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August 10, 2018

3420-LTR-03

John D'Angelo  
Fuller D'Angelo  
45 Knollwood Road  
Elmsford, NY 10523

RE: Haldane Central School District Steam System – UT Measurements – Follow-up

Dear Mr. D'Angelo:

On August 1, 2018 RAHEPC completed the ultrasonic testing of the steam system piping associated with the original school building located at Haldane Central School District, 15 Craigside Drive, Cold Spring, NY 10516. The purpose of the testing was to ascertain the overall condition of the steam system piping and identify any areas of immediate concern. The areas of proposed testing were completed as per the walk-through conducted earlier. The test locations are described in Table 1.

### **Background**

The school had experienced several steam system failures over the last few years. These failures were discussed in detail in our letter report 3420-LTR-01. The pipes that had failed had all failed via an "outside-in" corrosion mechanism.

### **Observations- Site Visit**

The team met the Haldane Maintenance staff at the side entrance and began our data collection beginning in the Science Room crawl space; we then moved on to the Boiler Room and then the Utility Corridor.

The exterior of pipes that were insulated were found to be in good condition when exposed for testing. The un-insulated (exposed) pipes that were tested were also found to be in good condition with two exceptions:

1. Proposed Sample Location 3 which could not be reached. Two adjacent pipes within reach were measured instead. However, the exterior of the pipe looked severely corroded. Figure 2 shows the exterior condition and its similarity to the previously failed pipe section.

2. Sample 4, which feeds a small bathroom, exhibited evidence of long-term exterior corrosion.

Both of these samples were located in the Boiler Room.

Ultrasonic Test Results.

The data collected showed that the pipes have minimal wall loss and very low corrosion rates. Table 2 presents the summary of the data collected.

**Conclusions/Recommendations**

The piping locations measured all have very low corrosion rates, yielding remaining life estimates in the hundreds of years. The exterior surfaces of the pipes were all in excellent condition with the exception the pipe adjacent to Sample 3.

Our recommendation would be to pre-emptively repair the pipe identified near Sample 3 and shown in Figure 2.

The balance of the accessible pipe that we were able to inspect is in good condition.

If there are any questions regarding these findings please call.

Very truly yours,

R A HOFFMANN ENGINEERING, PC



Robert Hoffmann  
Mechanical Engineer

REH:cgb

cc: R. A. Hoffmann, P.E.

<b>Table 1 – Steam Pipe Test Locations</b> <b>Haldane Building and Grounds - Steam Piping System</b> <b>RAHEPC – 3420-LTR-03, August 10, 2018</b>		
<u>Item No.</u>	<u>Location</u>	<u>Notes</u>
1 (1A & 1B)	MS Science Room (Rm 101)	Pipes 1A and 1B (supply and return)
2 (2A & 2B)	Supply Closet (SP1)	Pipes 2A and 2B (supply and return to the runouts)
3 (3A & 3B)	Boiler Room-Ceiling Corner	Elbow section was out of reach and appears very corroded.
4	Boiler pipe - Runout to bathroom (old)	Heavy corrosion on the exterior.
5	Boiler Room - Main Header	Noted water stain on insulation - Area examined
6	Utility Corridor - Steam Return line	In Janitor's Closet.
7	Utility Corridor - Steam Main	In Hallway at Janitor's Closet
8	Utility Corridor - Main line	1980s feed. (access past 1960s corridor)
9	Utility Corridor - Return line	1980s return (access past 1960s corridor)
10	Utility Corridor - Main line	1980s feed. (access near art storage)
11	Utility Corridor - Return line	1980s return (access near art storage)
12	Classroom (B2) - Radiator Runout	Above drop ceiling - Feeds radiator in Bathroom
13	Classroom (B2) - Radiator Runout	Above drop ceiling - Line not tested as insulation appeared friable.
14	Stairwell (ST2) - Radiator Runout	Feeds 2 <sup>nd</sup> Floor Radiator
15	Stairwell (ST2) - Radiator Runout	Feeds 2 <sup>nd</sup> Floor Radiator
16	Radiator connections at Stage	Runouts not measured. Appeared to be new.

TABLE 2 Test Data Summary RAHEPC 3420-LTR-03, DATED 8/06/18								
Pipe ID	Location	Service Life (Yrs)	Nominal Pipe Size	Wall Thickness Readings (inches)			Corrosion Rate (mils/yr)	% Remaining Wall
				Maximum	Minimum	ASTM Nominal		
1A	1	98	2	0.184	0.149	0.154	0.4	81
1B	1	98	2	0.135	0.135	0.133	0.1	93
2A	2	98	1	0.159	0.123	0.133	0.4	77
2B	2	98	2	0.158	0.147	0.154	0.1	93
3A	3	98	1.25	0.137	0.123	0.140	0.1	90
3B	3	98	1.25	0.136	0.129	0.140	0.1	95
4	4	98	1	0.139	0.122	0.133	0.2	88
5	5	38	12	0.337	0.329	0.33	0.08	98
6	6	38	2	0.159	0.142	0.154	0.4	89
7	7	38	2	0.159	0.134	0.154	0.7	84
8	8	38	4	0.241	0.219	0.237	0.6	90
9	9	38	2	0.156	0.148	0.154	0.2	95
10	10	38	4	0.239	0.221	0.237	0.5	93
11	11	38	2	0.158	0.149	0.154	0.2	94
12	12	98	0.75	0.125	0.111	0.113	0.1	89
13	13	NA	NA	NA	NA	NA	NA	NA
14	14	98	1.25	0.153	0.142	0.14	0.1	93
15	15	98	0.75	0.126	0.115	0.113	0.1	91
16	16	NA	NA	NA	NA	NA	NA	NA



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FIGURES

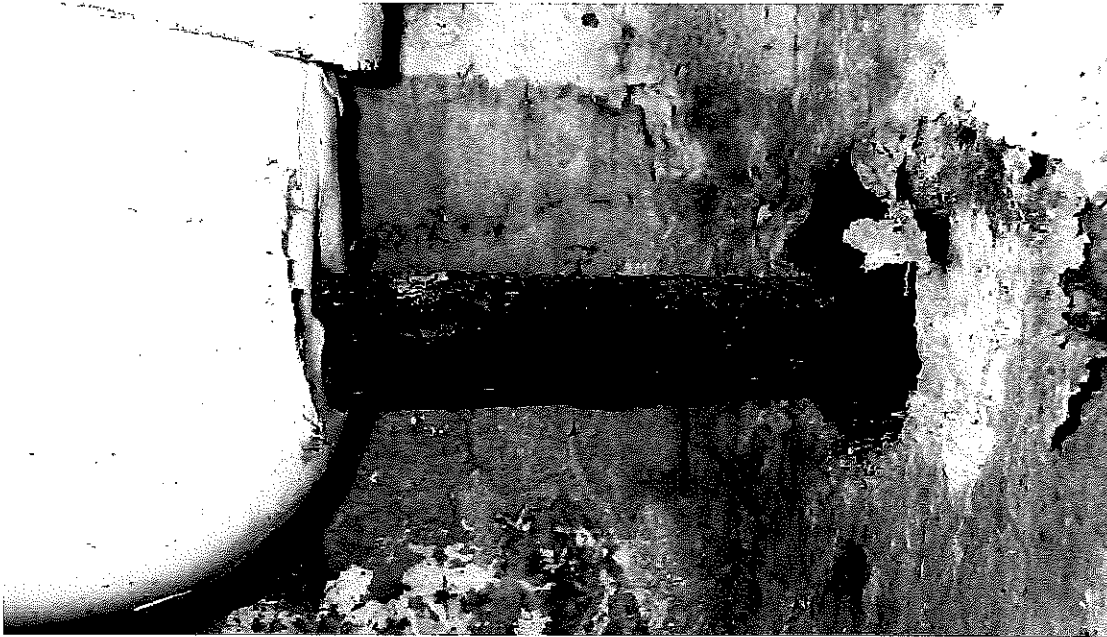


Figure 1. **Boiler Room:** Sample Pipe #4 - Bathroom Feed. This pipe section was uninsulated and exhibited exterior corrosion. The tabulated wall thickness measurements for this pipe did not reveal a significant corrosion rate or wall loss.



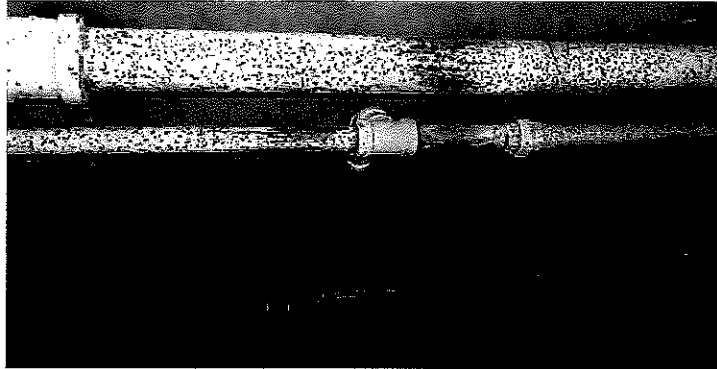
2A

2B

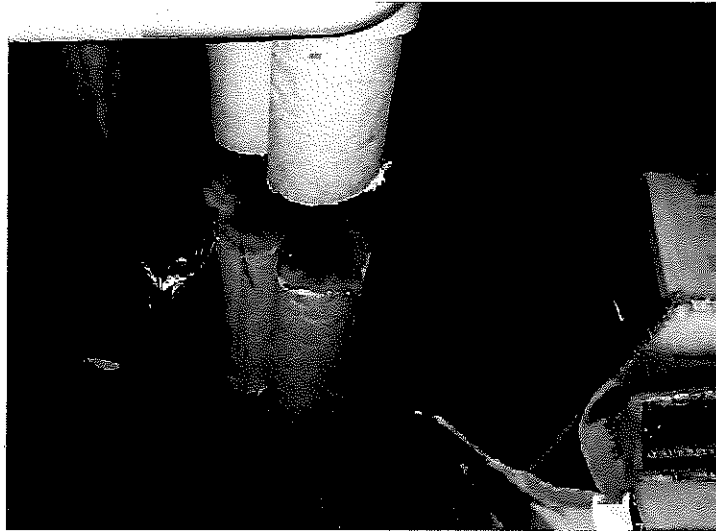
2C

Figure 2. **Boiler Room - Corrosion on exposed piping.** Figures 2A and 2B show the NW corner of the boiler room at a location that has experienced corrosion in the past. Figure 2C is an example of the previous failure. Note the similar exterior condition.

3A



3B

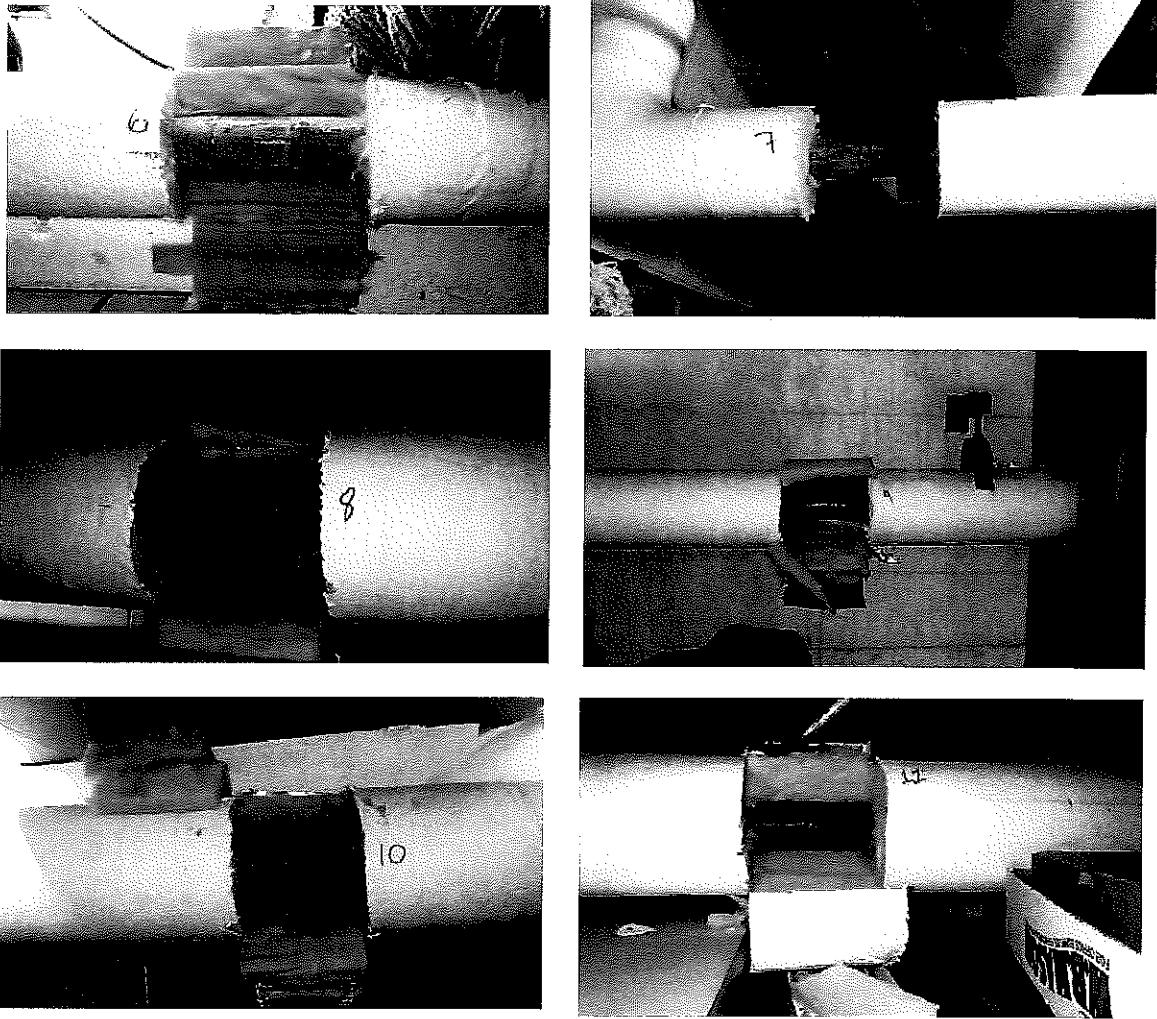


3C



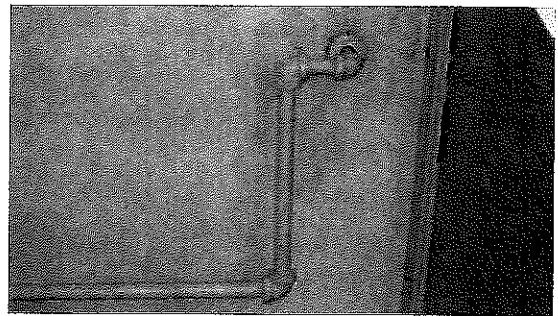
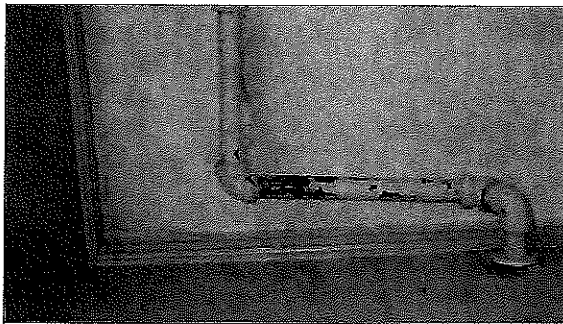
Figures 3A,3B and 3C. **Samples 1A,1B,2A,2B and 5.** These figures reveal the tested conditions. Note the painted condition of Sample 1 and the well-insulated condition of Samples 2 and 5. No corrosion was noted.





4A 4B  
4C 4D  
4E 4F

Figure 4. **Samples 6 to 11 – Utility Corridor** – Figure 4 reveals the excellent condition of the pipes tested along the utility corridor.



5A

5B 5C

Figure 5. **Exposed Pipe:** Figures 5A thru 5C reveal Samples 12, 14 and 15. These were painted and in good condition. Sample 12 supplies the Boys Bathroom radiator on the main floor, Samples 14 and 15 serve the radiator on the 2<sup>nd</sup> level in the stairwell.