01 34 10: Project and Plan Review Services

Brown University

NOVEMBER 2021 UPDATE

CONTENTS

PURPOSE

FM Global provides project and engineering and loss prevention management services to support Brown University's property insurance program. These services are intended to help projects meet "highly protected risk" (HPR) standards at the projects' outcome. This guide supports this goal by providing:

1. General guidelines for FM Global involvement.
2. High-level FM Global design standards and references to FM Global Property Loss Prevention Data Sheets.
3. Project support coordination and timelines.

GENERAL GUIDELINES FOR FM GLOBAL INVOLVEMENT

FM Global should be involved with the following types of construction/projects:

- All new construction (includes prospecting new locations for relocation/expansion).
- Existing facility renovations resulting in significant change in occupancy or construction.
- Modifications to fire protection (new construction and renovations).
- All roof projects (recovers, replacement, decks, rooftop-mounted equipment).
- Emergency power and fuel oil systems, including boilers and generators.
- New solar power installations.

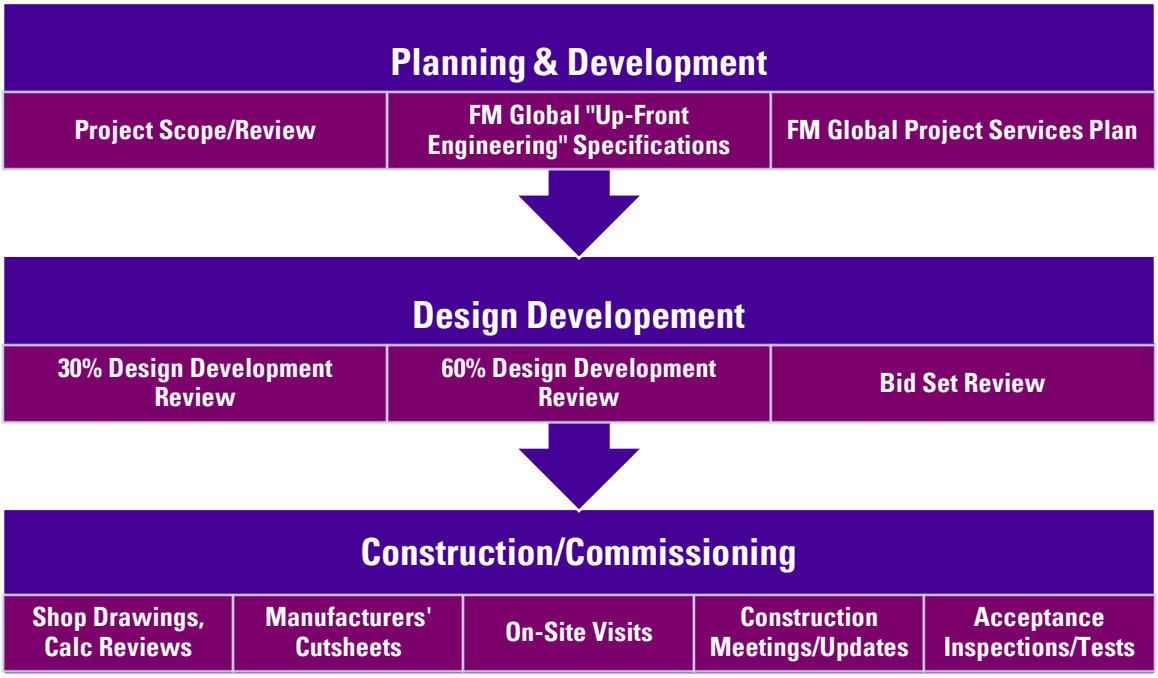

Figure 1. Project Milestone Flow Diagram

FM Global should be involved early – the sooner the better. In other words, FM Global should provide needed design information well-before budgets are requested and/or approved. The best outcomes and the most effective and efficient communications and expectations-setting results when FM Global is involved at the conceptual design stages. The following chart shows what FM Global project services and activities should be provided and by what milestone in a given project's timeline.

Brown and its contractors are asked to provide the Brown University's FM Global account number 56301 in the subject line when submitting project information and the project's FM Global index number:

- College Hill: 015371.50-02
- Knowledge District: 015558.17-03
- Graphic Services and Library Storage: 015367.51-02

FM Global does not need to be involved with minor interior renovations, such as relocating interior gypsum walls, door/hardware changes, furnishings, etc. However, check with Brown's risk and facilities departments and FM Global when in doubt.

AUTOMATIC SPRINKLER SYSTEMS, INCLUDING FIRE PUMPS

FM Global provides design information for automatic sprinkler systems to ensure these systems are adequate for the intended occupancy. Adequacy accounts for proper hydraulic sprinkler design, including water supply demand/duration requirements are met. FM Approved materials should be used throughout these systems either on a system or component basis.

"Up-Front Engineering" and Consultation First

The greatest challenges typically lie with identifying and confirming occupancy usage to subsequently select the proper hydraulic design. As a result, FM Global should be involved very early-on to help select the proper hydraulic design. A description of the occupancy is always needed; on-site visit/consultation is often helpful, particularly if mixed-occupancy, ignitable liquids are used/stored, or storage is present.

Plan Review Second

Once the occupancy and hydraulic sprinkler design requirements have been identified and confirmed, then the following information should be submitted for review:

- System drawings/schematics.
- Hydraulic calculations.
- Fire pump arrangement – drawings/schematics, fire pump house/room construction and layout.
- Fire pump single-line diagram (electric fire pumps).
- Fire pump certified bench curve.
- Manufacturers' specification sheets ("cutsheets"), including those for fire pumps, drivers, and controllers.
- FM Global *Contractor's Materials & Test Certificate for Automatic Sprinkler Systems* (Form 85A).
- FM Global *Contractor's Materials & Test Certificate for Underground Piping* (Form 85B).
- FM Global *Contractor's Pump Acceptance Test Data* (Form 105).

References

- FM Global Property Loss Prevention Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
- Data Sheet 3-7, *Fire Protection Pumps*
- Data Sheet 3-10, *Installation/Maintenance of Private Service Mains and Their Appurtenances*
- Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*
- Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
- Data Sheet 7-32, *Ignitable Liquids Operations*
- Data Sheet 8-1, *Commodity Classification*

- Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*

FIRE ALARM SYSTEMS

FM Global provides design information for automatic fire alarm systems to ensure these systems are adequate to provide the level of detection that is required. FM Approved materials should be used throughout these systems either on a system or component basis.

Plan Review

The following information should be submitted for review:

- System drawings/schematics – including control wiring, battery back-up requirements/calculations.
- Manufacturers' specification sheets ("cutsheets"), including those for initiating devices, alarm boxes, sprinkler flow alarms, tamper switches, supervisory devices, etc.

References

- FM Global Property Loss Prevention Data Sheet 5-40, *Fire Alarms Systems*
- Data Sheet 5-48, *Automatic Fire Detection*

SPECIAL PROTECTION SYSTEMS

FM Global provides design information for special protection systems to ensure these systems are adequate for the intended occupancy. Special protection systems account for using various extinguishing agents, such as carbon dioxide, dry-chemical, FM-200, Inergen, foam, and water-spray systems. Adequacy accounts for proper design, including density/duration requirements are met and FM Approved materials/systems are used throughout these systems.

"Up-Front Engineering" and Consultation First

The greatest challenges typically lie with identifying and confirming occupancy usage to subsequently select the proper design/system. As a result, FM Global should be involved very early-on to help select the proper design/system. A description of the occupancy is always needed. On-site visit/consultation is often helpful, particularly if it is a mixed-occupancy, if ignitable liquids are used/stored, or if storage is present.

Plan Review Second

The following information should be submitted for review:

- System drawings/schematics.
- Occupancy details – room and subfloor dimensions, including presence of ordinary combustibles (desks, chairs, paper, etc.)
- Pre-Engineered vs. Component Systems – Use FM Approved pre-engineered gaseous suppression systems from the FM Approval Guide.
- Hydraulic Calculations – required densities/concentrations and durations are met.
- Manufacturers' specification sheets ("cutsheets"), including those for initiating devices, alarm boxes, supervisory devices, etc.
- FM Global *Contractor's Checklist for Carbon Dioxide Extinguishing System Installations* (Form 251).
- FM Global *Contractor's Application for Acceptance of Gaseous Extinguishing System Installations* (Form 2332).

- FM Global *Contractor's Checklist for Foam Extinguishing System Installation* (Form 7615).
- FM Global *Contractor's Application for Acceptance of Water Mist System Installations* (Form 5560).

References

- FM Global Property Loss Prevention Data Sheet 4-0, *Special Protection Systems*
- Data Sheet 4-1N, *Fixed Water Spray System for Fire Protection*
- Data Sheet 4-2, *Water Mist Systems*
- Data Sheet 4-3N, *High-Expansion Foam Systems*
- Data Sheet 4-9, *Halocarbon and Inert (Clean Agent) Fire Extinguishing Systems*
- Data Sheet 4-10, *Dry Chemical Systems*
- Data Sheet 4-12, *Foam Extinguishing Systems*

ROOFS, ROOFTOP-MOUNTED EQUIPMENT, & WALLS (Fire and Windstorm Exposures)

FM Global provides design information for roofing systems to ensure these systems are adequate for both fire and windstorm exposures. RoofNav is a free tool from FM Approvals that provides access to the most up-to-date FM Approved roofing products and assemblies.

http://www.roofnav.fmglobal.com/Account/Login

FM Approved roof assemblies are only FM Approved as assemblies. Product substitutions and deviations inherently result in non-FM Approved assemblies – unless – those substitutions and deviations are specifically listed and associated with the specific RoofNav number assembly listing.

FM Global Design Requirements

All roof and wall systems should be designed to account for the following parameters:

- Basic Wind Speed (3-second gust): 105 mph (College Hill, Knowledge District, and Graphic Services/Library Storage). However, check with FM Global for site-specific guidance for other properties.
- Ground/Surface Roughness Coefficient: Default to "C." However, check with FM Global for site-specific guidance. Select buildings may be "B" while other areas, such as the Knowledge District, may be "D" given their proximities to the Providence River and Narragansett Bay.
- Importance Factor: 1.15
- Safety Factor: 2.0

Cross-Laminated Timber (CLT) Roof Deck Construction

FM Global does not recommend using CLT roof construction. Currently, there are no FM Approved roof assemblies that use CLT products. If CLT roof construction is used, then the guidance in *Appendix A: CLT Roof Deck Construction Guidance* should be strictly followed. (It is important to note that while the approach outlined in Appendix A uses an FM Approved roof assembly as a basis, the installed roof will not be considered FM Approved.)

Plan Review

The following information should be submitted for review:

- Construction set (architectural, rooftop MEP, and structural).
- Specifications (sections concerning roofing, perimeter/edge metal flashing, and nailers).
- Roof uplift calculations, FM Global RoofNav assemblies, and RoofNav Contractor's package.
- FM Global *Checklist for Roofing System* (Form 2688) for each roof area. Forms should include building dimensions, proposed RoofNav assembly numbers – brands, components, thicknesses, securement rates, etc.
- Any Boundary Layer Wind Tunnel study reports.

References

- FM Global Property Loss Prevention Data Sheet 1-15, *Roof Mounted Solar Photovoltaic Panels*
- Data Sheet 1-28, *Wind Design*
- Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components*
- Data Sheet 1-31, *Panel Roof Systems*
- Data Sheet 1-35, *Vegetative Roof Systems*
- Data Sheet 1-49, *Perimeter Flashing*
- Data Sheet 1-52, *Field Verification of Roof Wind Uplift Resistance*

FUEL-FIRE EQUIPMENT

FM Global provides design information for fuel-fired equipment to ensure these systems are adequate for the intended equipment installation. Adequacy accounts for proper installation, safeguard controls design (including sequencing), adequate fire protection for fuel oils and other potential ignitable liquids, and FM Approved equipment and components are used throughout these systems.

Plan Review

The following information should be submitted for review:

- Fuel trains and piping diagrams.
- Electrical one-line diagrams and PLC diagrams.
- Manufacturers' specification sheets ("cut-sheets") for all equipment and components, including those for initiating and supervisory devices, etc.
- FM Global *Contractor's Oven/Furnace Manufacturer's Checklist* (Form 69).
- FM Global *Installer's Checklist for Automatic-Lighted Boiler Safety Combustion Control System* (Form 82).

References

- FM Global Property Loss Prevention Data Sheet 6-0, *Elements of Fuel Fired Equipment*
- Data Sheet 6-4, *Oil and Gas Fired Single-Burner Boilers*
- Data Sheet 6-5, *Oil and Gas Fired Multiple Burner Boilers*
- Data Sheet 6-12, *Low-Water Protection for Boilers*
- Data Sheet 6-22, *Firetube Boilers*
- Data Sheet 6-23, *Watertube Boilers*

PLASTICS-IN-CONSTRUCTION

Plastics-In-Construction involves those construction materials that are inherently composed of plastics. Such materials are inherently more combustible rendering fire protection inadequate even if designed to FM Global standards (unless fire protection properly accounts for plastic construction materials). Another concern is these materials create unprotected, combustible concealed spaces if not managed appropriately. Automatic sprinkler protection requirements can also be much more conservative than first-anticipated depending upon installation and extent of combustible loading.

As a result, plastic construction materials should be avoided; otherwise, all should be FM Approved. Attention should be made to ensure FM Approved products are used/installed in accordance with their Approval. Attention should also be made to ensure "green" and recycled construction materials are adequately identified. Many of these materials contain significant plastics-loading. Any questions or concerns about these materials should be made to your local FM Global field engineer or FM Global client service team.

References

- FM Global Property Loss Prevention Data Sheet 1-57, *Plastics in Construction*

AUTOMATIC SPRINKLER SUPERVISION - AUTHORIZED & MANAGED OPERATIONS (IMPAIRMENT MANAGEMENT PROGRAMS)

Authorized, controlled, and managed operations of a property's automatic sprinkler and fire protection systems are a core philosophy to FM Global human element programs. FM Global's clients' loss histories clearly demonstrate that fires in sprinklered facilities were much more severe where sprinkler valves and other fire protection was impaired compared to unsprinklered and unprotected facilities. The practices of locking sprinkler valves wide-open and managing fire protection impairments using the FM Global Red Tag Permit System will help ensure sprinklers are and remain in-service, especially areas under construction.

References

To help support sprinkler supervision management, FM Global has several online client training offerings.

- Managing Impairments Using FM Global's Red Tag Permit System (training module: 1-hour)
- Managing Fire Protection System Impairments (recorded webinar: 38 minutes).

These offerings, as well as multiple others, can be accessed free-of-charge at FM Global Client Online Learning Solutions at:

https://fmglobaltraining.skillport.com/skillportfe/custom/login/fmglobal/fmgloballogin.action?path=fmglobal/login/FmglobalLoginAction&lang=en

APPENDIX A: CLT ROOF DECK CONSTRUCTION GUIDANCE

If CLT roof construction is used, then the following guidance should be strictly followed:

- Use a RoofNav assembly designed for use on steel deck with appropriate ratings described in FM Global Property Loss Prevention Data Sheet 1-28, *Wind Design.* The assembly should include within its listing a gypsum thermal barrier directly over the CLT deck or a gypsum coverboard over the insulation.

- Fastener spacing that is specified within the RoofNav listing should not be modified unless adequate wood screw resistance cannot be met following the guidance presented in *Appendix A: Screw Wind Resistance Calculations*. If this proves to be the case, then a tighter spacing can be utilized and the analysis verified according to the equations and limits of *Appendix A*. Regardless of the spacing, the specified fasteners should be replaced with wood screws that have an equivalent head shape and size.
- The required minimum penetration of the wood screws should be calculated in accordance with *Appendix A* without exceeding the upper resistance limit of the screw.
- The penetration length of the wood screw must be less than the thickness of the CLT deck.
- If the upper resistance limit is violated, either a larger screw size or higher-grade screw material should be used and the analysis recalculated in *Appendix A*.
- It is important to note that while this approach uses an FM Approved roof assembly as a basis, the installed roof will not be considered FM Approved.

Wood Screw Size	Required penetration of screw into Solid Sawn Lumber Wood Members (including CLT)	Upper resistance limit (Factored load/fastener)
#8	$$\boldsymbol{Required\ penetration}\ [\boldsymbol{in}] = \left(\frac{\mathbf{1}}{\mathbf{115}} * \boldsymbol{Rating} * \boldsymbol{Trib\ Area}\right) + \mathbf{0.3} > \mathbf{1}"$$	$$\boldsymbol{Factored\ Load\ per\ fastener}\ [\boldsymbol{lb}] \leq \frac{\boldsymbol{F_u}}{\mathbf{111}}$$
#10	$$\boldsymbol{Required\ penetration}\ [\boldsymbol{in}] = \left(\frac{\mathbf{1}}{\mathbf{133}} * \boldsymbol{Rating} * \boldsymbol{Trib\ Area}\right) + \mathbf{0.4} > \mathbf{1}\frac{\mathbf{3}}{\mathbf{16}}$$	$$\boldsymbol{Factored\ Load\ per\ fastener}\ [\boldsymbol{lb}] \leq \frac{\boldsymbol{F_u}}{\mathbf{83}}$$
#12	$$\boldsymbol{Required\ penetration}\ [\boldsymbol{in}] = \left(\frac{\mathbf{1}}{\mathbf{151}} * \boldsymbol{Rating} * \boldsymbol{Trib\ Area}\right) + \mathbf{0.4} > \mathbf{1}\frac{\mathbf{5}}{\mathbf{16}}$$	$$\boldsymbol{Factored\ Load\ per\ fastener}\ [\boldsymbol{lb}] \leq \frac{\boldsymbol{F_u}}{\mathbf{65}}$$
#14	$$\boldsymbol{Required\ penetration}\ [\boldsymbol{in}] = \left(\frac{\mathbf{1}}{\mathbf{169}} * \boldsymbol{Rating} * \boldsymbol{Trib\ Area}\right) + \mathbf{0.5} > \mathbf{1}\frac{\mathbf{1}}{\mathbf{2}}$$	$$\boldsymbol{Factored\ Load\ per\ fastener}\ [\boldsymbol{lb}] \leq \frac{\boldsymbol{F_u}}{\mathbf{50}}$$

Table 1. Screw Wind Resistance Calculations

Note to Table and Equations:
The equations provided are based on the following:

- NDS equation 12.2-2
- NDS Appendix L wood screw dimensions
- Wood Specific Gravity value of 0.35 (conservative)
- For actual wood specific gravity > 0.5, a pilot hole is required.
- Wood moisture content ≤ 19%.
- Wood not exposed to temperatures > 150°F for extended periods.

- Load Duration Factor of 1.0 (conservative)
- Minimum wood screw penetration is 6 x screw diameter; this is depicted by the value on the right side of the inequality.
- Required penetration includes the tapered end of the screw but not unthreaded portions. In other words, required minimum penetration is met with threaded portion of the screw only.

Notes specific to the upper resistance limit:

- The value F_u is the tensile strength [psi] of the selected wood screw. If this is unknown, use 45 ksi as a conservative estimate.
- Upper resistance limit is based on allowable tension in screws per AISI S100-16, J4.4.3, $\Omega_t = 3.00$, and derivation based on tensile strength and net area calculated using root diameter (D_r) of wood screws in NDS Appendix L.
- Manufacturer's data, when available, may be used in lieu of the calculation for the upper resistance limit (Factored Load per fastener must be less than ultimate strength).