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**Guideline Scope of Work
Design Build Guidance Criteria
Retrofitting Low-slope Roofs with a Vegetative Roof System**

All ARRA-funded roof projects must use a cool roof, a vegetative roof, building integrated photovoltaic or photovoltaic-ballasted roof. This scope of work serves as a guideline and should be adapted to suit the needs of each individual project by a qualified roofing design team. For vegetative roofs (intensive and extensive) include in the selection criteria a planted roof specialist requirement. The following requirements shall be included in the project in addition to requirements in the *Facilities Standards for the Public Buildings Service (P100)*; any discrepancy should be referred to the PMO and the Chief Engineer for guidance.

1. Summary

- 1.1. This scope of work serves as a guideline and should be adapted to suit the needs of each individual project by a qualified reroofing design team.
- 1.2. Acceptable roof candidates for application of a vegetative roof system include only Inverted Roofing Membrane Assemblies (IRMA) fully bonded to the structural deck with a designed minimum life expectancy for the system of 20 years. Existing roofs meeting this requirement in which the existing waterproofing membrane is considered to have more than ½ of the remaining useful life upon acceptance of the original membrane manufacturer may be retrofit allowing the existing membrane to remain in place. Consideration by the design team should be give to re-emulsification and re-work to extend the useful life of these systems. Existing IRMA with less than ½ the remaining useful life must consider re-emulsification and rework to return the assembly to the original targeted life expectancy.
- 1.3. Unacceptable roof systems include roof membranes constructed over insulation and all single-ply roof membrane applications

2. Project Description

2.1. Project Goals

- Increase the insulation value of the roof.
 - Extend roof membrane life.
- Other goals may include:*
- Capture rainwater to maintain the sites natural hydrological cycle.
 - Provide habitat for beneficial insects and animals.
 - Reduce urban heat island effect.
 - Lower roof temperature for indoor air intake.
 - Provide visual beauty for employees that look down on a roof area.

- Provide additional usable space for employee benefits.
- Reduce acoustical issues from sources above the building.

2.2. Reference Materials

- 2.2.1. Roofing design and installation must follow the recommendations of the National Roofing Contractors Association (NRCA) as contained in the NRCA Roofing and Waterproofing Manual.
- 2.2.2. ASTM E2400-06 Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems.
- 2.2.3. ASTM E2397-05 Standard Practice for Determination of Dead Loads and Live Loads associated with Green Roof Systems
- 2.2.4. EPA *Technical Guidance on Implementing Section 438 of the Energy Independence and Security Act*, when available.

3. General Requirements

3.1. Performance Objectives

3.1.1. Thermal Performance

Roofing replacement designs should target a composite insulation value of R-50 including insulation and a calculated value of the soils and vegetative overburden. (It is recognized that the insulating qualities of the soils is subject to change based on moisture content etc.) Existing closed cell insulation in good condition without excessive moisture or structural degradation may be reused. Any roof system unable to meet an R-50, shall submit best alternatives to GSA for consideration. The design shall included consideration for existing penetrations, parapets, and historical issues.

3.1.2. Rainwater Capture (*projects over 5,000 square feet*)

The project design shall restore the predevelopment hydrology of the site in the affected area of the roof with regard to the temperature, rate, volume and duration of flow. The design shall control the 95th percentile rainfall event in the location of the site and consideration should be given to new and existing low impact development Best Management Practices (BMP's) associated with the building.

3.1.3. Drainage

All drains shall be tri-level design with primary drainage at the membrane to prevent ponding, secondary drainage via through the insulation and vegetative media and tertiary overflow above the level of the vegetation. Access to the drain for maintenance and cleanout must be provided

3.1.4. Water Test

The existing / modified roof shall be water tested prior to the installation of the vegetative roof system for a minimum of 24 hours. This shall be witness by GSA and signed off on prior to installation of the vegetation.

3.1.5. Roof Walkways

The design shall incorporate a roof walkways system made from high density paver units or similar materials. Provide an approved protection layer between the paver and the roof membrane.

3.2. Project Management Responsibilities

3.2.1. Meetings

An initial meeting before work begins shall include GSA, the roofing contractor, planted roof contractor, and other sub contractors needing access to the roof. The

purpose of this meeting is to coordinate logistics, sequence of work, special conditions of material delivery, accessibility once roofing installation begins, and maintenance including initial watering strategies and plant infill.

4. Scope of Services

4.1. Design Stage

4.1.1. Survey

- 4.1.1.1. The A/E is to visit the site, consult with the Building Manager concerning the nature of the roof problems, examine the roof, taking non-destructive samples as necessary, and examine any existing record construction documents and/or shop drawings.
- 4.1.1.2. The structural capacity of the existing deck for the vegetative roof must be assessed in order that the roof will support the extra dead load of the designed planting media, other components, and detained water. All of these loads are exclusive of applicable snow loads.
- 4.1.1.3. Upon accessing and analyzing the data compiled via the above-described process, the A/E is to produce a narrative that validates the type of roof and installation that the A/E has selected to meet the project objectives and maximize the roof membrane warranty.

4.1.2. Design

- 4.1.2.1. The design must include any functional programmatic requirements based on discussion with GSA, i.e. walkways and patios, outdoor furniture, lighting with buried electrical cables, water features, window washing, and fire barriers. All programmatic components must work together to not compromise the critical functions of the roof and keep the green roof growing and operating as planned.
- 4.1.2.2.

4.2. Construction

- 4.2.1. Remove existing roof material to arrive at a suitable base for installation of the new vegetative roof. The contractor shall be responsible for the suitability of the substrate surface to accept the vegetative roof.
- 4.2.2. Provide a new roof installation including but not limited to roof waterproofing and closed-cell insulation material. The roof waterproofing must be able to withstand ponding water, survive expected deflection or expansion, resist chemical action of acid rain and fertilizers, and be resistant to root penetration. The design shall utilize an engineered soil medium and plants as ballast. Compatibility between the engineered soil medium, plants, and the roofing system below must be demonstrated to avoid negation of any manufacturer warranties. The roof warranty must include the planted roof system and all components.
- 4.2.3. Any excess water that is not contained by the engineered soil medium shall drain positively to the existing roof drains. Utilize composite drainage mats to assist with drainage. The selection of the roof waterproofing system must support the ease of leak detection and not allow water to travel under the waterproofing.
- 4.2.4. The plantings must be selected according to their USDA hardiness zone classification and withstand the extremes of a roof condition. The planting density shall provide complete coverage within 2 years from the date of planting unless designated otherwise as part of the design. Plants may be distributed by seed, plug, cuttings, mat, or other method to meet the coverage requirements. Invasive species shall not be considered. Selected plantings must not add to the potential

for fire hazard in the event of severe drought. Vary plant selection with an overall landscape plan for the roof. No large areas of monocultures will be accepted.

- 4.2.5. The engineered soil medium must be designed for the physical conditions and local climate to support the plants and shall consist of non-synthetic materials. The design must provide a wind erosion blanket that protects the engineered soil medium until the plantings are established. No area shall have less than 3 inches of engineered soil medium.
- 4.2.6. It is recommended that all penetrations, changes in elevation, and parapet walls have a minimum 12 inch wide buffer area of gravel or other non-vegetative area. Where access to the roof façade is via the roof perimeter an area of sufficient width to support associated equipment and protect the roof shall be provided.
- 4.2.7. The installation contractor shall provide watering, weeding and periodic maintenance as needed for planting design for the two year plant warranty period.
- 4.2.8. Tray systems (additional requirements)
 - 4.2.8.1. Trays shall not directly contact the waterproofing membrane. A protection layer compatible with the waterproofing shall be provided. Before installation, the waterproofing shall be thoroughly cleaned to remove foreign objects.
 - 4.2.8.2. Tray systems shall be delivered with plants of size and quantity to provide complete coverage within 90 days from installation including all exposed edges of the tray.
 - 4.2.8.3. Trays shall provide for drainage suitable to meet hydrological requirements.
 - 4.2.8.4. A tray system design shall provide complete coverage of the waterproofing with the tray or appropriate rock or paver ballast .
 - 4.2.8.5. Tray systems must be engineered to meet code required roof dead loads considering the wet weight of the planting media and wind loads must consider the dry weight.
- 4.2.9. Intensive systems (additional requirements)
 - 4.2.9.1. Select plants to minimize the use of irrigation. Provide an irrigation system as required to provide for the health of the plants. Irrigation systems shall be drip method and shall consider the use of mechanical water, captured water, or gray water before using potable water.
 - 4.2.9.2. Large plants extending above parapet walls shall be secured in a manner so as not to blow away. Attachments shall be coordinated with waterproofing.

4.3. Warranty

- 4.3.1. A planted roof is a complete system and the waterproofing warranty shall include all components of the waterproofing and planted roof. The waterproofing system shall be warranted for a minimum of 20 years covering wind damage for up to 60 mph.
- 4.3.2. A plant warranty against disease and death shall extend for 2 years from date of planting. Replant areas that fail to provide a uniform cover of plants, with specified materials, until the Owner accepts all affected areas.
- 4.3.3. Provide for all new roofs a single source responsibility warranty, including removal and replacement of the overburden and the growing media.