

INVESTIGATION REPORT

PREPARED FOR:
UNIVERSITY OF NORTHERN IOWA
CEDAR FALLS, IA

Prepared By:
HBK Engineering, LLC.
921 West Van Buren Street, Suite 100
Chicago, IL

HBK PROJECT # 18-0788
October 2, 2018



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Mr. Michael Hager
University of Northern Iowa
122 Lang Hall
Cedar Falls, IA 50614-0003

Dear Mr. Hager,

HBK Engineering, LLC (HBK) has completed our investigation of the incident that occurred on the University of Northern Iowa campus on Monday, September 10, 2018, and have summarized our findings in the attached report.

The report provided herein is based on HBK's site visit on September 11 – 12, our review of the system drawings, and interviews with UNI personnel. This report includes HBK's initial on-site observations, our observations of the steam system design, and our review of the UNI safety protocols related to the steam system and the utility tunnel. Also included in the report are pictures taken during our site visit that help illustrate our findings.

Should you have any questions regarding this report or need any additional information, please contact us using the information provided below.

Sincerely,

Matt Thomas, P.E.
Project Engineer
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The following is HBK Engineering's (HBK) report on the incident that occurred at the University of Northern Iowa (UNI) campus on September 10, 2018. This report is based on information gathered during HBK's site visit on September 11th and 12th of 2018, including a walkdown of the steam system in the dining hall utility tunnel and discussions with UNI staff.

Incident Description

UNI staff provided a timeline of the events on September 10. The steam supply to the dining hall was being provided from the east loop steam supply line, so both the dining hall supply line and the east loop supply line were energized. The west loop steam supply line had been shut down for approximately 5 days. UNI desired to restart the west loop steam supply line in order to provide full steam supply to the dining hall and to restore the system to full operation.

An attempt was made to open the isolation valves to the west loop supply line, these being the valve located in the utility tunnel and one remote valve to the west. A maintenance worker was in the utility tunnel actuating the supply valve. There was a failure of some kind and steam entered into the tunnel. This steam could be seen escaping the tunnel through the access door in the dining hall, through the vents under the loading dock, and through the manhole in the loading dock driveway. After the steam release, the steam supply loop was closed at both remote valves, from the east and west.

HBK's Initial On-Site Observations

On September 11, HBK arrived on-site and began observation of the steam system in the dining hall utility tunnel. UNI personnel stated that they had not changed anything in the utility tunnel area before HBK arrived on site. Iowa OSHA representatives had conducted an initial site visit on the morning of September 11 prior to HBK's arrival. HBK was asked by UNI to aid in the investigation to find the specific failure that resulted in the incident and act as a third-party observer.

HBK performed a walkdown of the steam system in the utility tunnel, along with UNI staff. No obvious failure or breach was found – no pipe cracks or fitting failures were observed. Some pipe insulation was removed for additional visual access, but otherwise no system components were disassembled. One area of pipe insulation was discovered to be significantly wetter and more damaged than other areas in the utility tunnel, but no visible cause or leak was found. Since no failure location was found, UNI staff decided to perform a test where the steam system would be partially restarted at very low pressure to look for escaping steam. Condensate that had accumulated in the steam lines was allowed to drain out overnight, but otherwise the steam system was kept with the same valve positions as when the incident occurred.

On the morning of September 12, a system restart and test were performed while HBK was on-site. The utility tunnel area was remotely monitored using two cameras with live feeds. The isolation valve located in the vault was left in the same partially opened state as at the time of the incident. The remote valve from the east steam supply loop was opened slightly to provide steam to the complete dining hall steam piping branch and up to the remote isolation valve to the west. The pressure in the steam lines was monitored and kept below 5 psig during the test.

Steam appeared on camera approximately 10 minutes after the east remote steam valve was initially opened. Instructions were relayed to shut the east remote valve to shut the steam off. Once the system was verified to be shut down, UNI staff and HBK engineers entered the steam tunnel for further investigation. A small condensate drip was noted on a 2" capped pipe drain attached to the bottom of the steam supply line to the dining hall. Further investigation revealed the center part of the cap was missing. This drain is located near the south elbow of the steam supply line to the dining hall in the tunnel area, and is located upstream of the dining hall steam supply isolation valve. This cap is located in the area where wet insulation had been

observed the prior day. A second test was run which verified this pipe drain as the source of the steam leak observed on camera.

In HBK's opinion, the sudden, catastrophic failure of this cap is the likely cause of the incident. Such a failure would have allowed steam to immediately enter the utility tunnel and would likely have resulted in a loud noise, like the one a UNI worker reported hearing at the same time as the incident.

The failed drain cap was removed and replaced with a plug fitting while HBK was on site. A valve in the steam supply line to the dining hall, that was previously known to have a leaky bonnet, was replaced with a new valve at the same time, while the complete system was shut down. The valve in the west loop steam supply line in the utility tunnel was closed to isolate the dining hall from the west loop. While HBK was on site, the steam supply to the dining hall was restarted and brought online using only the east loop supply line. No further steam leaks or abnormal operation were observed. This concluded HBK's site visit.

HBK's Steam System Design Observations

HBK was provided with both schematic and physical drawings of the steam system in the utility tunnel area and the nearby loop supply areas. These drawings were used along with in-person observations to review the overall design of the steam system.

HBK did not observe anything in the design of the steam system in the utility tunnel area that would be considered uncommon or atypical for steam systems of similar pressure and temperature class. The location of expansion joints and pipe supports as originally designed appeared to be reasonable. The location of the drain pots and associated steam traps and valves is consistent with common design practice.

UNI personnel stated that one expansion joint had been recently replaced with a solid spool piece and a nearby pipe support released. Per UNI personnel, the modification was deemed acceptable by their engineering firm of record, Shive-Hattery. No design documents related to this modification were provided for review by HBK.

No written startup procedures were available for the steam system for HBK to review. No maintenance records for the steam system were provided to HBK for review.

Review of UNI Safety Protocol

HBK was provided with UNI's safety protocol document for charged systems and restricted space entry. HBK reviewed this document, and found that it is in conformance with common industry practice. The safety protocol includes typical requirements such as the use of and specified type of personal protective equipment, pre-planning meetings prior to restricted space entry, call-in to dispatch prior to restricted space entry, and continuous communication between workers in restricted spaces and workers outside. HBK did not find anything in the safety protocol that appeared to be inadequate, and does not believe that UNI's safety policies had any adverse impact on the incident.

HBK discussed the events of September 10 with UNI personnel with regard to the restricted space entry protocol. UNI confirmed that all of the steps of the safety protocol were followed, and all requirements observed by participating UNI personnel.

HBK did not review employee safety training records.



Figure 1: Area where wet insulation was found at the south end of the utility tunnel. (The insulation was removed from the elbow as part of the investigation.)



Figure 2: The location of the 2" drain and the failed cap. (All insulation has been removed as part of the investigation.)



Figure 3: The failed cap after it had been removed from the steam pipe.