Appendix F

TVA Sustainable Check List

This Appendix is maintained and coordinated through TVA's Internal Energy Management Program (IEMP).

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REVISIONS, DATES and REASON:

Revision 0, November 9, 2006. First issue of Appendix.
Revision 1, August 15, 2007. To incorporate EO 13423 and related guidance.
Revision 2, June 30, 2008. To incorporate updated EO 13423 guidance including how to meet the goal for 15% of the existing Federal capital asset inventory to incorporate the Guiding Principles. To incorporate new requirements from the Energy Independence and Security Act (EISA) of 2007.

TVA Energy and Sustainable Architecture Check List

Introduction:

This is a check list of required minimum sustainable standards that need to be used in all building renovation or new building design. Items listed have been placed in categories and noted whether they apply to renovation, new construction or both using a check box. Also listed are optional items to consider implementing to achieve greater sustainability. For more information on each item consult TVA's "Sustainable Architecture Guideline."

Required Minimum Standards

Integrated Design & Optimized Energy Performance:

** All new construction and major renovations shall be performed using an integrated planning and design process that uses a team approach and takes advantage of the following:

- Initiates and maintains an integrated project team in all stages of a project's planning and delivery.
- Establishes performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building.
- Reduced HVAC size to account for more efficient building design.
- Life-cycle costing of energy/water/sustainable technologies.
- Design for future building changes, uses and/or deconstruction.
- Building commissioning to verify design intent.
- Installation of meters to track and optimize energy use plus compare actual performance to modeled design estimates and goals.
- Sharing of lessons learned by entering building data into the EPA Energy Star Benchmarking tool and the DOE High Performance Buildings Database.
- Considers all stages of the building's lifecycle, including deconstruction.

Minimum Components to meet Federal Requirements:

E.O. 13423 states that agencies are to retrofit 15% of their existing buildings with sustainable technologies outlined in the "Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings memorandum of Understanding (2006)". These principals are indicated below with " ** ". The "High Performance and Sustainable Buildings Guidance - Final (12/1/08)" provides clarification on how to calculate agency progress in meeting the 15% goal.

The baseline square footage for the 15% goal is comprised of owned and leased agency-occupied space that is reported in the agency Annual Report to Congress on Federal Government Energy Management and Conservation Programs. TVA currently has 2,758 buildings (28,166,840 GSF). Of this amount 1,619 (19,100,89 GSF) are excluded facilities leaving 1,135 goal subject buildings (9,066,031 GSF). 15% of the gross square footage of the goal subject buildings (1,359,905 GSF) need to be retrofitted to meet the sustainable guiding principals by the 2015 date. TVA intends to incorporate the sustainable guiding principles in its larger buildings scheduled for renovation provided it is feasible, practical and cost-effective to do so. Following guidance developed for metering, TVA feels that the best opportunities for applying the guiding principles cost-effectively would be to apply them to larger buildings that use greater than $40,000/year of energy. Looking at TVA's goal subject building inventory this would result in 32 buildings (4,086,216 sf) that would be potential candidates for application of the sustainable guiding principles.

The TVA Facilities Asset Preservation Plan will be used to identify buildings needing renovation and its schedule will be adopted to establish milestones for implementation of the sustainable guiding principles. Any deficiencies will be identified and corrective measures documented in TVA's "Gap Analysis Plan". The TVA Energy Management Committee will be responsible for oversight of the implementation of all sustainable, energy and water requirements.

<-Renovation <-New const.

* - Is a Green Building Council "Leadership in Energy & Environmental Design" (LEED) energy/environmental strategy (Number of points or "R" - required). To be LEED certified your building must have 26 points. To obtain silver certification you need 33 points, gold-39 and platinum-52. ** - Is a required sustainable guiding principle.

Site

Required Minimum Standards

- Choose a site that is closest to the users to minimize transportation energy.
- *Choose a site that is well suited to the building and minimizes disturbance to the environment (1).
- Preserve and make use of existing site features such as trees for shading.
- Orient buildings with the long axis facing north and south for solar heating, daylighting and photovoltaic sys.
- Combine buildings with related functions. Avoid building small multiple buildings.
- Anticipate future expansion, contraction, or change of function when developing the building design.
- *Minimize the building footprint to preserve existing natural features & provide open landscaped space (1-2).
- Plant deciduous trees to shade south glass in summer and allow solar heat gain in winter.
- Plant conifer trees and shrubs to block or divert cold winter winds.
- Choose climate appropriate plants for landscaping to minimize watering, pesticide use and maintenance.
- If additional watering is needed, install drip irrigation systems instead of sprinklers.
- *Adopt an erosion & sediment control plan for the project site during construction to keep sediment on site (R).
- * ** Cut potable water use for landscaping 50% (Guiding Principle min. / 1 point) or 100% (2 points - optional).

Optional Items

- *Choose a site that is accessible to mass transit and promote its use through employee incentives (1).
- *Choose a site that has been built on before (brown field) and already has utility services in place (1).
- When laying out multiple buildings orient new streets to run east-west so bldgs. will be oriented correctly.
- *Consider the use of permeable paving and green roofs to keep storm water on site & reduce energy use (1).
- *Use retention ponds or constructed wet lands to treat parking runoff and keep it on site (1).
- Consider the use of earth berms to minimize heat loss and gain.
- Design the site around public transportation, bicycle use and pedestrian access instead of car access.
- *Minimize parking lot/garage size. Consider sharing parking facilities with adjacent buildings (1).
- *Include bicycle racks and showering/changing facilities in the building design or renovation (1).
- *Install alternative fuel refueling stations and setup carpool/vanpool programs for building occupants (1).
- Install a rainwater collection system to provide irrigation water.
- Use organic or natural gardening and grounds maintenance. Do not use chemicals to keep pests in check.
- *Build in urban areas with existing infrastructure, protect greenfields, preserve habitat & natural resources (1)
- *Shade, use light-colored or high reflective (ref. =< 0.3) materials for 30%+ of the site's non-roof surfaces (1).
- *Cut light pollution from site (1).

Building Shape

Required Standards

- Keep the building shape simple (rectangle) to minimize heat loss, heat gain and material usage.
- Orient rectangular buildings with its long side facing north and south.
- Avoid designing square buildings which can result in half the glass facing east and west.
- Avoid designing "L" shaped buildings which can place large areas of glass facing east and west.
- Do not design bldgs. with lots of corners, ins and outs, which increases area, energy and material use.
- Do not design large one story buildings which minimizes floor area that can be daylit by vertical glass.
- Do not design large one story bldgs. which results in large roof areas and increased heating & cooling.

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Optional	☐	☐	Shape buildings to collect sunlight for passive solar heating (if needed) and daylighting.

Building Space Layout

Required Min	☐	☐	Place people occupied space on exterior walls to provide them connection to the outdoors and daylight.
	☐	☐	Place high wall spaces (restrooms, conference, storage, HVAC. & circulation) in the interior of the bldg.
	☐	☐	Place buffer spaces (storage & HVAC) on the north side of heating dominated buildings.
Optional	☐	☐	*Layout space for daylight & views - 75% daylit occ. areas (1 point), 90% occ. Areas direct view to outside (1).

Building Design

Required Minimum Standards	☐	☐	* **Set energy performance goals for each project. 30-50% energy cost reductions are economically realistic (R).
		☐	**For new construction cut energy use 30% compared to a bldg. that meets ASHRAE 90.1-2007 Energy Code.
	☐		**For existing construction cut energy use 20% below pre-renovations 2003 baseline.
		☐	Maximize glass facing south and north for solar heat gain (if needed) and daylighting.
		☐	Recess east & west glass or provide overhangs and fins to minimize heat gain and cooling loads.
	☐	☐	*Install light colored roofs to minimize solar heat gain, air-conditioning loads & urban heat island effect (1).
		☐	Design recycling centers into the bldg. Provide vertical chutes in multistory bldgs. to support O&M.
		☐	Design <u>all</u> bldgs. with future function in mind. All bldgs. should be capable of being converted to housing.
		☐	Provide optimum insulation for all bldg. surfaces up to and including super insulation where applicable.
		☐	Provide operable windows where possible and arrange spaces to allow cross ventilation.
		☐	Provide fixed overhangs for south glass. Size overhangs for solar heat gain for heating dominated bldgs.
		☐	Minimize east & west glass to reduce solar heat gain & cooling . Provide minimum for views & daylighting.
		☐	Place people in the space perpendicular to the window wall to minimize glare when using computers.
	☐	☐	* ** Reduce building potable water use 20% (1 point) or 30% (2 points - optional).

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Optional Items		☐	*Reduce new building energy use by 20% (2), 30% (4), 40% (6), 50% (8) or 60% (10 points).
	☐		*Reduce existing building energy use by 10% (2), 20% (4), 30% (6), 40% (8) or 50% (10 points).
		☐	Use whole building energy analysis: base case, individual strategy performance and group performance.
		☐	For heat dominated bldgs. consider passive solar heating (trombe walls, greenhouses & hot air collectors).
		☐	Add thermal mass (concrete/water) to the bldg. to minimize temperature fluxuations in solar heated spaces.
	☐	☐	Consider the use of shade screens or tinted glazing for cooling dominated spaces.
	☐	☐	When designing and renovating consider using wood structures first, steel second and concrete last.
	☐	☐	Consider installing a photovoltaic system to provide some or all of the buildings power needs.
		☐	Design the roof for the potential future retrofit with a photovoltaic system once prices decrease.
	☐	☐	Consider installing a wind generator to provide some or all of the buildings power needs.
		☐	Consider installing radiant barriers in the roof and walls to reduce cooling loads.
		☐	Consider installing vented roof and/or thermal chimneys to provide natural ventilation cooling.
	☐	☐	Consider installing movable insulation (preferably automated) to close off glass areas during the night.
		☐	Design the roof to collect rainwater & provide storage tanks to use the water for landscaping & toilets.
	☐	☐	Control noise pollution, provide maximum separation between sources of noise and the spaces that are quiet.
	☐	☐	Ensure Operations and Maintenance are active participants & use environmentally responsible procedures.
	☐	☐	*Reduce the use of potable water for sewage by 50% or treat 100% of sewage on site (1).
	☐	☐	*Use renewable energy for a portion of the bldgs. energy use - 5%-(1 point), 10%-(2 points) & 20%-(3 points).
	☐	☐	*Reuse an existing bldg. or large portions - 75%-(1 point), 100%-(2 points) 100%+50% interior-(3 points).
		☐	*Provide occupant control of windows, lights & airflow for each 200sf perimeter zone & 50% interior area (1).
		☐	*Go above or beyond existing individual LEED requirements or come up with new and innovative design (1-4).

Materials

Required Minimum Standards	☐	☐	Consider the use of standing seam metal roofs first which have a long life span & can be easily recycled.
	☐	☐	Use locally available materials for construction to minimize transportation.
	☐	☐	Use durable, easily maintained materials inside and out to minimize future replacement.
	☐	☐	** Use non-toxic low or no VOC interior finishes (paint, flooring, carpet, adhesives and wall coverings).
		☐	Use double glazed glass with thermal break frames. Use heat mirror high R-value glass in colder climates.
	☐	☐	** Choose materials with recycled content, including EPA and FEMP designated products.
	☐	☐	** Use recycled content materials for 10% (based on $s) of all materials in the bldg. Min. 5% post consumer.
		☐	Choose materials which can easily be separated into there base components for easy recycling.
	☐	☐	Consider the use of cellouse insulation first. Encapsulate all fiberglass insulation.
		☐	Consider the use of autoclaved concrete block first which contains flyash & has a high R-value.
	☐	☐	Salvage and reuse building materials for the current project, or sell or donate materials for reuse by others.
	☐	☐	*Divert construction waste and other construction debris from landfills - 50%-(1 point), 75%-(2 points).

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Optional Items	☐	☐	Consider interior movable walls first. Movable walls provide for easy modifications with minimum waste.
		☐	Use natural cedar in place of pressure treated wood.
	☐	☐	Consider solid wood & water base finishes first. Avoid the use of particle board and vinyl finishes.
	☐	☐	*Use salvaged or refurbished materials for 5% of construction (1 point) or 10%-(2 points).
	☐	☐	*Use recycled content materials for 25% of construction (1 point) or 50%-(2 points).
	☐	☐	*Use locally available (within 500 miles) materials for 20% of construction (1 point) or 50%-(2 points).
	☐	☐	*Use rapidly renewable materials (bamboo flooring, wool carpet, strawboard, etc.) for 5% of construction (1).
	☐	☐	*Use certified wood from a renewable forest for a minimum of 50% of wood used in construction (1).
	☐	☐	*Use non-toxic materials: Adhesives (1 point), Paints (1), Carpet (1) & Composite wood w/ no formaldehyde (1).
	☐	☐	*Design building to prevent occupants from being exposed to chemical pollutants from both inside & outside (1).

Lighting

Required Minimum Standards	☐	☐	** Design new buildings to utilize daylighting (min. daylight factor of 2% in 75% of space excluding direct sunlight)
	☐		Retrofit existing buildings with daylighting where possible using existing windows.
		☐	Install switched control sys. in transition spaces & dimmable sys. in occupied spaces to respond to daylight.
	☐	☐	Use light colored finishes to maximize light distribution.
	☐	☐	Install energy efficient lighting systems (HID in high bay spaces & efficient fluorescent in low bay spaces).
	☐	☐	Consider an indirect lighting system first with supplemental task lighting as needed. Best for computer use.
	☐	☐	Install occupancy sensors in all transitional spaces (restrooms, individual offices, conference & storage).
	☐	☐	Install parabolic lighting fixtures in open office areas and prismatic fixtures in small enclosed spaces.
	☐	☐	*With exterior lighting, avoid light pollution and use compact fluorescent or metal halide lamps (1).

HVAC / ETC.

Required Minimum Standards		☐	Divide the building into multiple thermal zones so unused areas can be switched off or allowed to float.
		☐	Consider ground source heat pump HVAC system first, then high efficiency air-to-air heat pumps.
		☐	Install variable air volume systems instead of constant volume systems.
	☐	☐	Consider placing insulation on the outside of ducts first, instead of the inside to reduce potential mold growth.
	☐	☐	Install programmable thermostats for unoccupied setbacks/ups in small buildings.
	☐	☐	Install direct digital controls with energy management control systems (EMCS) in large buildings.
	☐	☐	Select energy efficient motors for HVAC equipment and other applications.
	☐	☐	Install variable frequency drives on any appropriate motor or pump.
	☐	☐	Install water saving plumbing fixtures.
	☐	☐	** Implement a moisture control strategy to control moisture, condensation to prevent damage and mold.
	☐	☐	** Meet ASHRAE Standard 55-2004 to provide thermal comfort including continuous humidity control.
	☐	☐	* ** Design the HVAC system to ASHRAE 62.1-2004 to provide minimum indoor air quality (R).
	☐	☐	*Provide zero exposure of nonsmokers to environmental tobacco smoke (R).
	☐	☐	** Protect indoor air quality during const. following 1995 Sheet Metal & AC Contractor Nat. Association Guidelines.
	☐	☐	** After construction conduct a minimum 72-hour flush-out with max. outdoor air to remove material contaminants.
	☐	☐	* ** Commission building - check and verify that all new systems are installed and working correctly including a designeated commissioning authority, verification in const. docs., commissioning plan & report (R).

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Required Min. Standards	☐	☐	** Meet at least 30% of the hot water demand through the installation of sloar hot water heaters when cost effective.
	☐	☐	** Implement renewable energy geneation projects on agency property for agency use, when cost effective.
	☐	☐	** Install building level utility meters (including natural gas & steam) to track and continuously optimize performance
	☐	☐	** Model the building to predict savings & monitor it after construction to verify performance (1).
		☐	** After one year of occupancy, measure all new major installations using the ENERGY STAR® Portfolio Manager for building and space types covered by ENERGY STAR®.
Optional Items		☐	Consider radiant heating systems in high traffic areas exposed to large amounts of air infiltration.
		☐	Consider installing a separate ventilation system which delivers fresh air directly to the occupants.
		☐	Consider installing under floor HVAC distribution systems for efficiency and individual user control.
		☐	Consider multiple boiler systems that are solar assisted or biomass fired, also consider cogeneration.
		☐	Use an air distribution system that distributes a large mass of air at a low velocity.
	☐	☐	Consider adding solar collectors to provide domestic hot water.
	☐	☐	Consider the use of air to water heat pumps to provide domestic hot water.
	☐	☐	Select high-efficiency and high-performance office, food service, and other equipment (Energy Star labeled).
	☐	☐	Install electronic controls with new plumbing fixtures or retrofit existing fixtures.
	☐	☐	Consider installing photovoltaic panels to supplement building electric use.
	☐	☐	*Do additional building commissioning before and after construction (1).
	☐	☐	*Eliminate the use of CFC refrigerants when installing new HVAC equipment (R).
	☐	☐	*Install or replace all HVAC equipment that has HCFC's or Halon (1).
	☐	☐	*Enter a two year contract to buy green power for a portion of the building's energy use (1).
	☐	☐	*Design the HVAC system to ASHRAE 62-1999 to provide minimum indoor air quality (R).
	☐	☐	*Install a carbon dioxide (CO_2) monitoring system to adjust ventilation (1).
	☐	☐	*Install a ventilation system that provides a minimum of .9 air changes per hour during occupied hours (1).
	☐	☐	*Exceed ventilation requirements (SMACNA IAQ Guidelines) during const. & Install new filters after const. (1).
		☐	*Flush building with 100% outside air for a minimum of 2 weeks after construction & replace filters (1).
		☐	*Provide very tight thermal comfort (ASHRAE 55-1992) (1point), install temp. & humidity monit. & controls (1).
	☐	☐	*Have at least one member of the design team complete the LEED Accredited Professional exam (1).