FMOC

Specification Section 07532 Single-Ply Roofing System (CSPE)

January 11, 2012

Revision 3

SAND 2011-5885 P

This document has been undergone the formal Review and Approval process, and its contents have been deemed unclassified/unlimited release.

National Nuclear Security Administration

Sandia National Laboratories

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Change Log

Rev	By	Date	Type	Change Description	ID
2	VL	5/11	Subst	Branded, formatted, and edited document. Changed "shall" to "must."	
3	DBH VL	1/12	Admin	Updated per 2009 I-Codes, added ASTM E108 Fire Test. Corrected excessive bold formatting.	

Part 1 - General

1.01 Summary

A. This Section includes all material, labor, equipment, temporary protection, and tools for the proper installation and completion of the work as required in this Specification.

B. The following items are specified in this Section:

1. Roof insulation
2. Fasteners
3. Roof membrane
4. Roof membrane flashings
5. Treated wood
6. Sealants
7. Adhesives

1.02 References

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections

B. Sandia National Laboratories (SNL) Construction Standard Specifications

Number	Title
Section 07600	Flashing and Sheet Metal
Section 13100	Lightning Protection
Section 15401	Plumbing (for roof drains)

C. American Society of Testing and Materials (ASTM)

Number	Title
A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
D573	Standard Test Method for Rubber—Deterioration in an Air Oven
D751	Standard Test Methods for Coated Fabrics
D1149	Standard Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber
D1203	Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
D1204	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
D2136	Standard Test Method for Coated Fabrics—Low Temperature Bend Test
D2240	Standard Test Method for Rubber Property—Durometer Hardness
E84	Standard Test Method for Surface Burning Characteristics of Building Materials

Number	Title
E108	Standard Test Method for Fire Test of Roof Coverings
E408	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
G90-10	Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight

D. California South Coast Air Quality Management District (AQMD)

- Rule 1168 Adhesive and Sealant Applications

E. California Bay Area Air Quality Management District (BAAQMD)

- Regulation 8, Rule 51 Organic Compounds—Adhesive and Sealant Products

F. Factory Mutual (FM)

- Approval Guide
- Approval Standard No. 4470 Class 1 Roof Covers

G. Federal Specification (FS)

- HH-I-1972/2 Class 1 Insulation Board, Thermal, Polyurethane or Polyisocyanurate Faced with Asphalt/Glass Fiber Felt on Both Sides of the Foam

H. Federal Test Method (FTM)

- FTM 101B Method 2031 Puncture Resistance

I. National Roofing Contractors Association (NRCA)

- Roofing and Waterproofing Manual

J. Underwriters Laboratories® (UL)

- Roofing Materials and Systems Directory

1.03 Submittals

A. Product Data

Submit manufacturer's technical product data, installation instructions, and recommendations for each type of roofing product required. Include data substantiating that materials comply with the specified requirements.

B. Submit manufacturer's documentation of recycled content for polyisocyanurate insulation.

C. Submit copy of the membrane manufacturer's warranty covering materials.

D. Submit copy of the Roofing Contractor's warranty covering workmanship.

E. Submit dimensioned shop drawings, which must include the following:

1. An outline of the roof and roof size
2. Proposed installation method for insulation and membrane for each different section of roof. Include insulation type (flat or tapered, for example) and fastener patterns if applicable. Show the Contractor's proposed method of achieving specified roof slopes.
3. Proposed profile details of flashing methods for penetrations and terminations if not indicated in the Contract Documents.
4. Proposed location of manufacturer-approved walkpads. Walkway corners must be rounded and welded in accordance with the manufacturer's written instructions. All side and end joints must be hot-air welded a minimum of 2 inches (51mm). Adhesive cannot be present within the lap areas.

F. Submit report from an independent testing laboratory certifying that the manufacturer's membrane has met a minimum of 3,000,000 langleys concentrated natural sunlight, according to ASTM G90-10.

G. Submit written documentation from the manufacturer indicating that the proposed roofing system components, including insulation and fasteners, are compatible and meet the applicable requirements and code approvals as referenced in this specification, and that the roofing system meets the requirements for the manufacturer's standard warranty covering material.

H. Submit from the membrane manufacturer a list of Contractor personnel who have been trained successfully to perform membrane welding and who will be working on this project. The membrane manufacturer must also submit approval of Contractor's welding equipment.

I. Submit location and names of building owners to meet the installation requirement of 500 roofing squares for more than 5 years in the Southwest.

J. Submit manufacturer's documentation of ENERGY STAR®–labeled roofing materials.

K. Submit Material Safety Data Sheets (MSDS) and manufacturer's documentation of volatile organic compound (VOC) content for each adhesive and sealant product.

L. Preliminary Hardware Submittal Conference

1. Meet with the Architect, SNL Project Lead, SNL Architect, and the SNL Inspector to review the roofing submittal.
   a. Confirm manufacturer and proposed roofing manufacturer meets current SNL standards.
   b. Identify any conflicts, changes, or modifications to the original layout that might modify or affect the project.
   c. Discuss any security issues for the building and the effect they have on the project.
   d. Discuss the importance of proper roofing practices, and convey the information to the subcontractors involved.
   e. Record all significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

1.04 Quality Assurance

A. Roofing system must be applied only by an approved Contractor authorized before bid by the roof membrane manufacturer. Before bidding, the Roofing Contractor must have completed a minimum of 500 roofing squares of chlorosulfonated polyethylene (CSPE) membrane in the Southwest. To qualify for this requirement, the completed membrane must have met all conditions to obtain material and labor warranty, and must be performing successfully.

B. The membrane manufacturer must supply a list of projects completed in the Southwest, where the specified membrane has been in place and performing successfully for a period of no fewer than 5 years. A minimum of 500 roofing squares must have been installed to meet this requirement.

C. There must be no deviation from this specification or the approved shop drawings without prior written approval by the manufacturer and the Sandia Delegated Representative (SDR).

D. Code Requirements

The proposed roofing system must meet the requirements of the following recognized code approval or testing agencies. These requirements are minimum standards, and no roofing work can commence without written documentation of the system's compliance, as required in section 1.03, *Submittals*.

1. UL Class A membrane
2. FM 1-60 or 1-90 uplift rating, as indicated on Contract Documents per FM Approval Standard No. 4470

E. ENERGY STAR Roof Compliance

The proposed roofing system must be ENERGY STAR roof compliant, and roofing materials must be ENERGY STAR labeled.

F. In accordance with NRCA Roofing and Waterproofing Manual good roof design practice for new installations, ponding must not occur. Ponding water must not be present 48 hours after rainfall.

G. No more than 20 patches per 10,000 square feet on new construction are allowed.

1.05 Delivery, Storage, and Handling

A. All products delivered to the job site must be in the original unopened container or wrappings.

B. Membrane rolls and insulation must be stored fully protected from moisture and wind damage. Remove plastic from insulation and cover with tarpaulins on a raised surface.

C. Bonding adhesives must be stored at temperatures recommended by the manufacturer.

D. Handle all materials to prevent damage. Any materials that the SDR determines are damaged must be removed from the job site and replaced at no cost to SNL.

1.06 Project Conditions

A. Construction might not be fully represented on the drawings, and some modifications to details might be required to accomplish the intent of the documents.

- Before bidding, the Contractor must ascertain to his or her satisfaction, and coordinate with the General Contractor and other subcontractors, that the specifications and drawings are workable and that they do not conflict with the manufacturer's requirements for a material warranty.

B. All work must be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The building and its contents must be protected against all risks, and any damages must be repaired or replaced at no cost to SNL. All exterior lighting, equipment, landscaping, and paving must be protected from damage.

C. The Contractor must test drains at the direction of the SDR before and upon completion of roofing work to ensure that no blockage exists or has occurred.

D. Install only as much of the new roofing, including all flashing work, as can be made weathertight each day. Plug all roof drains before starting work each day, and unplug all drains at the end of each workday.

E. All surfaces to receive insulation, membrane, or flashing must be thoroughly clean and dry. If surface moisture occurs, the Contractor must provide the necessary equipment and labor to dry the surface before application.

F. All construction, including equipment and accessories, must be secured against wind blow-off damage.

G. Temporary waterstops must be installed at the end of each workday and must be removed before proceeding with the next day's work. Waterstops must be compatible with all materials, must not emit dangerous or incompatible fumes, and must be installed per the manufacturer's recommendations.

H. The Contractor must provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Plywood protection must be provided for all new and existing roof areas that receive traffic during construction.

I. Before and during applications, all dirt, debris, and dust must be removed from surfaces by either sweeping or vacuuming. Compressed-air cleaning is prohibited.

J. Liquid materials such as solvents and adhesives must be stored and used away from open flames, sparks, and excessive heat.

K. Membranes and accessories must not be exposed to a temperature exceeding 160°F (71°C) for a prolonged period.

L. Contaminants such as grease, fats, oils, and solvents must not be allowed to come into direct contact with the roofing membrane. Any exposures must be presented to the membrane manufacturer for assessment of effect on the roof system performance.

M. Clean the site, including both interior and exterior building areas below or adjacent to or in any way affected by the construction of the roof. Cleaning the membrane with gasoline is prohibited. Only cleaners approved by the roof membrane manufacturer and the SDR can be used to clean the membrane. Notify the SDR before using any solvent or cleaner to allow intake fans to be shut down.

N. All roofing, insulation, flashings, and metal work removed for construction must be promptly taken off the site to a legal dumping area.

O. After exposure to sunlight for 24 hours or longer, the membrane may have achieved a "surface" curing. Before hot-air welding, an application of manufacturer's recommended primer is required to achieve a proper weld. The need for primer is determined by a test weld in the presence of the SDR.

P. The Contractor must ensure that overloading of deck and structure does not occur during application and storage.

Q. Precautions must be taken when using adhesives at or near rooftop vents or air intakes. Coordinate closing or shutoff of vents and air intakes during roofing and flashing operations.

1.07 Warranty

A. Upon construction completion, the manufacturer's 10-year warranty covering materials must be issued to SNL.

B. The Roofing Contractor must supply SNL with a minimum 2-year workmanship warranty. In the event that any work related to roofing, flashing, or metalwork is found to be defective or otherwise not in accordance with the Contract Documents within 2 years of final acceptance, the Roofing Contractor must remove and replace the defects at no cost to SNL.

Part 2 - Products

2.01 General

Provide an insulated roofing system that is composed of fully compatible components for use in the proposed application. All proposed materials must be compatible with the substrate.

2.02 Membrane

Use polyester-scrim-reinforced CSPE sheet conforming to the following minimum physical properties:

Property	ASTM Test Method	Specification
Color		White
Weight	D751	0.29 lb/ft^2 (1.41 kg/m^2)
Nominal Thickness (Min.)	D751	0.060 inch (1.5mm)
Tolerance Thickness (Min.)	D751	+0%
Breaking Strength (Min.)	D751 (Grab Method)	225 lbf (1.0 kN)
Elongation (Min.)	D751	25%
Tear Resistance (Min.)	D751 (Tongue Method)	90 lbf (400 N)
Ozone Resistance (Min.)	D1149	Pass
Low Temperature Flexibility	D2136	Pass
Heat Aging	D573	Maintains 100% of Breaking Strength
Volatility, Max. Loss	D1203, Method A	0.5%
Hydrostatic Resistance	D751, Method A	300 psi (2.1 Mpa)
Shore A Hardness	D2240	80 + 5
Puncture Resistance	FTM 101B, Method 2031	200 lbf (900 N)
Dimensional Stability (Max.)	D1204	0.1%
EMMAQUA® Concentrated Natural Sunlight, 3 Million Langleys	G90-10	No Visible Surface Cracking or Stiffening
Change in Weight after Immersion in Water (Max.)	D570	+3.0%
Initial Solar Reflectance (Min.)	E903	0.65
Three-Year-Aged Solar Reflectance (Min.)	E903	0.50
Emissivity (Min.)	E408	0.90
Compliant with ASTM Roof Covering Fire Test	E108 or UL 790	

2.03 Flashing Membrane

Flashing membrane must be as supplied by the roofing membrane manufacturer. Flashing membranes are generally the same material as the roofing membrane, unless otherwise specified in the Contract Documents. Unreinforced 0.055 inch (1.4mm) minimum thick, uncured, white CSPE must be used for round flashings and corners.

2.04 Insulation

A. General

Provide insulating materials to comply with referenced standards and requirements indicated for materials; provide the manufacturer's standard thicknesses in size to fit applications.

1. Fully adhered systems: Provide no greater than 4-foot-by-4-foot (1.2m-by-1.2m) boards.
2. Mechanically fastened systems: Provide 4-foot-by-8-foot (1.2m-by-2.4m) boards.

B. Polyisocyanurate Board Roof Insulation

Provide and install rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core and manufacturer's standard facing laminated to both sides to comply with FS HH-I-1972/2 Class 1. Provide in 2 layers for a total thickness to meet an average R-value of 30.0, unless otherwise indicated in the Contract Documents.

1. Surface burning characteristics: Comply with ASTM E84 with a maximum flame-spread value of 25 and smoke-developed value of 145.
2. Recycled content: Minimum 9 percent

C. Insulation, fasteners, and adhesive must be supplied or approved by the roof membrane manufacturer for compatibility with the system and the required FM and UL requirements. Adhesives must comply with VOC limits of California South Coast AQMD Rule #1168.

D. Recovery Board

Provide ½-inch (13mm) DensDeck®, or approved equal, over all insulation and tapered insulation.

2.05 Accessory Products

A. Flashing Adhesive

As specified by the membrane manufacturer to comply with VOC limits of California South Coast AQMD Rule #1168. Adhesives containing carcinogens must be limited to vertical surfaces and flashings.

B. Walktread Membrane

Membrane manufacturer's walktread material.

C. Wood Nailers

Treated wood nailers must be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on the Contract Documents. Wood must be #2 or better, treated fire-retardant lumber. Creosote and asphaltic preservatives are prohibited. Height of nailers must match that of the insulation thickness or as indicated on the drawings. Nailers must be anchored firmly at a maximum spacing of 12 inches (305mm) unless noted otherwise on drawings and capable of resisting a force of 300 pounds per lineal foot (446 kg per meter) in any direction. Provide ½-inch (13mm) expansion spaces between lengths of nailers.

D. Sealants

As recommended by the membrane manufacturer to comply with California South Coast AQMD Rule #1168.

E. Miscellaneous Fasteners and Anchors

All fasteners, anchors, nails, and straps must be of zinc-coated steel, galvanized, or stainless steel, and be free of cadmium. All fasteners and anchors must have a minimum embedment of 1½ inches (38mm) and must be approved for such use by the fastener manufacturer and the membrane manufacturer.

F. Sheet Metal Accessory Materials

ASTM A653, with 0.20 percent copper, G90 hot-dipped galvanized, 24-gauge (0.61mm) or heavier.

G. Expansion Joint Covers

Must be the manufacturer's prefabricated units of the same material as the roof membrane.

H. Perimeter Edge Metal

Must be supplied by the membrane manufacturer and coated with the same material as the roofing membrane, and must be compatible with the roofing membrane for hot-air welding.

I. Slip Sheet

Provide only when needed between incompatible materials. Use membrane manufacturer's standard slip sheet material.

J. Base Sheet

Provide membrane manufacturer's recommended vented base sheet on all types of concrete decks or when required or recommended by membrane manufacturer for the intended application.

K. Vapor Barrier

Provide membrane manufacturer's recommended kraft paper vapor barrier between all metal decks and insulation as indicated on the Contract Documents or as recommended by membrane manufacturer.

L. B-Line Rooftop Supports or Approved Equal

To be placed at a minimum of 10 feet (3m) on center for proper support. Refer to SNL Standard Detail Drawings AE5035 and AE5036, for rooftop supports.

Part 3 - Execution

3.01 Inspecting Installed Work

A. The Contractor must carefully inspect the installed work of all other trades and verify that all such work is complete to the point that the work in this Section may properly commence.

B. Verify that work of other trades that penetrates the roof deck has been completed.

C. Verify that the roofing system is installed in strict accordance with all pertinent codes and regulations, the original design, and the manufacturer's recommendations.

D. In the event of discrepancy, immediately notify the SDR.

E. Do not proceed with installation in areas of discrepancy until all discrepancies have been fully resolved.

F. Upon starting the installation of a new roof, the SDR, General Contractor, and subcontractors (if applicable) will designate a portion of the installation to be used as a mock-up. This area will be the model of how the roof installation must be installed. All concerns with the remainder of the installation must refer to the installation of the agreed-upon mock-up. The mock-up should include the insulation, a curb, flashing, parapet, and an inside and outside corner along with a termination and lap seam.

G. Throughout the project and at construction completion, the SDR must be allowed to inspect the roof, including probing as necessary to ensure proper installation.

3.02 Preparing the Substrate

A. General

Comply with the insulation and membrane manufacturer's instructions for preparation of the substrate to receive the roofing system.

B. Clean substrate of dust, debris, and other substances detrimental to the system work. Remove sharp projections.

C. Request that the SDR inspect the substrate. The Contractor must not proceed with installation until the SDR has approved the substrate.

3.03 Installing the Insulation

A. Insulation must be installed according to the insulation manufacturer's instructions, and must be approved by the SDR and membrane manufacturer.

B. Insulation must be cut to fit neatly around all penetrations and projections.

C. Install tapered insulation, where applicable, in accordance with insulation manufacturer's approved shop drawings to achieve the specified slope.

D. Install tapered insulation around drains creating a drain sump.

E. Do not install more insulation board than can be covered with membrane by the end of the day or at onset of inclement weather.

F. Attachment

1. Insulation must be fastened mechanically or fully adhered to the deck with approved fasteners and plates or adhesives at a rate and pattern that meet the requirements of FM and the membrane manufacturer.
2. Fasteners and adhesives must be installed in accordance with the fastener manufacturer's recommendations. Fasteners must have a minimum penetration into the structural deck as recommended by the fastener manufacturer and membrane manufacturer. Fasten only in top of ribs of metal deck, not flutes.
3. Perform pull-out tests for the SDR to verify deck conditions and actual pull-out values before installation of the membrane.
4. Use fastener tools with a depth locator as recommended or supplied by the fastener manufacturer to ensure proper installation.
5. All joints and seams must fit tightly to prevent any gaps, voids, and surface irregularities.

3.04 Installing the Membrane

A. Install materials in accordance with manufacturer's instructions for the intended application.

B. Insulation surface must be inspected before installation of the roof membrane. The insulation surface must be clean and smooth with no excessive surface roughness, contaminated surfaces, or unsound surfaces such as broken or delaminated insulation boards.

C. Membrane must be installed the membrane manufacturer's written installation procedures for an approved mechanically fastened or fully adhered system.

D. Do not apply bonding adhesive to lap areas that are to be welded to flashing or adjacent sheets. All sheets must be applied in the same manner, lapping all sheets as required by welding techniques. Peel-and-stick products are not allowed.

E. Any repairs or patches must be hot-air welded. Peel-and-stick products are not allowed.

F. Adjacent sheets must be welded in accordance with the manufacturer's written instructions. All side and end lap joints must be hot-air welded. Lap area must be a minimum of 3 inches (76mm) wide when machine welding, and a minimum of 4 inches (102mm) wide when hand welding. Adhesive must not be present within the lap areas.

G. Hand and machine welding must be performed per the manufacturer's written instructions. All mechanics who intend to use the welding equipment must have successfully completed a course of instruction provided by a manufacturer's representative before welding. All welding equipment must be approved by the manufacturer before use.

H. The Contractor must check all completed seams for continuity after cooling using a screwdriver or suitable blunt instrument. In addition, the Contractor must perform an on-site evaluation of welded seams as directed by the SDR or membrane manufacturer's representative. Contractor must provide 2-inch-wide (51mm) cross-sectional samples

taken through completed seams. Two samples will be taken per 100 roofing squares. Correctly welded seams display failure from shearing of the membrane before separation of the weld. The Contractor must patch each test cut at no additional cost to SNL.

I. Exposed or cured membrane must be hot-air welded per the manufacturer's instructions.

J. During the course of the work, the entire roof area must be kept clear of loose or spilled fasteners and metal scraps to guard against accidental puncture of the membrane.

3.05 Installing Membrane Flashings

A. All flashing must be installed concurrently with the roof membrane as the job progresses. No temporary membrane flashings are allowed without the prior written approval of the SDR. Approval is granted only for specific locations on specific dates.

B. All flashing membranes must be fully adhered to substrates. All interior and exterior corners and miters must be cut and hot-air welded in place, or prefabricated corners and miters may be used.

- Bituminous elements must not be in contact with incompatible membrane. Manufacturer's recommended isolator must be used to isolate incompatible membrane flashing from bituminous coated elements such as vent stacks and pipes penetrating the roof.

C. All flashings must be hot-air welded at their joints and at their connections with the roof membrane. Peel-and-stick products are not allowed.

D. Pipe penetrations must be flashed a minimum of 8 inches (203mm) above the roofing membrane, and terminate with a stainless-steel hose clamp with sealant applied along the top edge. Pipe should be isolated by membrane. Factory-fabricated pipe seals and roof membrane must be welded as outlined. A buffer layer of membrane must be installed between hose clamp and flashing sheet to avoid damage.

E. All curb flashing membranes must be mechanically fastened along the top using nails with 1-inch-diameter (25mm) heads spaced a maximum of 6 inches (152mm) on center, or predrilled metal strips. All roof edge flashings must be hot-air welded to the membrane manufacturer's coated metal. Predrilled metal strips must be caulked along the top edge with a sealant. Expansion pins with nylon sheaths set in predrilled holes must be used to secure flashings to masonry and concrete surfaces. Reglets must be used on walls as shown on the Contract Documents.

F. Edge metal must be supplied by the membrane manufacturer and must be coated with the same material as the roofing membrane. The edge metal and membrane strips joining each piece of edge metal must closely match the color of the building perimeter, unless specified elsewhere on the Contract Documents or by the SDR.

3.06 Creating a Temporary Cutoff

A. Flashings must be installed concurrently with the roof membrane to maintain a watertight condition as the work progresses. When a break in the day's work occurs in the central area of the roof, a temporary waterstop must be constructed to provide a watertight seal.

1. Waterstop must be installed according to the manufacturer's recommendations and details shown on the Contract Documents.

2. When work on the new system is suspended, the stagger of the insulation joints must be maintained by installing partial fillers. New membrane must be carried into the waterstop.
3. When work resumes, the contaminated membrane, insulation fillers, and so forth must be removed from the work area and disposed of off-site. Do not reuse these materials in new work.

B. If inclement weather occurs while a temporary waterstop is in place, the Contractor must provide the labor necessary to monitor the situation to maintain a watertight condition.

3.07 Installing the Walkway

Install walkway pads at locations shown on Construction Documents. Hot-air weld along edges a minimum of 2 inches (51mm) to substrate, and fully adhere walkway pads between welds to substrate with compatible adhesive according to roofing system manufacturer's written instructions. Walkway corners must be rounded and hot-air welded in accordance with manufacturer's written instructions.

3.08 Completing Construction

A. At completion of construction and before the Contractor's request for final inspection by the SDR, membrane manufacturer's technical consultant must provide on-site inspection of installed roofing system.

1. The membrane manufacturer must provide the Contractor and the SDR with an itemized list of defects or noncompliance with manufacturer's recommendations.
2. The Contractor must immediately correct identified items. Complete corrections before requesting the SDR perform the final inspection.

B. Prior to demobilization from the site, the SDR and the Contractor must review the work.

1. Itemize defects or noncompliance with these specifications or membrane manufacturer's recommendations in the punch list.
2. The Contractor must immediately correct identified items to the satisfaction of the SDR and the membrane manufacturer before demobilization.

C. Upon completion of construction, the Contractor must install a metal sign (minimum size of 8 inches by 10 inches, or 203mm by 254mm) at each roof entryway providing the following information:

1. Contractor company name
2. Membrane manufacturer
3. Name of SNL Inspector
4. Date of installation

END OF SECTION