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**Note:** No single snow monitoring and response plan can address all conditions. Use this document as a basic guide to develop your own snow monitoring and response plan. Items that do not apply to your facility may be omitted; others may be expanded or added, as appropriate.

1. Purpose

This snow monitoring and response plan is an outline of actions to be taken prior to and during the snow season to monitor and address accumulation of snow on roofs, with the goal of reducing collapse risk and preventing property damage and business interruption.   
A quick succession of snowstorms may require repetition of multiple portions of the plan.

This plan should be a part of a facility’s emergency response plan. It should be reviewed and updated annually to address facility and personnel changes and to ensure that an effective action plan is in place.

1. Snow Collapse Hazard

Snow collapse hazards are unique and site-specific. Understanding the potential scenarios at an individual site provides for the development of plan components that will be most appropriate, leading to a higher level of success. Consult HIROC for assistance in determining the snow collapse hazards at your site.

Identify your site’s snow collapse hazards and critical facility features, including:

1. Description of likely weather event(s) or local “snow of record” history.
2. Sketch of the facility showing the live load capacity of all roof areas in psf (kN/m2).   
   Live load capacities may be found on structural drawings, or a structural engineer can   
   be retained to analyze the buildings and provide these numbers. Live load capacities are a key component of a monitoring plan and are essential to making informed decisions about snow response. Where live load capacities are unknown and a structural evaluation to determine them has not yet been made, temporarily use 65% of the flat roof snow load (Pf) or 15 psf (0.7 kN/m2), whichever is greater, to estimate the live   
   load capacity.
3. Sketch of the facility showing location of rooftop equipment, ducts, pipes, natural gas   
   lines, refrigeration, etc. to ensure that these are identified and are avoided during snow removal. The use of snow markers may also help to identify and avoid these items during snow removal.
4. Sketch of facility with utility shutoffs and isolation valves to facilitate shutdown if a collapse is imminent.
5. Identification of changes in roof elevation with approximate differences in elevation noted. Extra attention should be paid to those areas where snowdrifts have occurred regularly, as those areas are most likely to experience snowdrifts and collapse.
6. Identification of structural deficiencies such as sagging, corrosion, or altered framing. Prioritize these areas for structural reinforcement in long-term facility planning.
7. Authority to Activate and Team Members

A snow monitoring and response plan has two key phases: the initial *snow load monitoring phase* and a subsequent *snow response phase*.

Individuals with the authority to activate each phase should be carefully selected, as the decision to proceed may temporarily affect or halt operations in an effort to reduce overall damage and potential business interruption.

Supporting team members with specific roles in each phase should also be selected.

Individuals with the authority to activate and team members should be identified by name or position for each shift. Alternates for these roles should also be identified. Specific duties assigned to each role should be clearly defined.

|  |  |  |  |
| --- | --- | --- | --- |
| Snow Load Monitoring Roles & Duties | Shift | Person | Alternate |
| Authority to Activate |  |  |  |
| Weather Monitor |  |  |  |
| Snow Accumulation Monitor |  |  |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Snow Response  Roles & Duties | Shift | Person | Alternate |
| Authority to Activate |  |  |  |
| Snow Response Coordinator |  |  |  |
|  |  |  |  |

1. Snow Load Monitoring

Tracking the weather and potential for significant snowfall is the first step in the snow  
load monitoring phase of the plan.

Identify sources for monitoring developing snow events. These may include:

* The Weather Network <https://www.theweathernetwork.com/ca>
* Canadian Weather <https://weather.gc.ca/>
* Other weather agencies in your region
* Local emergency management agency
* Local television or radio stations

Measuring and evaluating snow accumulations in relation to roof live load   
capacities is the next step.

Identify the method(s) to be used for monitoring snow accumulations on roofs and how snow loads will be compared to roof live load capacities. Possible methods include:

1. Weight and density measurements using a bucket and scale.
2. Measurement or visual assessment of depth against snow markers and estimation   
   of the snow density using the following table.

|  |  |  |  |
| --- | --- | --- | --- |
| Roof Snow Load,  psf (kN/m2) | Typical Snowpack Depth, in. (mm) | Wet Snowpack Depth, in. (mm) | Equivalent Ice Depth, in. (mm) |
| 10 (0.5) | 8 (200) | 6 (150) | 2.5 (65) |
| 15 (0.7) | 11 (290) | 9 (220) | 3.5 (90) |
| 20 (1.0) | 14 (370) | 11 (280) | 4.75 (120) |
| 25 (1.2) | 17 (430) | 13 (330) | 6 (150) |
| 30 (1.4) | 20 (500) | 15 (380) | 7.25 (185) |
| 40 (1.9) | 24 (620) | 19 (470) | 9.5 (240) |
| 50 (2.4) | 27 (690) | 21 (530) | 12 (305) |
| 60 (2.9) | 30 (770) | 23 (590) |  |
| 70 (3.4) | 33 (840) | 25 (650) |  |
| 80 (3.8) | 36 (900) | 27 (690) |  |
| 90 (4.3) | 38 (960) | 29 (740) |  |
| 100 (4.8) | 40 (1020) | 31 (780) |  |
| 110 (5.3) | 44 (1120) | 34 (860) |  |
| 120 (5.7) | 48 (1220) | 37 (940) |  |

1. Deflection gauges on horizontal roof framing at strategic locations, with allowable deflections determined by a structural engineer.
2. Structural engineer review of accumulations and structure.

The final step is to identify when snow accumulations have reached the point   
at which the snow response phase of the plan should be activated.

A trigger point of snow loading at 50% of the roof live load capacity is suggested.

1. Snow Response

Upon activation of the snow response phase of the plan, well-coordinated   
response activities should commence, with consideration for site conditions   
and personnel safety.

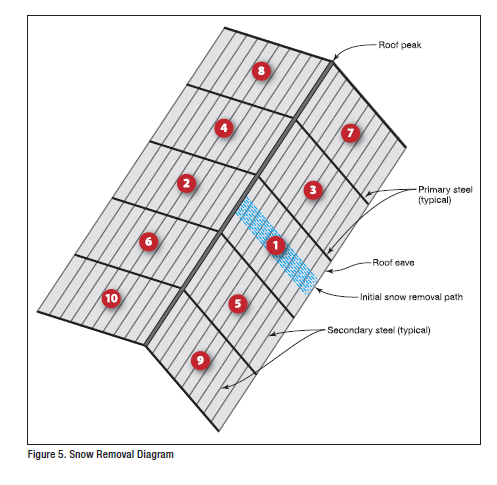
Specific snow response steps and necessary resources should be determined   
and secured in advance.

* Plan actions to take to reduce the risk associated with the increasing snow load.   
  These may include:
  + - * + Evacuation of the building and relocation of critical contents
        + Accelerating snow melt
        + Snow removal
* Identify who will complete the snow response activities (e.g., site employees or contractors versed in appropriate response methods and safety measures). When the services of a contractor are to be used, identify multiple contractors capable of doing the work and consider establishing agreements in advance for priority response.
* Determine the methods and equipment required, such as alternate location for contents, raising the temperature inside buildings, snow and ice melting systems, glycol snow melt blankets, shovels, snowblowers, crane and basket, etc. Obtain and maintain equipment on-site as needed or have agreements in place for equipment rentals.
* Understand and plan for the time needed to mobilize personnel and equipment and carry out response activities.
* If removing snow, plan snow removal steps to prevent additional overloading and collapse. Remove snowdrifts first at roof elevation changes, parapets, and large pieces of equipment, then shift to main roof sections, taking care not to pile snow onto areas already loaded. Keep all roof drains clear and provide a clear path for melted snow to flow to the ground. Avoid impact to roof equipment and prevent damage to roof surfaces.

For simple span steel-framed roofs, sequence of removal is critical to avoid framing overload and should follow the steps listed and depicted below. For other framing systems, consult a structural engineer for appropriate removal steps.

For simple span steel-framed roofs:

* Remove snow from the center portion of a bay
* Clear a path from the peak to the eaves
* Expand the width of cleared area on both sides until the entire bay is clear
* Repeat these steps, alternating bays, following the number sequence in the figure below, from one side of the ridge to the other until all bays are clear



FEMA, Risk Management Series, “Snow Load Safety Guide,” FEMA P-957, January 2013. Figure 5.

When snow response is not effective at reducing snow loads and there are signs   
that the roof is approaching its limit, a structural engineer should be retained to develop and employ a shoring plan. Steps to prepare for possible collapse should also be taken.

Signs indicating that the roof is approaching its structural limit may include snow loading nearing the roof live load capacity and audible or visual evidence of structural distress, such as strange noises, bending or twisting of ceilings, framing, piping, and ductwork.

Preparation for roof collapse should focus on limiting damage to contents and preventing fire. Equipment and inventory should be relocated outside of the potential collapse area. Utilities in the collapse area should be turned off. Maintain as much fire protection in service as possible, only shutting down fire protection in the immediate area if collapse is imminent.

1. Fire Hazard Mitigation

Snow response activities, shoring of structural members under distress, or collapse itself may damage or impair fire protection systems and increase the risk of fire. Mitigation of the fire hazard through the following precautions is critical to reduce the fire potential.

1. Eliminate all unnecessary open flames or heat sources, including smoking.
2. Keep fire protection equipment operational for as long as possible. Use the [FM Global Red Tag Permit System](https://redetag.fmglobal.com/) to manage any fire protection shutdown.
3. Perform Perform hot work only if there are no safer alternatives. Use the [FM Global   
   Hot Work Permit System](https://www.fmglobal.com/report-contact-page/order-hot-work-forms) to supervise any hot work being performed on the property.   
   Hot work should be performed only after fire protection systems have been restored and combustibles are removed from the hot work area.
4. Provide necessary electrical services, with restoration on an item-by-item basis, only after a thorough check by competent qualified personnel.
5. Check ignitable liquid and flammable gas storage (e.g., tanks), equipment, and piping systems for leaks before returning to operation.
6. Initiate a continual fire watch until normal operations are resumed.
7. Recovery Plan

Recovery activities should be coordinated and completed by facility personnel. Where services of contractors and suppliers will also be required, contact them in advance to ensure their availability. Once the site is secure, efforts should focus on restoring fire protection systems and facility operations.

**Restoration of Fire Protection Systems**

Promptly return fire protection systems to service by taking the following actions.   
Manage the return to service using the [*FM Global Red Tag Permit System*](https://redetag.fmglobal.com/).

1. Inspect sprinkler system piping for damage and repair as needed.
2. Inspect all sprinkler control valves to confirm that they are in the full-open position,   
   and that they are operable and undamaged.
3. Check all fire protection alarm systems and make necessary repairs.
4. Run or test fire pumps, fire pump drivers, and controllers. Repair if damaged.
5. Examine fire pump water sources (particularly for open bodies of water) to ensure debris will not enter the pump suction line and sprinkler system.
6. Remove debris from fire protection valve pits.

**Restoration of Facility Operations**

1. Where collapse has occurred, provide a temporary covering to help retain building heat. Use portable heaters to prevent freeze damage and support continuity of operations   
   in areas beyond the collapse. Set up temporary diking and pumps to capture and remove snow melt from inside the building. Direct water to an internal drain or outside the building.
2. Initiate salvage and cleanup activities. Separate salvageable from damaged equipment, stock, and supplies. Relocate salvaged items to a safe area and avoid accumulation of excess combustibles inside buildings. Designate an outdoor debris pile away from buildings and incoming utilities.
3. Prioritize rebuilding of collapse areas and replacement or repair of critical equipment.
4. Where prolonged interruption to site operations becomes apparent, take steps to relocate operations or set up temporary operations elsewhere.
5. Reviews & Updates

Review and update the plan:

* When facility personnel change (i.e., individuals authorized to active the plan   
  or monitoring and response team members)
* When significant facility modifications occur
* Annually to confirm validity of its contents and familiarity of personnel relied upon
* After each activation of the plan in response to a snowfall event

1. Training Exercises

Conduct regular snow monitoring and response plan training exercises that involve all staff required to respond. At least once each year, preferably prior to the snow season, organize a complete dry run to simulate activation of the plan.

1. References

FM Global Property Loss Prevention Data Sheets ([fmglobaldatasheets.com](http://www.fmglobaldatasheets.com))

Data Sheet 1-54, Roof Loads and Drainage

[Protecting your Facilities from Winter Storms](https://www.hiroc.com/resources/protecting-your-facilities-winter-storms-fm-global)

1. Attachments

Include these or other attachments as appropriate:

1. Facility plans with roof live load capacities and locations of rooftop   
   equipment, piping, etc.
2. Fire protection valve list/locations
3. Utility shutoffs and isolation valves
4. Critical equipment shutoffs
5. Key contacts, including:

* Snow response contractors
* Snow removal contractors
* Structural engineers
* Shoring contractors
* Fire protection contractors
* Cleaning and restoration contractors
* Equipment suppliers
* HIROC’s Engineering Liaison Associate, Jean Asuncion: [jasuncion@hiroc.com](mailto:jasuncion@hiroc.com)

1. Record of snow monitoring and response plan reviews and updates
2. Record of training exercises and dry runs