facility located in a floodplain will be exposed to a whole family of flood exposures to varying degrees. For example, if a facility is in a 100-year floodplain where there is a 1 percent chance each year that this flood will occur, that same facility is also in the 200-year flood plain with a 0.5 percent chance of the 200-year flood occurring, etc.

Protection

Flood protection can be divided into three types: permanent, contingent and emergency.

Permanent protection means that barriers are permanently attached to a building, or are always in place. Automatic sprinklers are examples of permanent fire protection. This is constant protection that requires no emergency action and is the most reliable. In some cases, however, a small degree of action may still be needed, such as sliding a flood shield into place and bolting it down.

In areas where flash flooding is common, rely only on protection that is constantly ready. Any unnecessary windows can be filled in or bricked up with materials similar to the wall construction. Where the design flood will produce fairly low levels, blocking only the lower portion of the window may be sufficient. Windows or other openings can also be protected by movable shields ready to roll into place when needed.

During both high-water conditions and actual floods, water can enter a sealed building through floor drains or other plumbing fixtures. Using hand-operated valves on piping will help prevent this. Check valves are less reliable as they can become clogged.

If water enters a building through any sizable opening such as a window, the use of pumps will be ineffective. In almost all cases, the water flow will totally overwhelm the pump.

Even if water cannot be prevented from entering a building, limiting damage may still be possible. If the expected flood level is only a few feet above the ground floor, building low protection walls around vital mechanical equipment such as boilers, furnaces, computers and switchgear may be practical. (For this reason, computers and other valuable equipment should never be located in basement areas.) These walls can be equipped with access openings that are protected by flood shields.

Where values are extremely high and the possibility of salvage is low, the flood damage potential may justify the construction of local-area fixed protection such as a flood wall or dike. The Army Corps of Engineers and other U.S. government agencies have constructed such barriers for entire U.S. municipalities. Cooperation among several neighboring companies could help make construction of a local-area flood wall feasible.

The successful use of *contingent protection* requires sufficient early warning and the existence of a detailed emergency operations plan Flood shields for windows and doors can be stored in a convenient location, carried to the opening when needed, placed over permanently mounted brackets and bolted down quickly. Similar procedures can be used for ground-level air vents. All shields should be numbered or otherwise identified to match their corresponding doors, windows and vents. If light metal shields are used, bracing may be necessary. If ½-in. (1.2 cm) steel or aluminum plates are used, reinforcing is often unnecessary, but the weight of the shield may make it difficult to transport.

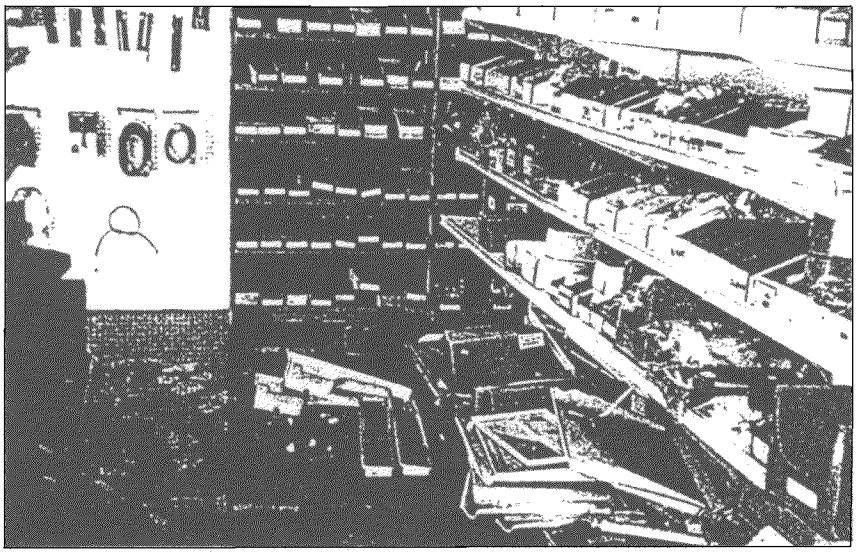
The success of both permanent and contingent protection is dependent on the existence of a reliable Emergency Organization (EO). The last form—*emergency protection*—is especially dependent on the EO. Several years without a flood can lull a facility into a false sense of security. To ensure that the EO is always prepared for a flood emergency, conduct annual training or review sessions prior to the flood season. Also, keep an updated list of emergency phone numbers on hand. Don't assign employees who live in the same flood-prone area to flood duty; understandably, their first concern during a flood emergency will be their own homes and families.

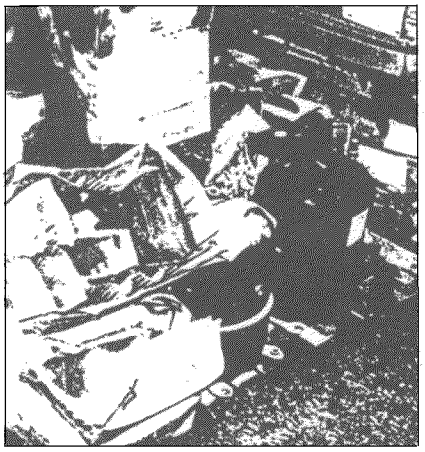
One person at a facility should be designated as the emergency coordinator and be authorized

Restoring fire protection

Following a flood, use this checklist to help bring your facility back to its normally fire-safe condition.

1. Test all sprinkler control valves to make sure they are in the open position, and examine them for physical damage. If valves are found closed, check for broken or disconnected piping before reopening.
2. Remove water and mud from valve pits.
3. Check yard mains and sprinkler systems for obstructions if pumps taking suction from open bodies of water have been operated. (Methods of test flushing these systems are given in FME&R Loss Prevention Data Sheet 2-81, *Inspection and Maintenance of Sprinkler Systems*.)
4. Check yard main systems and tank foundations for washouts.
5. Check the integrity of all fire protection supervisory system circuits.
6. Check all fire pumps, and immediately begin restoring any flood-damaged pumps, drivers and controllers.
7. Ensure that sprinkler protection is restored and that a hot-work control system is functioning before initiating any cutting and welding operations.
8. Check all flammable liquid or gas piping and tanks for leaks or damage.
9. Establish a procedure for removing combustible debris as it accumulates.
10. Eliminate all unnecessary open flames or heat sources, including smoking.
11. Have a continual fire watch in effect until normal operations are resumed.





▲ **A flood can damage a company's retail, warehouse and office space. Plan salvage operations ahead of time so that salvage crews know which areas to take care of immediately and which can wait a day or two.**

to shut down normal operations and initiate emergency protective actions as required. An emergency plan must be prepared well in advance of any emergency and it should include a prioritized list of the actions to be taken. The plan should also include estimates of the amount of time needed to implement the various actions Emergency protection procedures include sandbagging, securing flood shields, closing floor drains, relocating stock to higher stories or safer buildings, coating equipment with rustproofing, and topping off storage tanks to prevent floating.

A salvage crew should prepare a list of salvage procedures, noting which items must be taken care of immediately and which will suffer less damage if left for a day or two. Pre-flood planning will ensure that the vital hours immediately after the flood are spent wisely A delay in salvage operations will rapidly decrease salvageability.

Fire and water

Ironically, the threat of fire is a greater concern during a flood than at any other time. Flood waters often carry floating debris that can ram into and rupture flammable liquid tanks or piping. These liquids, generally lighter than water, can float into other rooms or buildings where they may come into contact with an ignition source. In addition, debris can break sprinkler piping, further complicating the situation. Since a facility may be inaccessible due to a flood, facility personnel won't be able to rely on public fire department assistance.

The following steps can help reduce the threat of fire:

- Shut off electricity and gas before a flood since submerged electrical equipment may short circuit, and gas lines could rupture and present a fire hazard.
- If a facility's fire pump driver runs on electricity, consider a backup, diesel-driven pump, or provide a second source of electricity. Also protect it from inundation. In either case, make sure the backup protection is not subject to the same flood hazard.
- Install barriers around sprinkler risers to protect them from floating debris. If inside sprinkler valves could become submerged, mark them high enough up to be found, if necessary.

After flood waters recede, the danger of fire continues. Salvage procedures often result in large piles of combustible materials in the yard. Trash removal companies may be backlogged and disposal of debris can become a major problem. Cutting and welding, a common part of salvage, increases the chance of fire. Cutting and welding should be forbidden until sprinkler systems are returned to service, combustibles are removed, and a fire watch is established.

New construction?

In the U.S., communities that participate in the federal Flood Insurance Program generally will prohibit new construction within a 100-year floodplain. And just barely avoiding the 100-year floodplain doesn't necessarily get you out of a defined flood zone. Your FME&R District Office or FMI Regional Office can help you determine if your prospective site is within a floodplain. In the U.S., these areas are delineated on Federal Insurance Administration Flood Insurance Rate maps, Flood Insurance Studies, U.S. Army Corps of Engineer reports and U.S. Geological Survey flood maps.

Your decision regarding a site location should be arrived at in conjunction with your insurance company and FME&R or FMI loss prevention consultant after a full assessment of the potential exposure and resultant impact.

They can also help you develop construction plans that include adequate loss prevention and protection measures. And, if you think flooding may be a factor in your area, they can specifically evaluate that potential as well. ■