vendors?

10) Can carpet or carpet padding made of recycled materials be specified for purchase?

11) Can furnishings that are recyclable at the end of their useful life be specified?

12) Can surplus furniture be stored in the process of facility clean-out for future furnishing?

13) Is office equipment EPA Energy Star rated?

14) Are carpets conforming to the Volatile Organic Compound (VOC) emission rate of 0.5 milligrams per square meter per hour or less been used?

15) Are Mylar coated sound attenuators used only where acoustical requirements cannot be met with unlined duct work? (No internal duct linings should be used.)

16) Are "breathable" wall finishes used instead of vinyl wall coverings in hot or humid climates?

17) Have appropriate partitions been used to provide speech privacy and separation from HVAC equipment areas?

3. G. Environmental

1) Have satellite accumulation areas and emergency spill control stations been included in the facility design?

2) Can drums be specified for recycling and/or be returned to the vendor for reuse? If drums will be reused on site, has a drum rinsing station been included in the facility layout?

3) Has a graywater scheme been defined and designed?

4) Can Indoor Air Quality (IAQ) be continuously monitored?

Special Facilities

4. A. Environmental

1) Have satellite accumulation areas and emergency spill control stations been included in the facility design?

2) Are items such as service piping, conduits, and ductwork kept to a minimum in areas that may become contaminated with radioactive or other hazardous materials?

3) Have as many equipment components as possible been located outside enclosures used for radioactive materials (only those equipment components functionally required to operate directly in the presence of radioactive materials should be located within the enclosures) to prevent contamination of equipment?

4) Will non-ozone-depleting cleaners, or no-clean soldering methods be incorporated, if routine soldering operations will occur in the facility?

5) Is it possible to reuse process waste water (either treated or untreated) rather than using raw water as makeup for evaporative losses?

6) Can hazardous liquid waste volumes be reduced through separation, neutralization, or other treatment methods?

7) Are surfaces that may come in contact with hazardous materials free of crevices or lined to facilitate decontamination?

8) Can countercurrent rinsing systems be included in process design to increase rinsing efficiency, and therefore decrease the volume of rinsing solution needed?

9) When the transfer line into a hazardous material tank is below the liquid level, is a one-way check valve or other backflow prevention device located on the line as close to the tank as possible?

10) Can pipe penetrations, drainage trenches, and doorways with raised thresholds be located or designed so that if a spill occurs, the penetrations will not act as a pathway for spreading the spill (e.g., pipe penetrations located above floor/maximum spill level or doorways with raise)?

11) Are storage tanks or containers designed so the hazardous materials stored in them can be completely drained or removed before cleaning or dismantlement?

12) Has spill prevention and control been considered in the design stage of the facility to minimize the possibility of an accidental release of hazardous materials to the environment?

13) Can volume compaction provide an opportunity for minimization of container use?

14) Are walls, ceilings, and floors finished with washable or strippable coverings to minimize the volume of building materials that will have to be disposed as hazardous waste during decommissioning?

15) Does the design allow for spills, overflow, or leakage from outdoor storage vessels or other primary confinement structures to be collected and retained within a suitable secondary confinement structure?

16) Is space provided in the facility to segregate hazardous and nonhazardous wastes?

17) Are outdoor waste container storage areas covered by roofs to prevent intrusive storm water and designed with recessed floors with separate drains for each segregated area?

18) Are individual tanks and piping isolated or segregated to prevent the unintentional commingling of waste?

19) Can mercury recovery and recycling be incorporated in laboratory practice if mercury and mercury instruments are used?

20) Have liquid process waste streams been evaluated for recycling potential (e.g., metal catalysts, photographic wastes containing silver, oily wastes, etc.)?

21) Have measures to lessen contaminant drag out been included in the process design for rinse tanks containing hazardous materials?

22) Can spent solvents be distilled or filtered for reuse or recycle?

23) Can equipment to recover solvents from laboratory extractions and separations be installed?

24) Are ventilation system filters positioned to minimize potential contamination of ductwork or other ventilation equipment?

25) Can training programs be conducted using a computer to reduce waste generation during training exercises?

26) Are change rooms designed to ensure that clean clothing and protective clothing are segregated and that proper storage of contaminated protective clothing will prevent spread of contamination beyond the storage container?

27) Can instrumental chemistry or computer simulation be used instead of wet chemistry to reduce wastes and improve worker safety?

28) Can closed storage and transfer systems (e.g., covered tanks, enclosed piping, and covered trucks, boxes, bins, etc.) be installed and used to reduce evaporation and standing or breathing losses?

29) Is storage space for contaminated clothing provided in change rooms to assist in controlling contamination spread?

30) Does the design of equipment that must be located within confinement systems allow for in-place maintenance or replacement?

31) Can process operations be designed to minimize the amount of radioactive mixed wastes generated by avoiding the combination of hazardous and radioactive materials?

32) Does the facility design provide for the segregation of hazardous wastes into compatible groups for safe storage and/or to facilitate recycling or reclamation of byproducts?

33) Can surplus and/or contaminated equipment from other U.S. Department of Energy sites be used instead of purchasing new equipment?

4. B. Support Systems

1) Are elevators designed so that if hazardous materials are spilled, the materials are contained sufficiently and will not contaminate the entire elevator shaft or leak to the ground?

2) Can conveyors be used to transport materials rather than manual transportation?

4. C. Radioactive Materials/Waste

1) Have as many equipment components as possible been located outside enclosures used for radioactive materials (only those equipment components functionally required to operate directly in the presence of radioactive materials should be located within the enclosures) to prevent contamination of equipment?

2) Are items such as service piping, conduits, and ductwork kept to a minimum in areas that may become contaminated with radioactive materials?

3) Has the design been reviewed to ensure there are no bypasses or drains in the radioactive liquid waste treatment system that may inadvertently release waste directly to the environment?

4) Are change rooms designed to ensure that clean clothing and protective clothing are segregated and that proper storage of contaminated protective clothing will prevent spread of contamination beyond the storage container?

5) Is storage space for contaminated clothing provided in change rooms to assist in controlling contamination spread?

6) Can process operations be designed to minimize the amount of radioactive mixed wastes generated by avoiding the combination of hazardous and radioactive materials?

Equipment Maintenance/Replacement

5. A. Equipment Maintenance

1) Has the determination been made that the piece of equipment has long enough time remaining the Life Cycle to justify the maintenance expense?

2) Will the maintenance activity improve the efficiency of the equipment?

3) Will the resultant wastes from the maintenance activity have to be disposed as hazardous, radiological, or mixed?

4) Are the repair parts non-toxic and "environmentally friendly"?

5) Can rebuilt/recycle repair parts be used?

6) Are non-ozone depleting substances used in cooling systems and as solvents?

7) Are tools that will become contaminated minimized?

8) Is the present equipment the "right size" for the function and load for which it is used?

9) Are "catch" containers identified for liquids that might leak from the system during maintenance activities?

10) Is monitoring equipment attached to the equipment that could indicate the next need for maintenance?

11) If the maintenance includes filter change, are reusable filters feasible?

5.B. Equipment Replacement

1) Have the design considerations for mechanical, electrical, and equipment been reviewed?

2) Has a LCCA been completed for the new equipment?