Commercial Investigation #1

ENGINEERING REPORT

June 2006

PREPARED FOR:	**DEPARTMENT STORE #1**
ATTENTION:	**MR. GREG SMITH**
CC:	**MR. DALE DAMERON**

INSURED:	**DEPARTMENT STORE #1**
DATE OF LOSS:	**JUNE 2004**
LOSS LOCATION:	OHIO
POLICY NUMBER:	N/A
CLAIM NUMBER:	<omitted>
IC1 FILE NUMBER:	<omitted>

INTRODUCTION

On January 2004, a flooding event occurred within an entry vestibule at Department Store #1 in Ohio. The flooding occurred while the store was open for business, and the event reportedly did not result in injuries. Store personnel noted that the water emanated from a ruptured 1 inch cast iron tee comprising a portion of a water-based sprinkler system installed at the store.

On March 2003, Mr. Dale Dameron of Insurance Company #1 of Illinois, contacted Investigation Company #1 (IC1) and requested IC1's assistance in determining the cause of the flooding.

The sprinkler system in the entry vestibule had reportedly been added as part of a building addition/modification program at the location that reportedly was completed in August 2003. A determination was to be made whether the failure was caused by defect(s) in design, materials, and/or workmanship.

The author of this report, Scott A. Jones, P.E., Mechanical Engineer of IC1, (812) 944-9988, was assigned to conduct the investigation. The observations and conclusions from the engineering investigation are contained in this report.

Background

Interview with Ms. Jennifer Cullen, Department Store #1 Loss Prevention Specialist

On January 2003, the author interviewed Ms. Cullen who was near the vestibule at the time of the store flooding event. Ms. Cullen had the following observations regarding the flooding loss:

- The store had completed a store expansion and renovation project in August 2003. The area of the subject "Merchandise Pick-Up" vestibule was added as part of the project. The project also included nearby expansion area for warehousing. Construction Company #1 reportedly performed the construction project.

- Ms. Cullen knew of no problems with the subject sprinkler system since the system was activated following the project work. She noted that motion-activated sliding glass doors on either side of the vestibule had properly operated since they were installed during the building addition work.

- On the day of the event, the store had opened for business at 10:00 A.M. At approximately 10:45 A.M., store employees noted water emanating from the overhead within the heated vestibule area.

- Ms. Cullen called the local fire department and informed them of the event.

- Ms. Cullen noted that the water traveled from the vestibule located at the south side of the store to interior areas of the store including the recently completed warehouse expansion.

Regional Weather History

The author obtained the regional weather history for the week preceding the day of loss. The data was obtained at historical archives at <omitted>. The mean daily temperatures for the <omitted> area appeared as follows:

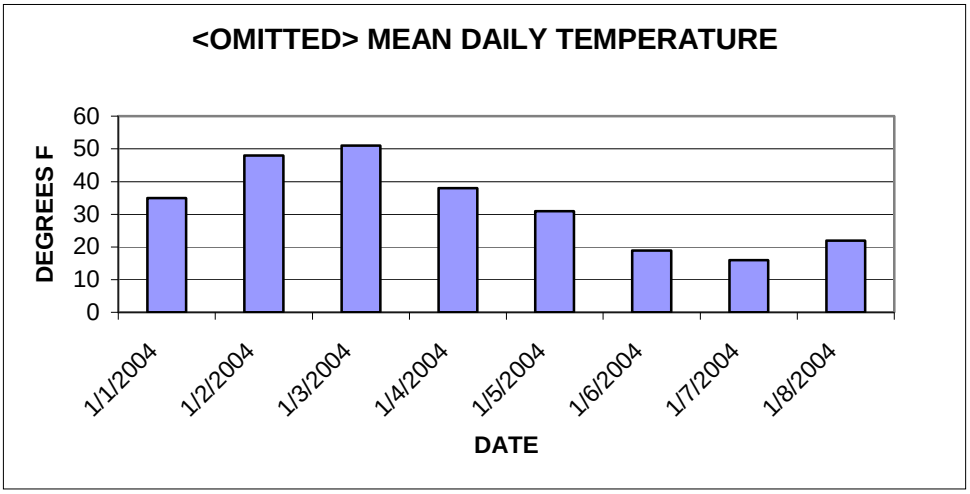

Figure 1 - Mean Daily Temperature for Week Prior to Event

As shown in ***Figure 1***, the mean daily temperature remained at or below 19º F for the two days prior to the event. There was no other period where the mean daily temperature remained at or below 21º F for more than one day since system installation in August 2003.

Observations

On January 2004, the author conducted an inspection of the loss site. Ms. Cullen and Mr. Bill Bowery, Manager of Loss Prevention, were present for a majority of the inspection. Mr. Bowery presented to the author the two halves of the ruptured piping tee that was removed from the vestibule sprinkler piping system following the loss. Mr. Bowery reportedly took possession to the tee halves from the technician who performed the restorative repairs to the building's fire sprinkler system.

The vestibule, which was situated at the south side of the store, served as the main customer merchandise pick-up area (*Photograph 1*). The entry consisted of inner and outer motion-activated, powered sliding glass doors.

The vestibule ceiling had been constructed of ½ inch wallboard over metal studs with two 48 inch, 4 bulb fluorescent lamp fixtures mounted to the studs. An approximate 2 foot by 2 foot scuttle way led to the unheated vestibule attic region (*Photograph 2*). A wall-mounted packaged terminal air conditioning unit (PTAC) provided heating and cooling to the vestibule space (*Photograph 3*).

Metal studs with 4 inch fiberglass insulation placed on end (*Photograph 4*) separated the vestibule attic region from the unheated attic region situated to the southern extent of the building. There was no wallboard or other construction material mounted to the metal studs to provide a weather seal between the southern attic space and the vestibule attic space.

A single wet system pendant sprinkler head with a decorative escutcheon provide fire protection to the vestibule (*Photograph 5*). The sprinkler was provided water via the boss port from a 1 inch cast iron tee mounted along the north wall of the vestibule attic space (*Photograph 6*). Two approximate 6 foot spans of 1 inch lacquered steel Schedule 40 sprinkler piping were connected to the in-line tee ports. Each span re-entered the attic space of the main store structure (i.e., situated on the north side of the vestibule attic space).

(Author's note: the sprinkler piping shown in Photographs 5 through 7 was photographed following the restorative repairs reportedly performed by Photography Company #1 at <omitted>.

The subject piping system had been repaired, re-installed, and re-pressurized by the time of the author's visit. Therefore, the author was unable to measure the thread profiles of the male National Pipe Thread that mated with the subject, ruptured tee.)

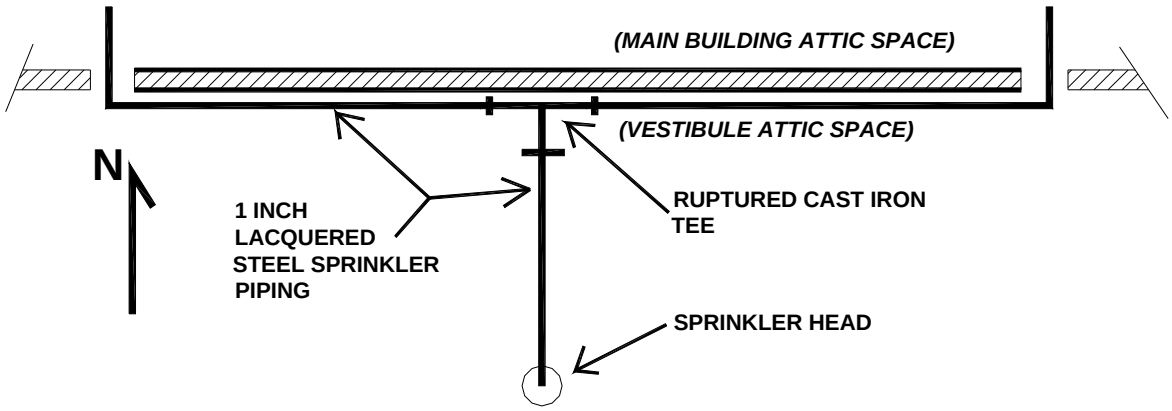

Figure 2 - Plan View of Vestibule Sprinkler Piping

The author created ***Figure 1*** to assist the reader in understanding the layout of the vestibule attic sprinkler piping. The right-hand span of sprinkler piping entered the heated main store attic space via the wallboard penetration shown in *Photograph 7*.

The author examined the two halves of the ruptured piping tee. As shown in *Photograph 8*, the piping tee was identified with "USA" and "1B" markings along with a proprietary foundry marking at the center. The opposite side of the casting was marked with a "1" on the boss port as shown in *Photograph 9*.

The tee fracture surfaces appeared rough with no apparent ductility. There were no indicators present on the failure surfaces of progressive fatigue failure. The casting halves are shown in *Photographs 10 and 11*.

The author rejoined the casting halves (*Photograph 12*) to measure the thread diameters at two different locations in each of the three ports. All measurements were made with Mitutoyo Digimatic digital calipers (*Photograph 13*).

The author conducted an inspection of the 5 fire system risers that serviced the structure. Mr. Bowery provided the author with access to the fire room, which housed the risers. One dry-type fire riser, which was designated as Zone 5 (*Photograph 14*) and four wet-type risers, which were designated as Zones 2, 3, 4, and 1 (*Photographs 16 through 18*, respectively), serviced the structure.

Discussion/Observations

The author requested Mr. Bowery to obtain the fire system activity report for the subject store from the Department Store #1 central station service (i.e., fire alarm monitoring service). *(Author's note: Department Store #1 utilizes a common central station service for all of its stores.)* The central station alarm log appeared as shown in Appendix A for January <omitted>, 2004.

As shown in the log, a fire alarm was received at 10:39 A.M. originating from "Riser #2", which is designated as Zone 2 (reference *Photograph 15*) at the subject store. It is believed that the fire alarm flow switch had detected the flow of sprinkler water upon rupture of the subject elbow and provided the flow alarm function in a manner similar to a sprinkler head rupture in the event of a fire.

The author measured the female thread profiles for each of the three threaded ports for the tee fitting. The measurements were compared to the dimensional standard for 1 inch (nominal) American National Standard Taper Pipe Threads, Table 3 of *Machinery's Handbook, 25th Edition*, 1996. All threaded ports were in proper dimensional agreement with standard dimensions. *(Author's note: as previously noted, the author was unable to obtain the dimensions of the mating, male pipe threads at the subject tee connection).*

Review of the regional temperature data for the region indicated that the mean daily temperature fell less than 19º F for the two days preceding the rupture event. At no other time since the reported installation of the system had the regional temperature stayed at or below 21º F for more than 1 day.

The subject tee was situated mid-span in two connector pipes that entered the heated attic space of the main building. In addition, the boss port of the tee connected to the sprinkler that extended down to the heated vestibule space. The tee, therefore, was situated at the most remote position relative to any other heated portion of the piping system.

It is believed that the water inside the subject cast iron piping tee froze over the two day period preceding the day of the event. During the process of freezing, the ice volumetrically expanded, which caused the sudden, catastrophic rupture of the subject piping tee by tensile overload.

It is believed that during the construction of the subject sprinkler system for the newly created vestibule, system designers and/or constructors improperly extended the Zone 2 (wet) system into the unheated vestibule attic space. Wet-style fire extinguishing systems are not to be utilized in spaces subject to freezing. Dry-style systems, which normally are

not filled with water, are properly utilized in unheated spaces such as the subject attic vestibule.

It is therefore believed that the sprinkler system designers and/or constructors improperly selected a wet fire sprinkler system (i.e., Zone 2 – wet) for the unheated vestibule attic rather than a dry fire sprinkler system (e.g., Zone 5 - dry). It is therefore believed that the system designers and/or constructors are responsible for the conditions that led to the subject flooding event.

The analysis and conclusions are based upon information reviewed to date, plus general engineering knowledge and experience. Information reviewed at a later date may warrant modifying or augmenting the conclusions.

We appreciate the opportunity to work with you on this evaluation. Pending further direction, this file is considered closed. Please let us know whether we can be of further assistance to you.

Sincerely,

Engineering and Fire Investigations

Scott A. Jones, P.E., C.F.E.I.
Mechanical Engineer